ST. JOHNS WATER WORKS WELL.

Loc.: At water and lighting plant. Record No. 2.

Elevation 753 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Blue clay	19	19
Pipe clay	12	31
Clay and hardpan	61	92
Stony and hardpan	19	111
Granite boulder	2½	113
Soft clay	10	123
Gravel and hardpan	13	136
Hardpan	5	141
Coal Measures:		
Red sandrock	5	146
Sandrock	20	166
Gray sandrock	17	183
Yellow sandrock	17	200
To shale rock	14	214
Shale rock	3	217
Slate rock	26	243
Blue sandrock	21	264
Yellow sandrock	23	287
Yellow hard and lighter	51	338
Parma sandstone:		
Sandrock	6	344
Hard blue sandrock	44	388
Water rock	23	411
Blue sand, harder	45	456
Maxville or Bay Port:		
Slate	12	468
White sand	10	478
Water rock sand	17	495
Blue packed sand	22	517
White water rock	10	527
Blue sand	13	540
Michigan Series:		
Hard strata	10′ 4″	541′ 4″
Blue sand to white	18′	559′ 4″
	3′	652′ 4″
Hard blue sandrock	27′	589′ 4″
Blue shale and sandrock (Very hard).	19′	608′ 4″

WATERWORKS WELL NO. 3.

Loc.: Three hundred ft. north of Electric Light and Water Works, St. Johns; 10 inch well 301 ft. in depth, drilled in 1908; deepened in 1914 to 780 ft.; 6 inch hole. A. R. Purcell, Jackson, contractor; Chance Emley, driller. Record of 10 inch hole from records of Water Works Dept., remainder of record by R. A. Smith from samples and information furnished by Archie Bishop, Supt. Electric Light and Water Works.

Elevation 753 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene or glacial drift:		
Clay	10	10
Clay and gravel	20	30
Water sand	20	50
Fine sand and clay	20	70
Fine sand and blue clay	10	80
Blue clay	10	90
Clay and sand	22	112
Coarse water gravel	31	143
Red clay	8	151
Saginaw Coal Measures:		
Red sand rock	6	157
White sand rock	4	161
Soapstone (probably "fire clay" or calcareous shale)	10	171
Blue shale	3	174
Red sandstone	9	183
White sandstone	5	188
Red sandstone	12	200
Blue shale	15	215
White sandstone	12	227
Soapstone	10	237
Red sand rock	10	247
White sand rock	8	255
Blue shale	10	265
Soapstone; end of 10 inch hole	36	301
Parma sandstone:		
Sandstone (Sandstone struck just below the bottom of the 10 inch hole, as reported by A. Bishop, Supt.)	24	325
Fine white sandstone	100	425
White sandstone; coarse and pyritic; water	25	450
Maxville, or Bay Port limestone. Upper Grand Rapids:		
Gray limestone; vig. eff. Sample marked 150 to 520 and next sample 500 to 540	70 or 50	520 or 500
Grayish white sandstone, pyritic	20 or 40	540
Michigan Series or Lower Grand Rapids:		
Gray limestone with much sandstone; the latter apparently from the sandstone directly above	10	550
Snow white gypsum and some shale	30	580
Dark gray shale and white gypsum	120	700
Napoleon or Upper Marshall:		
White sandstone and strong brine	60	760
Gray sandstone and shale	20	780
Well bottomed in white sandstone at 780 feet. Water rises to within 34 feet of surface. Can lower the head but six feet.		

ALLEGAN GAS, OIL & MINING COMPANY WELL.

Loc.: In Allegan on bluffs above river flats? (near P. M. depot?). J. E. Ellinger, President. Record by driller. Notes on samples by Lane.

Elevation 708? ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene or glacial drift:		
Sand and clay	120	120
Gravel and flowing water at 120 ft.		
Unreported	135	255
Slate and sandstone at 255 ft.; end of drive pipe. Sample impure gray banded sandstone at 255 ft.		
Coldwater shale:		
Sandstone. Brine at 292 ft. cased with 3 5-8 in pipe to 331 ft. Sample 260 pyritiferous bituminous coal, 275 siderite, 295 pyrite nodules and bluish shale, 331 brownish drab siderite, full of grains of calcite and pyrite with traces of fossils	76	331
Blue shale	249	580
Sample greenish bluish non-fossiliferous shales.		
Red rock	15	595
Sample red and green mixed shale, calcareous red shale, residue of red clay, very little grit.		
Blue shale	15	610
Sample red freely eff. shale.		
Red rock (Berea?)	5	615
Sample no eff. but burns from green to red with HCl.		
Antrim shale:		
Gray shale, fine drilling (in part Coldwater?). Sample no eff., greenish and bluish gray shales	375	990
Black shale	105	1095
Sample burns on heating—bituminous shale.		
Traverse (Hamilton) Formation:		
Hard rock, salt water between 1120 and 1200 ft	80	1175
Sample siderite. This may be merely a large nodule.		
Black rock or slate	20	1195
Sample bituminous black shale.		
Lime rock (top of Traverse?)	10	1205
Sample mixture of dolomite and black shale.		
Blue shale. Oil at 1245, crust very hard, turned drill	55	1260
Sample greenish or bluish gray shale, slowly eff.		
Dundee (Corniferous) limestone:		
Sandy limestone, oil at 1264	15	1275
Light yellow limestone rapidly eff., containing white chert and fragments of dark gray pyritiferous seams, also brachiopod fragments? Either Leptocelia acutiplicata or Spirifer gregaria	125	1400

NORTHERN OIL & GAS COMPANY WELL NO. 1.

Loc.: S. E. cor. N. E. ¼, sec. 32, Allegan Twp., H. F. Thomas farm. C. F. Mercer, president. Perry Fox, driller. Drilled in 1912.

Elevation 696 ft. A. T.	Thickness, feet.	Depth, feet.
Surface:		
Sand	320	320
Blue clay, sticky	20	340
Gravel, water	15	355
Coldwater shale:		
Flinty lime	10	365
End of drive pipe at 365 ft.		
Slate streaked in color	10	375
Black gritty lime or sand	15	390
Big flow of fresh water.		
Blue slate, no grit, soft	260	650
Cased 450 ft., 8¼″ casing.		
Red slate, hard	10	660
Little salt water under red slate. (Berea?).		
Blue shale, clean drilling, in part. Antrim?	500	1160
Berea? absent?		
Antrim shale:		
Light brown shale, changing to darker. Part of the shales grouped with the Coldwater are doubtless Antrim	110	1270
Traverse (Hamilton) Formation:		
Light blue shale, hard	10	1280
Gray lime, hard	3	1283
Blue slate	25	1318
Dundee (Corniferous) limestone:		
Light bluff lime. Oil	1	1319
Changed color most every screw.		
Total depth	68	1387
About water enough to drill with. Not accurate as to changes. Depth to top of Dundee measured by steel line.		

NORTHERN OIL & GAS COMPANY WELL NO. 2.

Loc.: S. E. cor. of S. W. ¼, Sec. 21, Allegan Twp. 1800 ft. north of old No. 1 (near P. M. depot) of Allegan Gas, Oil & Mining Co. and on river flats. Drilled in 1913. Record reported by Perry Fox, driller, and C. F. Mercer, president. Record from memory and rough notes. Top of Dundee accurate; measured by steel tape.

Elevation of well about 628 feet A. T.	Thickness, feet.	Depth, feet.
Surface:		
Ten in. drive pipe through drift	87	87
Coldwater:		
Soft blue clay or slate	200	287
Lime hard, black and dry	20	307
Lime shell	70	377
Slate, blue, soft	248	625
Yellow colored slate	5	630
Blue slate and red rock	10	640
Blue shale, hard (Largely Antrim)	510	1150
Berea absent?		
Antrim shale:		
Brown shale with streaks of black lime	70	1220
Part of shales above doubtless Antrim.		
Traverse (Hamilton) Formation:		
White or blue shale	15	1235
White lime shells	10	1245
Slate blue, hard	42	1287
Dundee (Corniferous) limestone:		
Lime called Dundee changeable, no grit	24	1311
Oil at 1287-1290 ft.		
Gritty lime	5	1316
Looked good for oil	10	1326
About 1 bbl. water an hour 1290-1295 ft.		
Total depth	.....	1340
Pumped at an average of 2 bbl. oil per 24 hours.		
Shot with 120 quarts of nitroglycerine, 60 qts. above and 60 qts. below gritty lime.		

DOWAGIAC WELL.

Loc.: Round Oak Gas & Fuel Co., Dowagiac. Drilled 1887 by Wm. M. Farr. Record by C. E. Wright from driller's notes and from samples.

	Thickness, feet.	Depth, feet.
Pleistocene or glacial drift:		
Fine and coarse sand	34	34
Gravel	4	38
Blue clay	18	56
Sand and some gravel	49	103
Blue clay	8	111
Coarse gravel	4	115
Blue clay, very tough	48	159
Coarse and fine sand and gravel	41	200
Coldwater shale:		
Blue argillaceous shale, slow eff	82	282
Red argillaceous shale (Land surface belonging to the Antrim?—Lane)	12	294
Antrim shale:		
Argillaceous shale, light blue with streaks of hard blue sandstone. Slow eff. 90% residue	49	343
Argillaceous limestone, very hard	5	348
Argillaceous shale, slow eff. 95% residue	177	525
Sandy shale; dark bluish drab, hard and soft; slow eff. 90% residue	50	575
Argillaceous shale, dark drab and brown, quite soft; slow eff. 95% residue of clay	65	640 –
Argillaceous shale; dark brown, hard and soft; slow eff. 90% residue of clay	10	650
Argillaceous shale, dark brown, medium hard	35	685
Brown argillaceous shale, burning with aromatic smell	90	765
Traverse (Hamilton) Formation:		
Dark drab argillaceous limestone; brisk eff. 10-15% residue of clay	40	805
Dark drab coarse grained limestone; brisk eff. 2% angular grains of silica	68	873 +
Dundee (Corniferous) limestone:		
Light gray fine grained (coarse at 950 ft.) limestone; brisk eff. 4-5% angular grains of quartz and silica, 1% at 920 ft	78	950
Dark drab fine grained limestone; brisk eff. 4%-5% of brown residue of silica and carbon	25	975
Light drab fine grained limestone; brisk eff. 5% of dark brown residue of silica and carbon	5	980
Brownish drab limestone; brisk eff. 5% siliceous residue	10	990
Monroe Formation:		
Dark gray and drab dolomite 25 to 30% residue of gypsum, anhydrite and silica	30	1020
Drab dolomite, fine grained; brisk eff. 10% residue of gypsum, anhydrite and silica	18	1038
Drab dolomite, fine grained; brisk eff. 12 to 25% residue of gypsum, anhydrite and silica	47	1085
Light gray dolomite, fine grained; brisk eff. 12% residue of gypsum, anhydrite and cherty silica at 1080 ft.		
Light gray sandy limestone (Sylvania?) 4 to 12% rounded grains of glassy sand, quartz and flint	15	1100
Niagara; Guelph and Lockport:		
Light gray limestone, dolomitic in part; 1 to 7% of chert, quartz, anhydrite, pyroxene	175	1275
Light gray argillaceous limestone 15 to 30% clay	45	1320
Gray limestone, dolomitic in part; brisk eff. 1 to 2% of rounded glassy grains of sand and angular ones of chert	120	1440
Creamy gray fine grained marley limestone; very brisk eff. 8% of silica and clay	40	1480
Creamy gray fine grained limestone, dolomitic in part	60	1540
Grayish white to gray fine grained limestone, brisk eff. 2 to 5% rounded grains of glassy sand and angular ones of flint, anhydrite, and clay	70	1610
Gray dolomitic fine grained limestone; brisk eff. 5% of silica and clay	35	1645
Creamy white marly limestone; 1 to 8% of rounded grains of sand, clay and anhydrite	35	1680
Rochester:		
Bluish drab clay shale; brisk eff. 95% clay	20	1700
Dark drab argillaceous limestone (Clinton?)	20	1720
Lorraine and Utica:		
Blue black calcareous argillaceous shale; slow eff. 95% clay	8	1728
Carbonaceous limestone brownish red to yellowish gray; brisk eff. 10 to 20% rounded glassy grains of sand, white chert and anthracite	32	1760

BERRIEN SPRINGS WELL.

Elevation 650 + ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Gravel	40	40
Blue clay	70	110
Antrim:		
Soapstone	440	550
Reached 550 noon June 5. Compare Benton Harbor at 280 ft. Niles at 415 ft.		
Black shale with pyrite, bituminous	70	620
Compare Benton Harbor at 475 ft., Niles at 460 ft. Dowagiac at 675 ft.		
Traverse:		
Limerock with indications of salt water at bottom	80	700
Stopped at 670 ft., June 15. Compare Dowagiac at 874 ft.		

NILES OIL & GAS COMPANY.

(Niles Well No. 6.)

Elevation 660 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Yellow impure sand (all the samples of the superficial deposits down to 265 ft. are more or less calcareous)	91	91
Fine gravel (Torpedo sand) with water	12	103
Till (or boulder clay, sand and gravel mixed)	79	182
Till	19	201
Clayey till	6	207
Clay, grit free, calcareous brown	10	217
Coarse sand	48	265
Antrim shale:		
Black shale, bituminous, very slightly calcareous (not so black as below)	20	285
Black shale, bituminous	136	421
Traverse (Hamilton) Formation:		
Blue calcareous shale	141	562
Light colored limestone (nearly pure $CaCo_3$)	18	580
Dundee (Corniferous) limestone:		
Slightly darker, and more magnesia? (with oil and salt water)	12	592 +

BRIDGMAN OIL AND GAS CO.'S WELL.

Loc.: Forty rods south of depot, on ground about 3 ft. lower than railroad track, e. i., 636 ft. A. T.—May, 1904.

Elevation about 636 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Sand	3	3
Clay, sticky	100	103
Sand, fresh water	5	108
Clay, blue	50	158
Sand, some fresh water	5	153
Clay, blue	40	203
Sand, fresh water	20	223
Gravel, cement	5	228
Clay, blue, waxy	30	258
Coldwater shale:		
Clay (really shale), big break	50	308
Antrim shale:		
Brown shale, gas near top, scum on water after striking gas	200	508
Dundee (Corniferous) limestone:		
So called Trenton, "bastard"	5	513
Samples 520 to 700, limestone with echinoderm fragments, quick eff.		
Salt sand	25	538
Brown sand, salt water rising nearly to the top	25	563
Trenton, porous, drilled nice	200	763
Salt water at bottom of this 200 ft., with traces of gas above.		
Monroe Formation:		
Sample at 768 a gypsiferous dolomite. Water stands 600 ft. deep in the well	5	768

BENTON HARBOR NATURAL GAS AND OIL CO.

Record by C. E Wright from samples. Samples from Fred Jordan.

Elevation about 600 ft. A. T.	Thickness, feet.	Depth, feet.
Surface:		
Undifferentiated	130	130
Antrim shale:		
Bluish gray argillaceous shale	5	135
Red shale	15	150
Chocolate brown shale, eff. in cold Hcl; 70 per cent residue. Under microscope, fine fringy argillaceous mass and small granules; does not depolarize the light.		
Light blue shale; quite hard; eff. slightly; large residue, finely granular, apparently isotropic	20	170
Blue shale or "slate"; no sample	110	280
Black shale or "slate"	195	475
Traverse (Hamilton) Formation:		
Argillaceous limestone; dark bluish drab; contains iron pyrites; brisk eff. 50 per cent residue of a fringy clay mass	165	640
Calcareous argillaceous shale; dark drab; medium hard; brisk eff.; 70 per cent residue of clay	25	665
Dundee (Corniferous) limestone:		
Arenaceous limestone; dark drab; brisk eff.; 20 per cent residue of rounded glassy grains of sand	35	700
Limestone, grayish white mixed with dark drab; brisk eff.; 10 per cent residue, mainly isotropic	11	711
Porous limestone; light gray; brisk eff.; 2 per cent residue of a finely granular mass	9	720
Grayish limestone; brisk eff. in cold acid, 10 per cent residue of round glassy grains of sand (and bits of green shale; no anhydrite	5	725
Similar?	10	735
Similar?	5	741
Dark drab to light drab limestone; brisk eff.; 5 to 10 per cent residue of rounded grains of sand	9	750
Water with strong brine at 750 ft.		
Similar?	5	755
Similar?	9	764
Light gray limestone; brisk eff.; 2 to 8 per cent residue of rounded glassy grains of sand	14	778
Brisk eff	10	788
Monroe (and Niagara?) Formation:		
Limestone; drab; brisk eff.; 20 per cent residue of sand and gypsum	27	815
Marly gypsum; very light gray; 80 per cent residue of anhydrite and a few grains of silica	17	832
Dolomitic limestone; drab; resembles sand; slight eff. in cold acid; 10 per cent residue of rounded glassy grains of sand, anhydrite and gypsum	108	940
Dolomite; slow eff. in cold acid; 3 to 20 per cent residue of grains of grayish sand	305	1205

SALZMAN MINERAL BATH CO. WELL.

(U. S. Geological Survey Well No. 183.)

Loc.: Cor. 5th and Park Sts., Benton Harbor. Drilled in 1904.

Elevation 600 (?) ft. A. T.	Thickness, feet.	Depth, feet.
Surface:		
Fine grained, light	130	130
A sand, fine grained, and considerable variety in the grains, showing it must be a glacial sand	5	135
Antrim shale:		
A light bluish shale	215	400
Light, rather gritty silicious shale. I suspect that this is from the top of the strata	180	580
Black shale. This is a typical Antrim or Ohio shale. If we may believe samples 4 and 5 the amount that is black is not as much as usual	60	640
Traverse (Hamilton) Formation:		
Dark, with crinoidal limestone mixed; may represent the Traverse	43	683
Record missing, probably limestone passing into shale 683-690 ft.		
Largely clay; perhaps the lower part of the Traverse	60	750

WHITE PIGEON WELL.

Loc.: Near the N. W. cor. of the N. E. ¼ of sec. 22, T. 8 S., R. 12 W. Record by A. C. Lane, from driller's log and from samples.

	Thickness, feet.	Depth, feet.
Pleistocene:		
Quicksand, fine silt	120	120
Gravel, ¼ inch pebbles (limestone, chert quartzites, dark traps)	20	140
130 ft. of 10 in. casing shutting off fresh water.		
Clay, blue calcareous	42	182
Compare surface to 93 or 136 ft. in the Constantine wells.		
Coldwater shale:		
Shale, blue non-calcareous	31	213
Quicksand	28	241
Calcareous and from the varied character of its grains, evidently a glacial sand, which must come in from some vertical fissure traversed by the drill, and yet is peculiar as being in very nearly the horizon of the Berea grit which yielded a strong brine and gas from 283 to 383 ft. in one of the Constantine wells, while in the other it seems to have been represented by 15 ft. of red shale, from 286 to 301 ft., while in this well it is not to be recognized at all. This variety in record is probably due to an unconformity at the base of the Carboniferous, and the red shale which appears in various records in this corner of the State may be due to the weathering and oxidation of black and green shales beneath an old land surface.		
Shale, dark blue, probably in part Antrim, belonging with the next division	224	465
Antrim shale:		
Black shale	108	573
This apparently corresponds to the base of the dark shales at Elkhart between 375 and 350 ft. down, and in the first Constantine well record the red calcareous shale immediately underlying is counted in, and 211 ft. of shales given between 492 and 703 ft. Corresponding horizons are found about 82 ft. deeper at Constantine.		
Traverse (Hamilton) Formation:		
Red calcareous shale	32	605
Very calcareous, gritty with a few large grains of sand and some crinoid buttons.		
Soft blue limestone	78	683
This formation was apparently not separated off in the Constantine records, but its base and top of the Dundee is probably nearly marked by the brine and sulphuretted hydrogen which occur at 790 ft. and correspond to the horizon of the "salt sand" from 696-711 ft. here. The red, gritty shale at the top may also mark a time between the Traverse and Antrim as here developed, when there was a land surface here. The paleontogist Schuchert assumes that there was a neck of land here at about such a time, and the more recent Niles and Dowagiac wells show a greater thickness of blue calcareous shale with no red shale mentioned, while from Coldwater and Elkhart no Traverse is reported. The Niles well in Volume V gives 415 to 500 ft. of very similar strata.		
Dundee (Corniferous) limestone:		
Sample missing. Said to be similar to those below	13	696
Limestone, very white, clear, fiercely eff. in acid, leaving a little quartz sand residue	15	711
"Salt sand," here a brine was struck which filled up the hole about 400 ft., no casing done when the well was shot.		
Five samples, all yellowish, fiercely eff. limestone with a little quartz and microcline sand and more chert	45	756
At bottom, "oil sand."		
Limestone; record says "blue shale," but sample is a coarsely chipping, fiercely eff., somewhat darker limestone, struck together with gypsum, possibly from the brine	7	763

CONSTANTINE WELL.

Levi Dodge, owner?

Elevation 803 ft. A. T.	Thickness, feet.	Depth, feet.
Surface:		
Sand	40	40
Blue clay	15	55
Sand	2	57
Blue clay	43	100
Sand	1	101
Hard pan	35	136
Coldwater shales:		
Soft "slate" or soapstone	150	286
Berea horizon:		
Red shale	16	301
Antrim shale:		
Gray "slate"	91	392
Black shale	311	703
Traverse and Dundee	377	1080 +
Limestone, brine at 790 ft. with H_2S.		

ST. JOSEPH WELL.

(U. S. Geological Survey Well No. 233.)

	Thickness, feet.	Depth, feet.
Surface:		
Sandy drift clay	50	50
Rusty, sandy, with a variety of pebbles	50	100
Bluish drift clay, sandy	80	180
Richmond or Berea?		
Rusty red	5	185
Record missing from 185-500.		
Antrim shale:		
Dark shale	20	520
Traverse not represented by samples but it probably lies between 520 and 750 ft.		
Dundee? (Corniferous) limestone.		
Mixed. Very white and pyritiferous, dark and fiercely eff	70	820

KALAMAZOO WELL.

Kalamazoo Natural Gas Co. Drilled in 1887. Record in part from samples.

Elevation 771 ft. A. T.	Thickness, feet.	Depth, feet.
Surface (approximately, P. B. Beardsley)	130	130
Coldwater Shales:		
Clay and shale (soft); drab color	170	300
Black sandstone (hard)	20	320
Dark blue shales (soft)	300	620
Red clay	110	730
Light blue soft shale	200	930
Berea?		
Twenty ft. of red clay between 900 and 1000 ft	20	950
Antrim shale:		
Dark drab soft shale	120	1070
Black slate, soft and somewhat sandy	130	1200
Traverse (Hamilton) Formation:		
Limestone, blue and hard	60	1260
Blue slate and shale, soft	10	1270
Dundee (Corniferous) limestone:		
Light gray sandstone, hard. Strong brine (probably cherty limestone)	40	1310
Limestone, briskly eff., light buff	180	1490
Monroe Formation:		
Gypsiferous dolomite, anhydrite, with strong brine	25	1515
Very salty, i. e., brine, from 1270-1740 ft.		
Flow of brine also from 1610-1635 ft.		
Salt and oil at 1490 ft.		
Mainly ferruginous dolomite with anhydrite	215	1730
Niagara (Guelph and Lockport):		
White dolomite	145	1875
Red sandy shale	45	1920
White sandstone	50	1970
Red sandstone	30	2000
Rochester:		
Dark shale	80	2080
Clinton:		
Dark gray dolomite, eff. moderately	40	2120
Light to buff dolomite, eff. slowly; small clay and quartz residue, ferruginous	110	2230
Medina:		
Brown sandstone, with a little calcite; rounded quartz and angular felspar, including microcline	20	2250

THE "MASON" WELL.

Loc.: Near Old Occidental Hotel. Mason Lumber Co. Drilled in 1875.

Elevation of well 594 ft. A. T.	Thickness, feet.	Depth, feet.
Surface:		
Sand	60	60
Clay	150	210
Hardpan	15	225
Napoleon or Upper Marshall:		
Sandrock with seams of iron pyrites and some shale	100	325
Lower Marshall and Coldwater:		
Shales and sandrock alternating	300	625
Overflow of water just above 625 ft.; some of the rock dark gray and shale.		
Blue shale, with streaks of some soft material	775	1400
Sandstones and limestones from 625 to 685 ft.		
Strong flow of mineral water at about 685 ft.		
Red rock not far from 900 ft. probably.		
Fine grained grits and sandstones, probably at about 1200 ft. Petroleum and gas. Good lubrication oil. Cf. Central Paper Co. well.		
Antrim shale:		
Solid blue shale	150	1550
Solid red shale	150	1700
Traverse (Hamilton) Formation:		
Limestone, with streaks of shale and soft limerock	300	2000
Salt bearing rock, with streaks of sand (Dundee?), 1 to 4 ft. thick. Cannot say whether salt was struck or not. Brine 100°	50	2050
Dundee not recognized unless it is this sandy horizon.		
Light colored limerock and shale	50	2100
Monroe Formation:		
Dark colored limerock, (dolomite probably and so indicated in a section drawn under Wright's direction)	250	2350
Salina:		
Gypsum and lime streaks, 4 to 6 ft. thick	50	2400
Limerock and gypsum, a little less gypsum than in preceding and more lime	145	2545
Rapid and various changes ending in dark limerock, loose and porous	82	2627

MICHIGAN OIL COMPANY WELL.

Loc.: Forty-four feet southwest of the Mason well.

Elevation 592 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Sand becoming finer downward	60	60
Calcareous blue clay free from pebbles	163	223
Gravel in clay and sand, till	12	235
Upper Marshall:		
White micaceous sandstone	105	340
Lower Marshall and Coldwater:		
Blue micaceous shale; drilled 65 ft. in 7 hrs	280	620
Harder shale with carbonates of iron and lime; drilled 70 ft. in 10 hours	80	700
Soft blue shale, calcareous	190	890
Brown limestone	24	914
Flagstones, shales with thin laminae of white sandstone and calcareous bands; drilled 40 ft. in 4½ hours, and 6 ft. in 33½ minutes	361	1275
White very fine grained micaceous sandstone or silicious shale, yielding a little oil	18	1293
Sandy shale	27	1320
Shale, somewhat darker at bottom	180	1500

RYERSON-HILLS WELL.

Elevation 588 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Sand	65	65
Clay	135	200
Hardpan	8	208
Hardpan, sandy spots and shale	90	298
Lower Marshall and Coldwater:		
Dark and light shale	200	498
Lime	4	502
Shale	20	522
Lime	1	523
Light shale	20	543
Lime	2	545
Light blue shale	40	585
Lime	2	587
Light blue shale	15	602
Hard lime rock	80	682
White and blue shale and streaks of lime	195	877
Red shale	8	885
Hard lime	3	888
Dark and light shale	222	1110
Lime	5	1115
Loose shale	312	1427
Depth reported 2050 to 2200 feet.		
Record from 1427 feet unknown.		

CENTRAL PAPER CO. WELL.

Loc.: On Lot 1, N. E. ¼, sec. 34, T. 10 N., R. 17 W., about 4¼ miles from Ryerson-Hills well.

Elevation of well 584 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Sand	50	50
Red calcareous clay.		
Smooth, red calcareous clay	183	233
Lower Marshall sandstone:		
Sandstone, greenish, calcareous, very fine at the bottom; a typical Marshall grit	77	310
Coldwater shale:		
Shale, dark, bluish, more or less calcareous	315	625
Limestone, a clayey and dolomitic water lime, with selenite; like limestones of the Michigan series	35	660
Shales, blue calcareous	185	845
Limestone, red and white, fossiliferous	25	870
Flags, i. e., blue and green silicious shales, with bands of very fine-grained grits, or sandstone; in places more or less calcareous	530	1400
Berea Horizon:		
Shales, red and green	80	1480
Antrim shale:		
Shale, black, bituminous, pyritic, especially at the base	135	1615
Traverse (Hamilton) Formation:		
Shale, blue, calcareous	35	1650

PERE MARQUETTE LUMBER CO. WELL.

Loc.: Near mill at the north end of Marquette lake, Ludington; 1½ miles north of Butters and Peters well. Drilled in 1885. Record in part from samples.

Elevation 590 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Sand	30	30
Marl, shells and pine sticks	5	35
Sand	21	56
Soft clay	4	60
Hard clay	20	80
Hard pan	10	90
Coarse sand and small stones	18	108
Sand and gravel	9	117
Sand	42	159
Sand and gravel	24	183
Sand with clay	17	200
Sand	5	205
Clay	4	209
Clay and gravel	5	214
Clay and sand	27	241
Hard pan	32	273
Clay	11	284
Clay and gravel	8	292
Clay	15	307
Clay and gravel	53	360
Clay	37	397
Clay and sand	15	412
Hard clay	52	464
Hard pan and gravel	12	476
Gravel	16	492
Gravel and sand	6	498
Sand	18	516
Gravel and clay shale	12	528
Coldwater shale:		
Blue shale	35	563
Limestone	15	578
Red shale and marl	8	586
Shale	8	594
Limestone	5	599
Blue shale	601	1200
In Lyon's No. 2 well, a showing of oil at 1175 ft.		
Antrim shale:		
Black slate or hard shale, with pyrite	165	1365
Traverse (Hamilton) Formation:		
Blue shale and limestone	70	1435
Black sandy limestone, with strata of gypsum. The limestone is quite crystalline at a depth of say 1460 ft. There are many specks of pyrites	45	1480
Brine 30°.		
Limestone	60	1540
Limestone and gypsum	20	1560
Limestone, hard with grit above, and softer with less grit below	240	1800
Brine 30°-36°.		
Blue shale	58	1858
Salt; either salt (?) or soft salt rock. 90° brine	4	1862
Limestone, very sticky. 70°-80° brine	100	1962
Slow eff. with some sand grains at 1880 feet.		
Bluish, argillaceous, moderately eff. with a large residue 1920-2005 ft.		
Dundee? (Corniferous) limestone:		
Very hard limestone. 20° brine	40	2002
Dolomitic limestone, with a residue of quartz sand and anhydrite.		
Monroe Formation:		
Dolomite, with soft streaks. 6 in. to 18 in. thick, 50°-56° brine	138	2140
Brisk eff. 2005-2050 ft.		
Mainly rounded sand, eff. slowly at 2100 ft.		
62°-64° brine.		
Largely rounded sand. Eff. slow at 2150 ft.		
Rusty white sand 2125-2220 ft.		
Hard gray limestone, contains gypsum and is soft in streaks	55	2195
Salina:		
Rock salt. 100° brine	18	2213
Limestone, containing 2 feet of rock salt	7	2220

J. S. STEARNS SALT & LUMBER CO. WELL.

Loc.: Ludington plant. One mile north of Butters and Peters well and on north side of Marquette Lake. Record by Lane.

Elevation about 600 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Sand	198	198
10 in. casing to 204 ft.		
Pink clay, calcareous	68	266
Water at about 300 ft., T. 53°.		
Gravel	94	360
Pink clay, calcareous	155	515
Gravel	61	576
8 in. casing to rock.		
Coldwater shale:		
Limestone	74	650
With 15 ft. of porous granular limestone and salt water 35 ft. below the casing.		
Blue shale	550	1200
Antrim shale:		
Black shale	200	1400
Traverse (Hamilton) Formation:		
Brown limestone	25	1425
Blue shale	35	1460
Brown limestone, oily with H_2S	40	1500
Pure limestone (possibly Dundee?—Lane)	250	1750
Brown sandy dolomite	160	1910
Calcareous shale (Bell or Marcellus)	90	2000
Monroe Formation (Dundee in part?):		
Dolomite	25	2025
Limestone (Anderson or Dundee—Lane)	25	2050
Dolomite	25	2075
Sylvania sandstone?	100	2175
Sandy dolomite and anhydrite	121	2196
Salina:		
Salt	8	2304

ANCHOR SALT CO. WELL NO. 4.

Loc.: Ludington, on north side of Marquette lake three-fourths mile northeast of Butters and Peters well. Completed in 1908, J. H. Brogan, driller. Record by P. Hardy.

Elevation between 635 and 650 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene drift:		
Sand and gravel	267	267
Clay	27	294
Hardpan	19	313
Clay	36	349
Sand	89	438
Clay	5	443
Hardpan and sand	25	468
Sand	40	508
Hardpan and gravel	2	510
Sand	4	514
Gravel	4	518
Sand	34	552
Gravel	6.5	558.5
Brown shale	3.5	562
Sand	1	563
Shale	10	573
Sand and gravel	2	575
Coldwater:		
Shale (Hard Illinoian till from 558.5 to 635 ft.? Depth to rock uncertain from record)	60	635
Limestone	14	649
Hard ''slate'' (shale)	24	673
Limestone	6	679
Red limestone	17	696
Lime	74	770
Sharp lime (sandy or cherty?)	112	882
Lime	18	900
Shale	167	1067
Lime	20	1087
Shale	146	1233
Antrim shale:		
Black shale	29	1262
Brown shale	176	1438
Black shale	58	1496
Traverse (Hamilton) and Dundee?:		
Lime, water at 1536 ft	44	1540
Lime, ''Trenton.'' Water at 1569 ft	37	1577
Brown sandstone	108	1685
Gypsum (anhydrite?) at 1586 and a vein of sand at 1617 ft.		
Sharp sandstone	10	1695
Black sandstone	46	1741
Sharp sand	29	1770
Black sand	8	1778
Brown sand	57	1835
Dark sand	13	1848
Sharp sand	8	1856
Black sand	9	1865
Brown sand	20	1885
Yellow sand	33	1918
Brown sand	34	1952
Black sand	27	1979
Sharp sand	7	1986
Probably the ''sand'' from 1540 to 1986 is dolomite, cherty or sandy in the ''sharp'' horizon.		
Streak of shale	3	1989
Limestone	6	1995
Shale	69	2064
Dundee (?) and Monroe:		
Black lime	10	2074
Brown lime	235	2309
Salina:		
Salt	20.5	2329.5
Bottom of salt at 2329.5 ft.		

ANCHOR SALT CO. WELL NO. 5.

Log furnished by J. H. Brogan, driller.

Elevation about 595 (?) ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Sand	90	90
Gravel	42	132
Sand	92	224
Gravel and hardpan	176	400
Sand	90	490
Blue clay	44	534
Coldwater:		
Slate (Hard Illinoian till?)	61	595
Blue lime	15	610
Slate and limestone (in part Antrim)	725	1336
Antrim shale:		
Brown shale	147	1482
Traverse (Hamilton) Formation:		
Hard limestone	468	1960
"Cave" (Soft shale? Bell shale? Cf. well No. 4)	70	2030
Dundee (?) and Monroe:		
Hard limestone, Dundee not recognized	233	2263
Salina:		
First salt	20	2283
Hard white lime	14	2297
Second salt	12	2309
Limestone	25	2334
Third salt	7	2341
Limestone	13.9	2354.9
Fourth salt	5	2359.9
Limestone	44.9	2404.8

Number.	Owner.	Location.	Elevation above lake. Feet.	Total depth. Feet.	Depth to top of salt rock. Feet.
1	Canfield & Wheeler No. 1...	0.7 mi. N., 0.68 mi. W., sec. 11, T. 21 N., R. 17 W.....	12	2,700	1,900
2	Canfield & Wheeler No. 2...	0.7 mi. N., 0.68 mi. W., sec. 11, T. 21 N., R. 17 W.....	12	1,947	.....
3	Manistee Lumber Co. No. 1.	.28 . 72 sec. 1.....	.....	1,926	.....
4	Manistee Lumber Co. No. 2.	.28 .72 sec. 1.....	.....	.....	.....
5	Louis Sands No. 1.....	.04 .44.....	.....	.....	.....
6	Louis Sands No. 2.....	.04 .44.....	.....	.....	2,012
7	Canfield S. & L. Co.....	.1 .08, sec. 1.....	.....	.....	.....
8	Canfield S. & L. Co.....	.1 .08, sec. 1.....	.....	.....	.....
9	R. G. Peters No. 1.....	.92 .28, sec. 7, T. 21 N., R. 16 W.....	.....	2,026.5	.....
10	R. G. Peters No. 2.....	.92 .28, sec. 7, T. 21 N., R. 16 W.....	.....	.....	.....
11	R. G. Peters.....	.92. .28, sec. 7, T. 21 N., R. 16 W.....	.....	.....	.....
12	R. G. Peters.....	.92 .28, sec. 7, T. 21 N., R. 16 W.....	.....	.....	.....
13	R. G. Peters.....	.92 .28, sec. 7, T. 21 N., R. 16 W.....	.....	.....	.....
14	Buckley & Douglass.....	.54 .40, sec. 12, T. 21 N., R. 17 W.....	.....	.....	.....
15	Buckley & Douglass.....	.54 .40, sec. 12, T. 21 N., R. 17 W.....	.....	.....	.....
16	Buckley & Douglass.....	.54 .40, sec. 12, T. 21 N., R. 17 W.....	.....	.....	.....
17	Buckley & Douglass.....	.54 .40. sec. 12, T. 21 N., R. 17 W.....	.....	.....	.....
18	Buckley & Douglass.....	.54 .40, sec. 12, T. 21 N., R. 17 W.....	30	2,015	1,965
19	Canfield S. & L. Co.....	.18 .36 sec. 7, T. 21 N., R. 16 W.....	.....	1,947	.....
20	Canfield S. & L. Co.....	.....	.....	.....	.....
21	State Lumber Co.....	.18 .21 sec. 12, T. 21 N., R. 17 W.....	.....	.....	.....
22	State Lumber Co.....	.....	.....	.....	.....
23	State Lumber Co.....	.....	.....	.....	.....
24	Louis Sands.....	.69 .97 sec. 18, T. 21 N., R. 16 W.....	.....	.....	.....
25	Louis Sands.....	.....	.....	.....	.....
26	Filer & Sons.....	.96 .86 sec. 19 T.....	.....	.....	.....
27	Union Salt & Lumber Co...	.72 .68 sec. 20.....	25	1,982	1,924
28	Union Salt & Lumber Co...	.72 .68 sec. 20.....	.....	or 2,016 to 2,025	.....
29	East Lake or Percy.....	East Lake.....	.....	2,045	2,025

CANFIELD-WHEELER WELL.

Loc.: Near mouth of Manistee River, Manistee. Record by E. D. Wheeler; notes on samples by Lane. (Samples appear to have been mixed.—Lane.)

Elevation 604 ft. A. T.	Thickness, feet.	Depth, feet.
Surface:		
Sand, with streaks of gravel	93	93
Reddish gray clay	2	95
Sand	107	202
Gray clay	94	296
Dark reddish clay	2	298
Quicksand	3	301
All shades of clay; some sand	54	355
Gravel	3	358
Clay, sand, gravel	36	394
Reddish clay, gravel and some sand	181	575
Dark clay and gravel	5	580
Dark shaly stuff	15	595
Light shaly stuff	7	602
Shale and gravel. Contains pebbles of white limestone, argillaceous marl; large residue of clay	113	715
Richmondville or Berea?:		
Sandrock, with occasional streaks of shale and lime	160	875
Antrim shale:		
Shale and streaks of hard lime. (Traverse in lower part)	200	1075
Light gray limestone and some black shale; medium residue of glassy grains of quartz and black slate at 965 ft. (Base of Antrim?)		
Grayish calcareous sandstone; large residue of small rounded grains of glassy silica at 1020 ft.		
Light gray limestone, medium residue of milky quartz, glassy quartz and black slate at 1040 ft.		
Traverse (Hamilton) Formation:		
Blue shale	380	1455
Bluish gray argillaceous marl; large residue of clay at 1100 ft.		
Light gray and dark brown limestone; medium residue of glassy quartz and black slate at 1145 ft.		
Hard gray and black limestone, with conchoidal fracture; also black and light gray slate at 1290 ft.		
Bluish? argillaceous shale and light gray limestone; also black shale at 1310 ft.		
Limestone as at 1290, and a little blue shale at 1325 ft.		
Light gray marl; very small siliceous residue at 1370 ft.		
Siliceous limestone and marl; residue of glassy quartz and gray and dark gray lumps at 1410 ft.		
Calcareous clay; large residue of clay at 1420 ft.		
Bluish gray calcareous clay; residue of clay 90 per cent at 1432 ft.		
Bluish gray calcareous clay; residue of clay 90 per cent at 1455 ft.		
Sticky grayish brown shale, cased 60 ft. above bottom when hole was 1520 ft. deep; brine 20 per cent	100	1555
This sample came up in the slops (i. e. on the sinker rods) when the hole was down 1510 ft. and is like previous sample.		
Bluish gray argillaceous shale; residue of clay 95 per cent at 1525 and 1530 ft.		
Shaly lime	20	1575
Dundee (Corniferous) limestone:		
Lime rock	29	1604
Reddish limestone, with numerous yellow specks of ochre; small residue of clay and silica at 1620 ft.		
Shale and lime	51	1655
Lime streaks, dark and light	40	1695
Yellow gray silicious limestone; appears quite friable; medium residue silicious and yellow at 1675 ft.		
Monroe Formation:		
White lime; brine 30 per cent from here to 1845 ft. Grayish white calcareous clay at 1200 ft.; large residue	10	1705
Lime and shale, hard	20	1725
Shaly and sticky	15	1740
Light gray argillaceous marl at 1735 ft.; large residue of clay and gypsum.		
Dark buff soft limestone at 1740 ft., as at 1675; medium residue of clay and gypsum.		
Lime cuts free	5	1745

CANFIELD-WHEELER WELL.—Concluded.

Elevation 604 ft. A. T.	Thickness, feet.	Depth, feet.
Calcareous shale	7	1752
Very hard spots and softer, and streaks of lime	28	1780
Very hard streaks, with streaks of softer	23	1803
Porous rock:		
Dark gray or drab dolomite at 1810 and 1825 ft.; very small residue, saline	32	1835
Porous rock:		
Dark drab dolomite, conchoidal fracture; very hard; very small residue at 1835	10	1845
Clay lime rock with hard thin streaks. Brine 80°; light gray soft limestone at 1845 ft., small residue of gypsum and silica	13	1858
Softer; cuts very fast from 1845 to 1858.		
Soft lime rock:		
Dark drab dolomite at 1858, as at 1835 ft	7	1865
Hard and soft streaks. Brine 92°	10	1875
Massive lime rock. 93° S. 1877 ft. similar to 1858 ft., and a yellowish limestone in small grains; very small residue	25	1900
Supposed to be salt. 96%	4	1904
Samples missing from 1904 to 1912 ft.		
Salina:		
Rock salt	30	1942
Hard lime rock	5	1947

BUCKLEY & DOUGLASS LUMBER CO. WELL NO. 5.

Elevation about 610 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
First casing 10-inch pipe driven 400 ft	.....	400
Second casing 8-inch pipe to bed rock through sand, clay and gravel	616	616
Antrim shale:		
Hard shale	324	940
$4\frac{1}{4}$ inch casing to 985 ft.		
3 inch casing to 1032 ft.		
A 3 inch pipe for brine inserted 985 ft.		
Traverse and Dundee:		
Limestone	630	1570
Soft shale, 7 inch hole drilled, brass lining to caving rock	110	1680
Monroe Formation:		
Limestone, 6 inch hole, no lining	195	1875
Salina:		
Six inch hole brass lining, caving rock salt and gypsum	20	1895
Limestone, 5 inch hole, no lining	90	1985
Brine cavity	30	2015

R. G. PETERS LUMBER CO. WELL.

Manistee No. 3 of Vol. V. Pl. XXXII.

Loc.: East Lake, Manistee. Drilled in 1885. Driller's record with correlations by C. E. Wright. No samples.

Elevation about 600 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene or surface:		
Sand, gravel and clay	614	614
Antrim:		
Black shale, in part bituminous. Some petroleum. Black water at 960 ft.	346	960
Traverse (Hamilton):		
Limerock, hard and salt, light colors	530	1490
Argillaceous shale (Bell shale), caves badly; looks like petrified worm-holes; dissolves readily in water	110	1600
Dundee and Monroe:		
Sandy limestone. Dundee cannot be distinguished from Monroe. First showing of oil at 1905	305	1905
Water and oil shot up from the 8 in. casing to 150 ft. above the surface; blew off the top of the derrick.		
Record missing from 1905 to 1988 feet.		
Salt to hard rock below	38	2026
Top of salt at 1988 ft.		

R. G. PETERS SALT & LUMBER CO. WELL NO. 7.

Loc.: N. W. ¼, N. W. ¼, sec. 7, T. 21 N., R. 16 W., East Lake. Record from samples and notes, furnished by R. A. Nickerson, General Manager. Samples examined by Lane.

Elevation 600 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene or surface	593	593
Antrim:		
Soft blue shale	4	597
Bluish gray calcareous shale, gas at 730 ft	203	800
Hard black micaceous shale	187	987
Traverse (Hamilton) Formation:		
Fine gray cherty limestone, vigorous eff. Some blue shale	347	1325
Very hard geodiferous dolomite with pearl spar in geods at 987 feet, gas at 1100 feet.		
Black shale and gray limestone with selenite (gypsum) crystals; vig. eff	75	1400
Gray limestone (Vig. eff.) and a little black shale; selenite. Harder than at 978	25	1425
Mainly light gray limestone (Vig. eff.) with a little black shale. Selenite	25	1450
Gray to dark gray and black shale	37	1487
Dark gray shale and light gray argillaceous limestone. Top of cave rock; mod. eff. and very pyritic; selenite	13	1500
Soft gray calcareous shale	50	1550
Crumbly soft shale (Bell) resembling blue clay; some eff	45	1595
Dundee (Corniferous) limestone:		
Hard gray to buff fine grained limestone; cherty (sand) and pyritic; violently eff	10	1605
Reddish fine grained brown limestone sandy and cherty; very pyritic and ferruginous; mod. eff	15	1620
Monroe Formation:		
Gray dolomitic limestone; pyritic and gypsiferous; some bituminous matter	18	1638
Reddish anhydrite and dolomite, sand and selenite	7	1645
Anhydrite and dolomite, light buff in part	7	1652
Ferruginous (altered from pyrite) buff dolomite, anhydrite, selenite. Gas at 1654 feet	4	1656
Buff dolomite, anhydrite, selenite; some chert from 1638 to 1658 ft. Some bituminous matter	5	1661
Pyritic buff dolomite with anhydrite and selenite; softer than above	19	1680
Very red (ferric oxide from pyrite) anhydrite and dolomite; very fine grained	20	1700
Mainly red (ferric oxide from pyrite) anhydrite, and some dolomite	80	1780
Dolomite and anhydrite with selenite	30	1810
Brown dolomite and anhydrite, selenite, and a little dark shale	10	1820
Mainly anhydrite, pyritous	10	1830
Mainly pure anhydrite with a little black shale	20	1850
Hard gray vesicular dolomite with selenite crystals	12	1862
Cherty dolomite and anhydrite; "cave rock"	8	1870
Brown dolomite with much anhydrite and selenite	10	1880
Vesicular grayish brown dolomite with selenite; ferruginous	15	1895
Vesicular gray dolomite with much selenite in cavities	10	1905
Mainly red (from altered pyrite) anhydrite and dolomite, gas rapidly increasing from 1911 to 1916. Quite a flow of oil from 1916 to 1925 feet	25	1930
Mainly very red anhydrite and dolomite	10	1940
Vesicular gray dolomite; selenite crystals; very salty	20	1960
Dark gray porous limestone (dolomite)	20	1980
Salt	20	2000

ANALYSIS OF ONEKAMA GAS.

Carbon dioxide	0.2
Oxygen	1.1
Carbon monoxide	0.1
Nitrogen	11.7
Methane	86.0
Total	100.0
Heating power B. T. U (cu. ft.)	1070.0
Candle power	3.0

LEONARD GAS WELL.

Loc.: Sec. 22, Onekama Twp., Manistee county. Owner, H. W. Leonard, Manistee; driller, W. W. Davis; 1912–13.

	Thickness, feet.	Depth, feet.
Red clay, gravel and sand	57	57
Blue clay	10	67
Sand	152	219
Layer of blue clay and sand	71	290
Red clay	120	410
Shale fragments with black water (sulphur water?)	20	430
Gas bearing sand	7	437
Gas free from water and hydrogen sulphide gas. Flow of gas estimated at 4200 cu. ft. per min.		

	Depth, feet.	Remarks.
Clark Well, Section 33	470	Gas but no flowing water.
Sands & Smith Well, Section 33	537	Gas and water.
August Lipkowski Well, Section 34	418	Gas and water.
H. Ward Leonard Well, Section 32	535	Gas and water.
Dunham Well, Section 26. Enough gas for one jet	510	Trace of gas but no water.
Showalter Well, Section 25	318	Trace of gas and good flow of water.
Dunham Well No. 2, Section 33	425	No gas.
N. & M. Transportation Co. Well	450	Gas and water.
Prosser Well, Section 35	399	Very little gas.

FRANKFORT WELL NO. 1.

A. G. Butler, owner? Reported by C. E. Wright and Mr. Percy. Vol. V, Pl. XVIII.

Elevation of mouth of well 600 ft. A. T.	Thickness, feet.	Depth, feet.
Surface	527	527
Traverse (Hamilton) Formation:		
Hard limestone	543	1070
Shale, soft caving stuff	160	1230
Dundee (Corniferous) limestone:		
Black to gray brecciated limestone with hard flinty blocks	150	1380
Bottom at	.....	1800
Much water towards bottom, 8000 barrels per day.		

PETOSKEY WELL.

Loc.: Thirty-three feet north of Chi. & West. Mich. R. R. station near end of Lake Street and 180 feet from Bear river. Drilled in 1888. Reported by H. P. Parmelee, Charlevoix; C. S. Hampton, G. S. Richmond, Petoskey.

Elevation of well 600 ft. A. T.	Thickness, feet.	Depth, feet.
Surface:		
Gravel, etc.	30	30
Traverse (Hamilton) Formation:		
Limestone strata, highly fossiliferous throughout the entire depth. The fauna is nearly the same as that found in the surface bed. Color light gray, a few strata quite dark and much harder	250	280
Ten to 15 ft. of blue shale, no fossils. Beneath this was a flow of quite pure water, somewhat charged with H_2S	15	295
A nearly solid bed of Acervularia limestone, without a trace of mollusca or other corals. Color light, often creamy white	60	355
A thin layer of gray lime rock of incoherent structure at 355.		
Bell shale (Marcellus):		
Dark shale	80	435
Dundee (Corniferous) limestone:		
About 120 ft. of crystalline limestone of same color, texture and composition throughout	120	555

BAY VIEW WELL.

Loc.: One hundred and twenty paces northwest from the door of G. R. & I. R. R. station and 40 feet from the shore of the bay. Reported by H. P. Parmelee, Charlevoix, and A. J. Richards. Completed July, 1895.

Elevation of well 585 ft. A. T.	Thickness, feet.	Depth, feet.
Surface:		
Shingle	4	4
Traverse:		
Cream limestone	260	264
Medium gray limestone	198	462
Dark limestone	11½	473½
Twenty-five feet of cellular blue shale	25	498½
Flow, 200 bbls. an hour.		

Elevation 600 ft. A. T.	Thickness, feet.	Depth, feet.
Surface:		
Sand	6	6
Gravel	9	15
Fine sand	155	170
Gravel	6	176
Sand; quicksand at 214 ft	54	230
Traverse:		
Fine grained earthy limestone, eff. with dilute HCl. No fossils found in the samples	10	240
Gray limestone, eff. freely with dilute HCl. No fossils in samples	10	250
Earthy or chalky, brownish, porous, much oxidized clayey limestone with a strong clay odor, being in fact in large part clay, but with sufficient lime to give it coherence, and cause free eff. with dilute HCl	10	260
Dark gray argillaceous and somewhat shaly limestone, eff. freely in dilute HCl	10	270
Finely stratified shale, eff. feebly with strong HCl. Compact in texture	10	280
Fossiliferous whitish limestone, containing *Atrypa reticularis* and other fossils. Eff. freely with dilute HCl	10	290
White crystalline limestone containing considerable crystalline calcite. It carries fragments of *Acervularia davidsoni*. Some portions of the samples are compact and argillaceous	10	300
White chalky limestone, non-argillaceous, fossiliferous; eff. freely with dilute HCl	15	315
Brownish, earthy and argillaceous limestone, with a strong clay odor; Bryozoa and other fossils have been observed. Eff. freely with dilute HCl	7	322
Gray calcareous clay of very uniform texture, partially oxidized. Eff. freely in dilute HCl, but is nevertheless a good clay	8	330
Gray, compact calcareous clay rock, but of massive character, and eff. freely in dilute HCl	5	335
Fragments of *Acervularia davidsoni* with the calices free from matrix, and evidently embedded in clay. No clay is, however, retained	10	345
Gray calcareous shale, mixed with pure white limestone, the latter containing Favosites and Acervularia	5	350
Gray argillaceous limestone and some white limestone, with fragments of Spirifer and Acervularia	5	355
Gray limestone. *Acervularia davidsoni* is abundant. Favosites and *Atrypa reticularis* also occur	5	360
Gray, compact, semi-argillaceous limestone; fossils not observed, except crinoid stems. Much shale is mixed with the limestone	7	367
Fragments of *Acervularia davidsoni* and Favosites	3	370
Compact, gray, argillaceous limestone; no fossils observed. It is almost a clay	5	375
Fine grained, compact, argillaceous rock	12	387
Limestone and black shale	3	390
Gray argillaceous limestone with whiter limestone containing *Acervularia*	10	400
Chalky clay. Crumbles and soils fingers. Cream colored	2	402
Bluish gray clay, slightly calcareous; eff. feebly with HCl	8	410
Compact, brown to gray limestone, weathering earthy	5	415
Cream colored calcareous clay, identical with the rock at 400 ft	5	420
Limestone similar to that at 410 ft. No fossils	10	430
Cream colored earthy clay, somewhat more calcareous than that at 402 ft	13	443
Brown banded limestone, mingles with black and gray shale containing *Atrypa reticularis*, etc	4	447
Bell Shale:		
Bluish clay, non-eff	13	460
Same as preceding	22	482

CADILLAC OIL & GAS COMPANY WELL NO. 1.

Loc.: C. R. Smith farm, S. E. ¼, S. W. ¼ sec. 28, T. 22 N., R. 9 W. Theo. H. Cross, well superintendent. Record by R. A. Smith from samples.

	Thickness, feet.	Depth, feet.
Pleistocene drift:		
Yellow sand with small pebbles. Yellow color due to oxidation of iron minerals	20	20
Fine light yellow sand	80	100
Gravel with pebbles of chert and limestone predominating	9	109
Fine yellowish clayey sand	15	124
Coarse gravel with much white chert and some pebbles of crystalline rocks	13	137
Fine yellowish sand	58	195
Gravel with white chert pebbles, some of fossiliferous limestone, black and white sandstone. Very few pebbles of crystalline rocks	10	205
Fine yellowish clayey sand	82	287
White sand and small pebbles of chert, magnetite, red jasper and green schist	143	430
Slightly finer yellowish clayey sand	40	470
Clay, highly calcareous with considerable white sand (probably from overlying bed). Clay brownish in natural sample, white when pulverized; vigorous eff. with cold dilute hydrochloric acid.		
Well in drift at 712 feet, according to reports.		

CHEBOYGAN WELL.

Loc.: At Swifts and Denks (?) near corner Blair and Turner streets. Samples examined by W. C. Alden, U. S. Geological Survey. (See Ann. Rept. for 1908, p. 96).

Elevation of well 600? ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Red clay, highly calcareous	150	150
Sand and gravel	53	203
Sand	2	205
Sand, gravel and red clay	25	230
Gravel	15	245
Sand with some calcareous material	5	250
Sand and gravel	5	255
Gravel	15	270
Fine sand with calcareous material	30	300
Gravel	34	334
Gravel, coarse	18	352
Fine sand with calcareous material	2	354
Fine sand with calcareous material, coarser	6	360
Fine sand with calcareous material, fine	15	375
Much water in drift.		
Fine calcareous sandy clay	5	380
Second box of samples.		
Light to whitish dolomitic limestone at 265 ft.		
Chips of dark grayish dolomite with some quartz sand grains from 265-278.		
Light colored limestone at 300 ft.		
Grayish, dark, porous, earthy dolomitic limestone at 320 ft.		
Monroe (Upper Silurian, Water Lime and Salina).		
Fine chips of brownish buff gray dolomite with a little chert at 380-438 feet.		
Red shaly stuff from 850 to 900 ft.; red sandy shale at 1000 ft.		
Flows of water at 1050, 1350 and 1400 ft.		
Brecciated dolomites with slits and cavities.		
Caved down to 750 ft.		
Salt (March 12, 1901), at ? 1400 ft.		
Fine grayish sand and dolomitic materials with some white chert and bluish and reddish shaly material at 1360?-1550 ft.		
Niagara:		
Beginning of Niagara (Guelph)	?	1550
Fine quartz sand, slightly calcareous	?	1615
Fine quartz sand, slightly calcareous, brownish	?	1625
Fine quartz sand, slightly calcareous, brownish	?	1635
Light grayish crystalline dolomite	?	1652
Light grayish crystalline dolomite	?	1725
Buff fine angular grains of quartz, chert with some dolomitic material	?	1975
Dark gray, very cherty dolomitic material	?	2000
Fine, angular, gray dolomitic material	?	2050
Fine, angular, gray dolomitic material. Lockport about here—2065 ft	?	2100
Fine, angular, gray dolomitic material; Rochester shale 2136-2200 ft	?	2150
Fine, angular, gray dolomitic material	?	2175
Fine, angular, gray dolomitic material. Dark colored, nearly black	?	2200
Clinton:		
Fine, angular, gray dolomitic material. Lighter colored	?	2225
Fine, angular, gray dolomitic material. Lighter colored. Contains small particles of iron or magnetite	?	2250
Medina (See Lorraine below):		
Dark purplish ferruginous material, reddish streak, in small flattened, rounded lenticular pellets. With this is some bluish shaly material, moderately calcareous. Some particles rounded. Also few quartz grains. Bluish shaly material increases in lower samples	125	2425
Lorraine. Lower part:		
Dark drab shale, or dolomite, somewhat calcareous. Small particles of iron or magnetite	125	2425
Dark drab shale, or dolomite, somewhat calcareous. Small particles of iron or magnetite	300	2725
Utica at	.....	2750

GRAYLING WELL NO. 3.

Salling, Hanson & Co., owners, Grayling. T. Percy, driller. Drilled in 1901. Samples, records from notes of A. C. Lane and F. W. Cooper.

Elevation of well 1140 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Sand	50	50
Till or boulder clay	50	100
Mainly sand, some clay and gravel, plenty of water. Progress slow through water bearing quicksand	200	300
Sandy clay till	25	325
Coarse cement sand, etc	25	350
Michigan Series:		
Dark shale	30	380
Blue or bluish shale and gypsum	30	410
Dark blue shale	30	440
Upper Marshall or Napoleon:		
White sandstone, micaceous toward the bottom	100	540
Lower Marshall and Coldwater:		
Blue shale	90	730
Brownish and probably sideritic (iron carbonate nodule) at 720 ft.		
Dark blue shale	650	1380
Compact blue shale	220	1600
Berea horizon?		
Apparently not recognized.		
Antrim shale:		
Black shale	20	1620
Blue shale	20	1640
Black shale	60	1700
Dark blue shale	60	1760
No sample at 1740 ft. nor none from 1780 to 1880	120	1880
Light blue shale	80	2060
Black shale	60	2120
Dark gray shale	20	2140
Black shale	40	2180
Gray shale	20	2200
No sample at 2200 ft.		
Black shale	20?	2240
Brown shale	40	2280
Pyritic from 2240-2280 ft.		
Traverse (Hamilton) formation:		
Light blue shale	20	2300
No sample at 2320 ft. Probably shale.		
Fossiliferous light blue shale and limestone	20?	2340
"Salt and pepper" limestone and shale	40	2380
Light and dark limestone	20	2400
Steel gray limestone	20	2420
Light colored limestone	20	2440
"Salt and pepper" limestone	20	2460
Light colored limestone and blue shale	20	2480
Light colored limestone	100	2580
Dark limestone, fine grained	20	2600
Steel gray fine grained limestone	20	2620
Light colored fine grained limestone	80	2700
Steel gray fine grained limestone	40	2740
Dark steel gray fine grained limestone	20	2760
"Salt and pepper" fine grained limestone	40	2800
Bell shales should occur just below 2800 ft, and the top of the Dundee at about 2880 ft.		

PRESQUE ISLE DEVELOPMENT COMPANY WELL.

Loc.: S. E. ¼, N. W. ¼, Sec. 5, T. 34 N., R. 2 E., on Merrit Chandler property, 40 rods W.-N. W. from Detroit and Mackinac railroad station at Onaway. Contractors, Schrier and Kerr, Lancaster, Ohio. Well started July 14th and finished November 14, 1913. Record by R. A. Smith from driller's notes and log and from samples.

Elevation 830 ± ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene of glacial drift:		
Pink calcareous clay	10	10
Traverse (Hamilton) formation:		
Gray limestone; moderate eff	15	25
Buff and dark gray limestone, and very argillaceous limestone; viol. eff. with strong smell of petroleum. Dark brown oily scum	100	125
Gray granular limestone; bituminous; fossiliferous, crinoids and corals; Viol. eff.; much white calcite	15	140
Soft calcareous gray shale	10	150
Gray limestone with much disseminated calcite; fossiliferous (corals); vigorous eff	20	170
Dark limestone; highly calcareous black shale; disseminated calcite	80	250
Gray, brown and black shale, slightly calcareous	60	310
Dundee (Corniferous) limestone:		
Light buff, brown and black limestone, with much white calcite; vigorous eff. Limestone mottled and streaked	165	475
Reddish buff and light gray limestone. Buff violently eff. Red apparently an oxidized zone. Crevice from 480 to 510 feet. Water	35	510
Upper Monroe, Detroit River series:		
Hard, light buff limestone with rusty spots (from pyrite?); violent eff.; crevice at 525 feet	15	525
Dark gray and buff limestone; pyritic; vigorous eff	50	575
Gray to brown bituminous limestone; oily scum; violent eff	50	625
Mainly buff limestone; violent eff	25	650
White friable marl and fine grained light colored limestones; violent eff. No sample at 675 feet. Crevice from 655 to 700 feet; more water	50	700
Very hard white to light buff limestone, vigorous eff	25	725
Very hard white and brown limestone; vigorous eff	40	765
Crevice at 750. No drillings obtained from 740 feet.		
White limestone and dolomite; cherty; some fragments eff. vigorously, others slowly	15	780
White limestone, cherty, some gray and brown limestone, vigorous eff	45	825
White and black limestone; vigorous eff	30	855
Mainly black limestone, some white; bituminous oily scum; vigorous eff.	5	860
Brown to dark brown limestone, some white limestone and chert; vigorous eff. "20 feet of black limestone"	15	885
Grayish brown limestone; vigorous eff	15	900
Grayish buff limestone; cherty; vig. eff	25	925
White to buff gray limestone and dolomite; some particles eff. vigorously, others slowly	25	950
White to gray limestone; vigorous eff	50	1000
Argillaceous marl and gray limestone; vigorous eff	25	1025
White and buff gray limestone—"salt and pepper;" cherty; vigorous eff. Much water above 1050 ft. rose to within 160 ft. of surface; could lower head	25	1050
Sylvania? (Middle Monroe):		
White limestone, very cherty; vigorous eff	50	1100
White limestone; vigorous eff	25	1125
Extremely hard white and very cherty limestone, medium eff	100	1225
Marl and dolomitic limestone; medium eff	25	1250
"Water (brine) not shut off."		
Hard white sandy limestone; vigorous eff	50	1300

PRESQUE ISLE DEVELOPMENT COMPANY WELL.—Concluded.

Elevation 830 ± ft. A. T.	Thickness, feet.	Depth, feet.
Lower Monroe; Bass Island series:		
Hard reddish brown limestone; very ferruginous; very red at 1375 ft.; vigorous eff	50	1350
Very hard cherty gray dolomite; slow eff	25	1375
Hard gray dolomite, with rusty spots either from pyrite or from particles of the drill. Selenite crystals, slow eff. More or less anhydrite down to the salt	25	1400
Hard gray dolomite; slow eff	25	1425
Light buff and gray dolomite; slow eff	125	1550
Red shale and dolomite; slow eff	15	1565
Gray dolomite; slow eff	15	1580
Brown dolomite; slow eff	50	1630
Cased to 1640 feet.		
Salina:		
Reddish salt	145	1775
Red shale	30	1805
White salt	25	1830
Light shale and anhydrite	100	1930
Reddish salt	150	2080
Hard shale	10	2090
Reddish salt	65	2145
White salt	25	2170
Buff shale	10	2180
Gray salt	15	2195
Dolomite	15	2210
White salt	35	2245
Pink to very red salt	75	2320
Mainly anhydrite; some shale	10	2330
Mainly salt, some dolomite	15	2345
Dolomite and anhydrite	75	2420
Salt	50	2470
Anhydrite, dolomite and salt	10	2480
Soft red shale	15	2495
Dolomite and anhydrite	25	2520
Mainly anhydrite	25	2545
Salt and anhydrite	15	2560
Gray dolomite and anhydrite	10	2570
White salt; "caving at 2625 and at 2740; have to drill three screws to two of hole"	225	2795
Driller's record. No samples below 2825 ft.		
Gray limestone. 6 5-8 in. casing; no water	15	2810
Brown limestone, very hard; 25 ft. per day	40	2850
Hard gray or white limestone; 10 to 15 ft. per day	226	3076

ALPENA LAND COMPANY WELL NO. 1.

Loc.: About 14 miles north of Alpena at Grand Lake. Lot 1, Sec. 8, T. 34 N., R. 8 E.

	Thickness, feet.	Depth, feet.
Traverse:		
Bell shale	50	50
Dundee:		
Crinoidal and fossiliferous limestone, bituminous and pyritic	215	265
Upper Monroe:		
Mixed samples of dolomite and limestone	30	295
Lucas:		
Stylolitic limestone	15	310
Amherstburg:		
Blue and buff dolomite	70	380
Anderdon limestone:		
Brown limestone	55	435
Dolomite and lime	15	450
Limestone	85	535
Black shale mixing with sample below, and limestone. (Cf. Milan 820)	80	615
Flat Rock?:		
Limestone, crinoidal in many places	85	700
Sylvania horizon. Cf. Milan 845-890:		
Cherty, crinoidal limestone	100	800
Largely chert	30	830
Cherty limestone	170	1000
Lower Monroe:		
Gashed dolomite and limestone	20	1020
Limestone, sometimes deep brown (dolomite also)	85	1105
Bluish dolomite, often gashed, with a few grains of sand	25	1130
Limestone, with a little sand, brown at top, then yellow. Water at 1257 feet	130	1260
Dolomite, Cf. Carmen 1210	24	1284
Top of salt formation or Salina, just about 450 feet below the cherty crinoidal limestone horizon that cannot be far from the Sylvania horizon. Compare Goderich groups IV and V.		
Salina:		
Salt	6	1290
Brown dolomite	50	1340
Salt and dolomite	7	1347
Hard layer	5	1352
Dark salt	5	1357
Salt, very clear from 1360-1395	80	1437
Anhydrite	28	1465
Reddish sand, marl or anhydrite	5	1470
Salt (top eight feet reddish)	40	1510
Salt and anhydrite?	4	1514
Brown salt	14	1528
Salt and shale	5	1533
Dolomite, anhydrite and shale	19	1552
Salt and anhydrite	20	1572
Salt, clear	17	1589
Impure salt with shale and anhydrite	5	1594
Salt, mainly clean, white	57	1651
Salt with clay and anhydrite streaks at 1655-1678. Cf. Carmen well 2105	50	1701
Anhydrite and dolomite	11	1712

CHURCHILL WELL.

Elevation of well 585 ft. A. T.	Thickness, feet.	Depth, feet.
Surface:		
Sand and boulders	41	41
Traverse:		
Hard white (light colored) limestone	25	66
Shale	9	75
Very hard white limestone	49.5	124.5
Shale	2.5	127
Extra hard gray limestone	40	167
Blue shale	20	187
Hard white limestone	34	221
Shale, 7 ft. white and slimy, possibly gypsum (?)	18	239
Hard white limestone	23	262
Very sticky blue shale	27	289
Hard white limestone	32	321
Shale	3	324
Hard white limestone, upper two-thirds extra hard	39	363
Bell:		
Shale	24	387
Hard white limestone	5	392
Shale, mostly blue. Some water at 427 feet	52	444
Dundee:		
Hard white and gray limestone, mostly extra hard. Strong flow of water at 489 feet	60	504
Extremely hard (flinty) limestone	39	543
Monroe:		
Shale	25	568
Hard gray and white limestone (Dundee?) Great flow of fresh water at 590 feet. Vein of sulphur water at 605 feet	103	671
Shale	20	691
Hard white limestone water	86	777
Sandy lime and shale	10	787
Hard white limestone	480	1267
Salina:		
Rock salt	20	1287

KILLMASTER WELL NO. 3.

Loc.: Five hundred paces N., 1000 paces W. of the south line of sec. 22, T. 26 N., R. 8 E. On the east side of the stream 10 rods from the bridge. No samples.

Elevation 670 ± ft. A. T.	Thickness, feet.	Depth, feet.
Surface:		
Sand, then till, no gravel at the bottom	240	240
Coldwater Shale:		
Sandstone	4	244
Gray shale	6	250
Sandstone	4	254
Gray shale	275	530
Sunbury (Berea) Shale:		
Red shale	20	550
Black shale	20	570
Berea Grit:		
Sandstone: Gas in top of sandstone, and a very small quantity of oil, which was overcome by salt water in the sandstone below the gas. However, bubbles of burning gas (not H_2S or CO_2) are now coming up continually in the water	40	610
Antrim Shale:		
Gray shales (compare Bedford shales)	150	760
Dark shales (compare Cleveland shales)	150	910
Gray shales (compare Erie shales)	25	935
Dark shales (compare Huron shales)	65	1000
(The top of the Traverse may be here.—Lane.)		
Gray shale and limestone	32	1032
Black shale (compare Huron shale)	58	1090
Traverse (Hamilton) Formation:		
Hard limestone	8	1098
Soft limestone	80	1178
Hard limestone	90	1268
Hard limestone	4	1272
Soft limestone	20	1292
Limestone	238	1530
Color varies from light to dark from 1090 ft. down.		

HARRISVILLE WELL.

Loc.: Court House, Harrisville.

Elevation of well 640 ft. A. T.	Thickness, feet.	Depth, feet.
Post Glacial and outwash:		
Yellow loamy soil	12½	12½
Quicksand	14	26½
Red clay	6½	33
Gravel	6	39
Glacial:		
Wisconsin. Last till sheet (sand of mixed character, boulders, etc.)	60	99
Interglacial:		
Sand, signs of oil	30	129
(Quicksand, solidified to a blue hard pan at base).		
Earlier till sheet:		
Red hard pan	59	188
(Weathered till sheet).		
Red clay	4	192
Blue hard pan and pebbles	38	230
Berea Grit:		
White fine grained sandstone	30	260
Antrim shale:		
Light gray shale (Bedford) or weathered black shale	149	409
Brown and black shale	97	506

TAWAS CITY WELL.

Loc.: Grant & Sons Mill.

Elevation about 600 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Sand		
Clay, yellow	30	30
Napoleon or Upper Marshall:	20	50
Sandstone, whitish		
Lower Marshall and Coldwater:	60	110
Sandstone, red		
Sandstone, gray	15	125
Sandstone, red	5	130
Shale, light colored	40	170
Shale, arenaceous red	10	180
Shale, light colored	30	210
Shale, arenaceous red	5	215
Shale, blue	88	303
Sandstone, red	35	338
Shale, hard, light colored	40	378
Sandstone, red	60	438
Shale, white	5	443
Sandstone, red	15	458
Shale, hard, light colored	5	463
Sandstone, red	40	503
Shale, white	5	508
Shale, arenaceous, light colored	3	513
First indications of brine.	3	516
Shale, white, hard		
Richmondville?:	164	680
Sandstone, gray		
Abundant supply of strong brine.	195	875
Appears to be too near the top of the Coldwater to be the Berea.		
Shale, blue	10	885

PRESCOTT WELL.

Loc.: S. W. Cor. of sec. 36, T. 22, R. 4 E., Ogemaw county. Franz Jahncke, contractor, Alpena, Mich., March 16, 1912. Record furnished by Mr. Jahncke, also samples.

Elevation of well about 768 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Red clay	6	6
Blue clay	9	15
Fine white sand	6	21
Red clay	37	58
Gravel	2	60
Red clay	55	115
Red clay and grit	14	129
Blue clay, round fragments of gypsum and rock	25	154
Michigan Series:		
Gray rock (Sample missing)	4	158
Blue shale	27	185
Gypsum	3	188
Blue shale	4	192
Dark rock	3	195
Dark shale	3	198
Gray limestone	4	202
Blue shale	5	207
Dark rock	1	208
Gypsum	2	210
Dark blue limestone	10	220
Brown limestone	3	223
Gypsum	8	231
Blue shale calcareous	3	234
Blue limestone	4	238
Brown limestone	12	250
Gypsum	3	253
Blue limestone	9	262
Hard gray limestone	12	274
Chert (a little flow of water)	2	276
Dark blue limestone	12	288
Blue shale and dark	18	306
Chert very hard	2	308
Upper Marshall or Napoleon:		
White sand (water rises from 26 ft. to 22 ft. 4 in. from top of casing)	10	318
Chert (Sample missing)	2	320
White sand	16	336
Red sand (Sample missing)	3	339
White sand (Sample missing)	21	360
Light blue sand	68	428
Water 16 ft. 7 in. from surface.		
Lower Marshall:		
Red rock with mica	55	483
Coldwater?		
Blue shale (Sample missing)	45	528
Brown rock with mica	62	590
Blue shale sandy	44	634
Brown shale sandy	16	650

JAMES NORN WELL.

Loc.: Standish.

Elevation of well 626 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Clay, sand, etc	60	60
Saginaw Coal Series:		
Gray sandstone	40	100
Blue shale	20	120
Black shale	10	130
Upper Grand Rapids:		
Blue and gray limestone	70	200
Gray sandstone	40	240
Lower Grand Rapids:		
Blue rock	40	280
Shale?	20	300
Shale?	30	330
Blue rock	60	390
Blue shale	10	400
Hard gray rock; streaks of shale; big flow of water	50	450
Upper Marshall or Napoleon Sandstone:		
Gray sandstone, rapid drilling	200	650
Lower Marshall Sandstone:		
Red sandstone and blue shale (brine easily exhausted.) Blue shale with some red shale	250	900
Coldwater Shale:		
Mostly blue shale. Some water at the top	100	1000
Blue shale, some brine but scarce	400	1400
Blue shale	400	1800
Berea Shale:		
Black shale, some water	50	1850

LAKE PARK WELL, MILWAUKEE.

	Thickness, feet.	Depth, feet.
Hamilton (Traverse) Group:		
Soapstone	80	80
Cement rock	12	92
Soapstone	30	122
Dundee absent:		
Waterlime? Brown limestone	30	152
Niagara limestone	320	470
Cincinnati shale (Medina to Utica)	180	650
Galena and Trenton limestone	300?	950?
St. Peters sandstone at	.....	958
Potsdam sandstone	.....	?

MARINETTE WATER WORKS WELL NO. 1.

Loc.: Waterworks, Marinette, Wis

	Thickness, feet.	Depth, feet.
Pleistocene:		
Red sand and gravel	70	70
?	15	85
Galena limestone:		
Round chipped limestone (or to 196 ft.)	59	144
Trenton limestone:		
Blue shales (Galena?)	52	196
Chipping limestone coarse	44	240
Chipping limestone	10	250
"Slate" light blue and white	70	320
(Base of Trenton uncertain, St. Peters sandstone absent?)		
Lower Magnesian (Calciferous) limestone:		
Chipping limestone, coarse	130	450
Coarse chipping limestone light colored and dolomitic	100	550
Potsdam group?:		
White sandstone, very white, mealy-looking	10	560
White and greenish, calcareous sandstone	110	670
White sand	15	685
Rounded white sand	27	712
Huronian? (Potsdam wholly or in part?):		
"Granite" (broken and lost)	4	716
Dark red quartzite	?	716 +

MARINETTE WATER WORKS WELL NO. 2.

	Thickness, feet,	Depth, feet.
Surface sand and gravel	69	69
Galena dolomite	121	190
Trenton dolomites, brown and blue shaly (at 260 to 275 sandy)	135	325
St. Peters sandstone	75	400
Calciferous (Lower Magnesian)	180	580
Potsdam	215	795
Pre-Cambrian:		
Cherty or jaspilitic arkose quartzite	183	978

ESCANABA BREWING COMPANY WELL.

	Feet.
Surface	39
Limestone	150–200
Sandstone	300–400
Struck "iron" at	730
Water very red.	

RICHTER BREWING COMPANY WELL.

	Feet.
Sand	50
Hard clay	9
? ((probably limestone mainly)	300
Sandstone	410
"Granite" at	810

A. WAGNER WELL.

Loc.: Delta county, S. W. ¼ of N. W. ¼ of sec. 8, T. 39 N., R. 21 W. Drilled for coal. Formerly A. Wagner farm; present owner Jno. Wagner.

Elevation over 650 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Gravel and clay	9	9
Lorraine (Hudson River):		
Blue shale	45	54
Fossiliferous shale	13	57
Brown shale	28	95
Blue shale	20	115
Brown shale	8	123
Gray shale	70	193
Light gray shale	8	201
Utica:		
Bituminous shale	50	251
Trenton limestone:		
Galena:		
Limestone	83	334
Fossiliferous limestone	55	389
White limestone	8	397
"Upper blue" of Wisconsin, Trenton?		
Dark limestone	9	406
"Upper buff?"		
Quartzite (geods?)	6	412
Limestone	44	456
Quartz (geods?)	1	457
Limestone	24	481
"Lower blue."		
Blue shale	4	485
Black limestone	14	499
Limestone	19	518
Blue shale	4	522
"Lower buff."		
Sandstone, soapstone and limestone (perhaps in part St. Peters)	38	560
St. Peters:		
Red clay shale (weathered surface of Lower Magnesian?)	1	561
Sandy shale	1	562
Calciferous:		
Limestone, soapstone and sandstone	66	628
Crystalline limestone	12	640
Depth of hole	.....	640

A. WAGNER HOLE NO. 2.

Loc.: S. W. ¼ N. W. ¼, sec. 8, T. 39 N., R. 21 W. Formerly A. Wagner farm; present owner, Jno. Wagner. Three or four miles northeast of Stonington. Drillers, Gunter of Escanaba and Chris. Skaug of Stonington. Drilled about 1910.

Elevation over 650 feet.	Thickness, feet.	Depth, feet.
Surface:		
Sand and gravel	8	8
Clinton, Medina, Lorraine and Utica:		
Fossiliferous limestone	32	40
Alternate shale and limestone	200	240
Bituminous shale (Utica in lower part)	250	490
Trenton, Calciferous, St. Peters, Potsdam:		
Limestone, sandstone and blue shale	490	750
Hematite. Two veins two and seven inches thick, interbedded in sandstone (Huronian?)	1	751
Sandstone	29	780
Huronian:		
Hard white quartzite with pebbles in it	68	848

ST. PAUL AND STE. MARIE RAILWAY WELL.

Loc.: Gladstone.

Elevation 605 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene or surface:		
Sand (old dug well)	13	13
Quicksand	38	51
Till (clay and hardpan)	10½	61½
Sand and gravel	15	76½
Clay and limestone	10½	87
Boulders	4	91
Trenton:		
Limestone	234	325
St. Peters:		
Lime and sandstone in mixed layers. Some water at 400 feet	89	404
Calciferous (Lower Magnesian):		
Limestone (crystalline dolomite at 632 feet)	228	642
Potsdam:		
Shell sandstone (white round sand at 742 ft.)	101	743
Main water flow; 150 gallons per minute. Soft water.		

RAPID RIVER WELL.

Loc.: Two hundred paces W., 505 S. of N. E. Cor. of sec. 34, T. 42 N., R. 21 W.; 7 mi. N. and 2 mi. E. of Rapid River.

	Thickness, feet.	Depth, feet.
Surface:		
Swamp peat and muck	3–6	6
Marl	10	16
Fifteen ft. 10 in. casing.		
Trenton limestone:		
Dolomite with geods lined with fine dog-tooth spar calcite and filled with oil "gum"	264	280?
St. Peters horizon:?		
Signs of oil. Strong flow of water, over 1 quart a second. Temperature 47° 3 F.		
An old well 300 ft. west was 202 ft. deep	350	630
Calciferous?		
S. at 620 box 380, a dolomite.		
Potsdam sandstone:		
"White sandstone comes in 600-700 ft. down," Clear white glass sand (Upper Potsdam of Rominger).		
Samples, boxes 300 to 370	80	710
Reddish sandstone coarse:		
Sample, box 290	10	720
Coarse red sandstone.		
Sample, boxes 250 to 280	40	760
Feldspathic sandstone.		
Box 290	10	770
Coarse mixed very micaceous red sandstone.		
Box 210-230	30	800
Last samples, large fragments of decomposed chloritic schist, like Archaean rocks.		

A. E. NEFF WELL.

Loc.: Seven miles N. E. of Rapid River, Mich. Owner, A. E. Neff. Driller, Cisco. Drilled in 1904.

	Thickness, feet.	Depth feet.
Surface materials	12	12
Trenton limestone:		
Top limestone—dark, mixed, some sand	218	230
Limestone—mixed brown and blue	60	290
No record 290–302	12	302
St. Peters:		
Sand—round quartz sand, white	18	320
Calciferous:		
Limestone—fine grained, white, massive	35	355
Sand—clean, white, quartz sand	20	420
Sandy lime—white powder	10	430
Sand—clean white quartz sand	20	450
Sand—white dolomitic powder	25	475
Sand—quartz and white dolomite mixed	25	500
Sand—cemented by dolomite	30	530
Cased 9 5-8 in. pipe.		
Slate—dull bluish	25	555
No record 565-630	75	630
Lake Superior or Munising Sandstone:		
Gray, sandy round quartz and rarely other grains	45	675
Red sandstone—light pinkish quartz grains	35	710
White sand—white quartz grains	15	725
Red sand—pinkish quartz grains "725 grit." Water flow	25	750
Sand—mica, quartz, feldspar, etc., mixed	30	780
Sand—mica, quartz, feldspar, chlorite. Arkose? but not rounded. "780 red granite"	50	830
No record 830-875 ±.		
Pre-Cambrian:		
Rusty, much mica. "Wedged in bottom from description in gabbro"	125	.....
Quartz and feldspar? a pounded aplite?	.....	875 ±
Feldspar, chlorite, mica hornblende	.....	890 ±
Fine grained dark feldspar, chlorite, etc	.....	900 ±
Bottom	.....	1000 ±

ANALYSES.

	No. 1. Percent.	No. 2. Percent.
Distilled at 212° to 347° (mainly water)	25	2.21
Distilled at 570° to 600° (mainly oil)	45.36	46.55
Asphalt	24.56	46.73
Balance ash or decomposition products	5.08	4.51
Total	100.00	.....

MANISTIQUE MUNICIPAL WELL.

Loc.: Cor. of Garden Ave. and Potter St. Finished August, 1903.

Elevation 595 ft. A. T.	Thickness, feet.	Depth, feet.
Sand	2	2
Dolomite, light buff, massive	2	4
Light dolomitic limestone	9	13
Bluish white dolomite (harsh feel)	11	24
Brownish crystalline dolomitic limestone	16	40
Light bluish dolomitic limestone	12	52
Buff crystalline cherty limestone	13	63
White limestone	7	70
Buff, crystalline dolomitic limestone	10	80
Hard drilling from 0 to 80 ft.		
White limestone (Blaney—Fiborn bed?)	27	107
Mottled gray dolomite	18	125
Buff dolomite	11	136
Soft drilling from 80 to 140 feet.		
Yellow dolomite	22	158
Gets harder; very little water at 140 feet but no flow.		
Yellowish limestone	30	188
Yellowish dolomite	12	215
This may be base of coralline, top of Byron beds of Wisconsin, Rominger's lower division.		
White thin banded lithographic dolomite	10	225
At bottom white limestone	15	240

ST. IGNACE WELL NO. 1.

Mackinac Lumber Co. O. W. Johnson, Racine, Wis. W. A. Burt. Drilled in 1887 by Henry Errata.

Elevation about 600 ft. A. T.	Thickness, feet.	Depth, feet.
Surface:		
Sawdust and clay	15	15
Monroe Formation:		
Red and blue slates, principally red. Strongly impregnated. Salt water with a bitter taste	385	400
Red marl and a vein of salt	4	404
Blue slate	100	504
Niagara (Guelph and Lockport):		
Limestone (contains a little dolomite and gypsum.) Very light buff. Dolomite with slow eff. Upper strata are probably Monroe; see well No. 2	300	804
Driller's name, sandstone; with a strong smell, oily. S. white limestone; contains a little gypsum, 2 per cent	95	899
S. Calcareous sandstone (gray); 90 per cent chert, etc.; rusty. Some gas	20	919

ST. IGNACE WELL NO. 2.

Loc.: Two mi. north of No. 1 on sec. 31, T. 41 N., R. 3 W.; 600 ft. N. of town line and 300 ft. from Lake Huron.

Elevation 590 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Surface	34	34
Gravel with gypsum	9	45
Monroe Formation:		
Dolomite	63	to 89
Dark dolomite	100	to 104
Gypsum	174	to 187
Red shale	.....	.....
Blue shale	.....	.....
Gypsum	255	to 260
Red shale	.....	.....
Blue shale	.....	.....
Gypsum, about	.....	300
Blue shale with gypsum at 329 and 364 to 400 ft. and other spots to 426 feet	126	426
Gypsiferous dolomite	18	444
Light dolomite	19	463
Dark brown dolomite	47	510
Niagara (Guelph):		
Light dolomite	60	570
White sandy dolomite	15	585
Good water at 575 ft. 589 ft., January 29.		
Hard mixed cherty dolomite	7	592
White sandy dolomite	196	788
581 ft. Feb. 10; H_2S water for over 100 ft.; 870, March 23.		
Brown and mixed dolomite	232	1020
Lockport (?):		
Limestone	90	1110
Rochester (?):		
Blue shaly dolomite	35	1145
Brown cherty dolomite	5	1150
Light dolomite	16	1166

NEEBISH WELL.

Loc.: Near Sailor's Encampment, Neebish Island, or across the west channel on the mainland opposite Trombleys and about 1000 ft. south of north line of Trombleys; about 100 ft. from river, 6 or 7 ft. above water, and about 1½ miles below the rapids in the river. Reported by A. W. Palmer, Jan. 15, 1900.

Elevation about 587 ft. A. T.	Thickness, feet.	Depth, feet.
Surface:		
Clay, boulders and sand	33	33
Trenton limestone:		
Limestone, hard	1	34
Limestone, vein water, soft	1	35
Limestone, hard	14	49
Limestone, gritty, softer	40	89
Limestone, darker in color, not so gritty but harder (111-138 light colored)	17	106
Limestone, softer	13	119
Limestone, shale	2	121
Limestone, hard	3	124
Limestone, softer	3	127
Limestone, hard	7	134
Limestone, softer	6	140
Limestone, shale	2	142
Limestone	7	149
Limestone, hard (148-158 light colored)	4	153
Limestone, softer	5	158
Limestone, shale (bluish, thin chips)	5	163
Limestone, brittle (bluish, chipping, 163-200)	22	185
Clay	1	186
Limestone, brittle	4	190
Shale; cased here for first time	8	198
Limestone	2	200
Shale (large chips, thin bedded)	5	205
Limestone, darker in color (sandy dolomite)	9	214
Limestone, shelly, full of little seams	9	223
St. Peters (Calciferous?):		
White sand rock	10	233
Shale	2	235
White sand (glass sand) rock, got first flow water at 250 ft., and more in several places in going through the sand	149	384
Potsdam:		
Light red sand	27	411
Sand; harder, looks like granite boulders pounded up	6	417
Pre-Cambrian:		
Sandy shale; sand pumpings look red but when washed out are black. (Coarse red conglomerate; grows coarser)	89	506
Sand rock	21	527
(At 430 ft. red pebble? of Huronian quartzite; 506-510 ft. and 510-527 ft. material mainly Huronian.)		

PICKFORD WELL.

Loc.: Sec. 6, T. 43, N., R. 1 E. F. G. Holden, H. D. Van Campen, Sault Ste. Marie; Mr. Taylor, Pickford.

Elevation about 670 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Lake Superior red clays	119	119
Sand, source of local flows of water	13	132
Described by Leverett. Head 6 to 7 ft., light flow.		
Niagara (Lockport):		
Hard dolomite; slow eff., a few loose shaly layers at top; then very hard.	128	260
About 3 miles S. of town the land rises to the Niagara escarpment.		
Lorraine:		
Blue shale	215	475
Utica:		
Black shale, "slate"	50	525
Trenton limestone:		
White limestone; ready eff.; residue of pyrite cubes and chert	275	800
St. Peters:		
Thickness unknown	.....	600
Water at 600-700 ft. said to be in white sandstone but it is doubtful; no samples.		
Samples of water 575 to 650 ft. show 70-79 per million Cl and are hard and have SO_4.		
Calciferous?		
At 800 ft. 10-24-06 Iron Mtn. Tribune-Gazette.		
Potsdam or Lake Superior sandstone	700	1500
Red rock at 800-900. (Holden.)		
J. L. Ward also thought they passed Trenton at 900 ft.		
Said to be muddy. (VanCampen).		
At 1360′ red as blood. (J. L. Ward).		
Flow of water March 22?, 07 "warm."		
Into an oily sandstone—Detroit Times.		
VanCampen thought the casing was crushed at 1200-1300 ft. Water flowed with over 25 ft. head.		
Depth—Marquette Mining Journal, 3-23-07, 1500; 6-7-07, 1425.		

GORE BAY WELL.

	Thickness, feet.	Depth, feet.
Pleistocene or drift	1	1
Niagara:		
Limestone extra hard and gray	45	46
Rochester:		
Blue shale	89	135
Clinton? Lorraine?		
Limestone	1	136
Shale	29	165
Limestone	1	166
Lorraine:		
Blue shale	90	256
Utica shale:		
Brown shale	60	316
Black shale	15	331
Trenton limestone:		
Limestone	250	581
Oil at 425 ft.		

	I.	II.	III.	IV.	V.
Clay and sand	38.45	34.60	37.26	48.27	73.57
Carbon	6.83	6.63	0.61	6.99	15.03
Hydrogen	0.74	0.77	0.83	1.13	1.65
Oxygen	3.20	2.96	1.71	3.39	5.39
Carbonate of lime	45.02	49.31	52.60	20.30	1.29
Carbonate of magnesia	2.09	2.53	3.42	11.48	0.76
Alum. and oxide iron	2.16	2.09	3.29	7.99	2.79
Total	98.49	98.89	99.72	99.55	100.48

	Crude oil, gallons.	Ammonium sulphate, pounds.
Geo. Irving seam, N. B. (shale retorted in Scotland)	48	77
Albert mines, N. B	32–58	49–82
Albertite, N. B	135	65
Stellarite coal, Nova Scotia	60–150	.....
Baltimore shales, N. B	55–68	30–112
Taylorville shales, N. B	52–57	85–101
Utah and Colorado black shales	10–61	.....
Torbanite, Scotland	108–156	.....
Pumpherston seams, Scotland	19–24	55–60
Union oil-coal, W. Va.	32	.....
Elk River oil-coal, W. Va	54	.....
Kanawha oil-coal, W. Va	88	.....
Wolgan and Capertee, N. S. Wales	120	.....
Kentucky Cannel coal	156	.....
"Old Kentucky Boghead."		

	Moisture.	Volatile Hydrogen.	Fixed Carbon.	Ash.
Torbanite, Scotland	.....	*71.17	7.65	21.18
Albertite, N. B	.....	*54.39	45.44	0.17
Joadja oil-shale, N. S. Wales	.....	*89.57	5.27	4.98
New Zealand torbanite	2.83	56.05	26.02	5.10
Kentucky Cannel Coal	1.21	55.36	35.17	8.26
Stellarite, Nova Scotia	0.37	68.38	22.35	8.95
Antrim shale, Barry Co	6.595	6.025	3.95	83.435
Bone coal, Saginaw Valley	8.08	30.74	49.29	11.89
"Cannel" Arenac Co	11.35	35.80	41.10	11.87
St. Charles, Saginaw Co	2.37	36.18	58.99	2.46
English Cannel, Wigan	.....	*39.64	57.66	2.70

*Dry material.