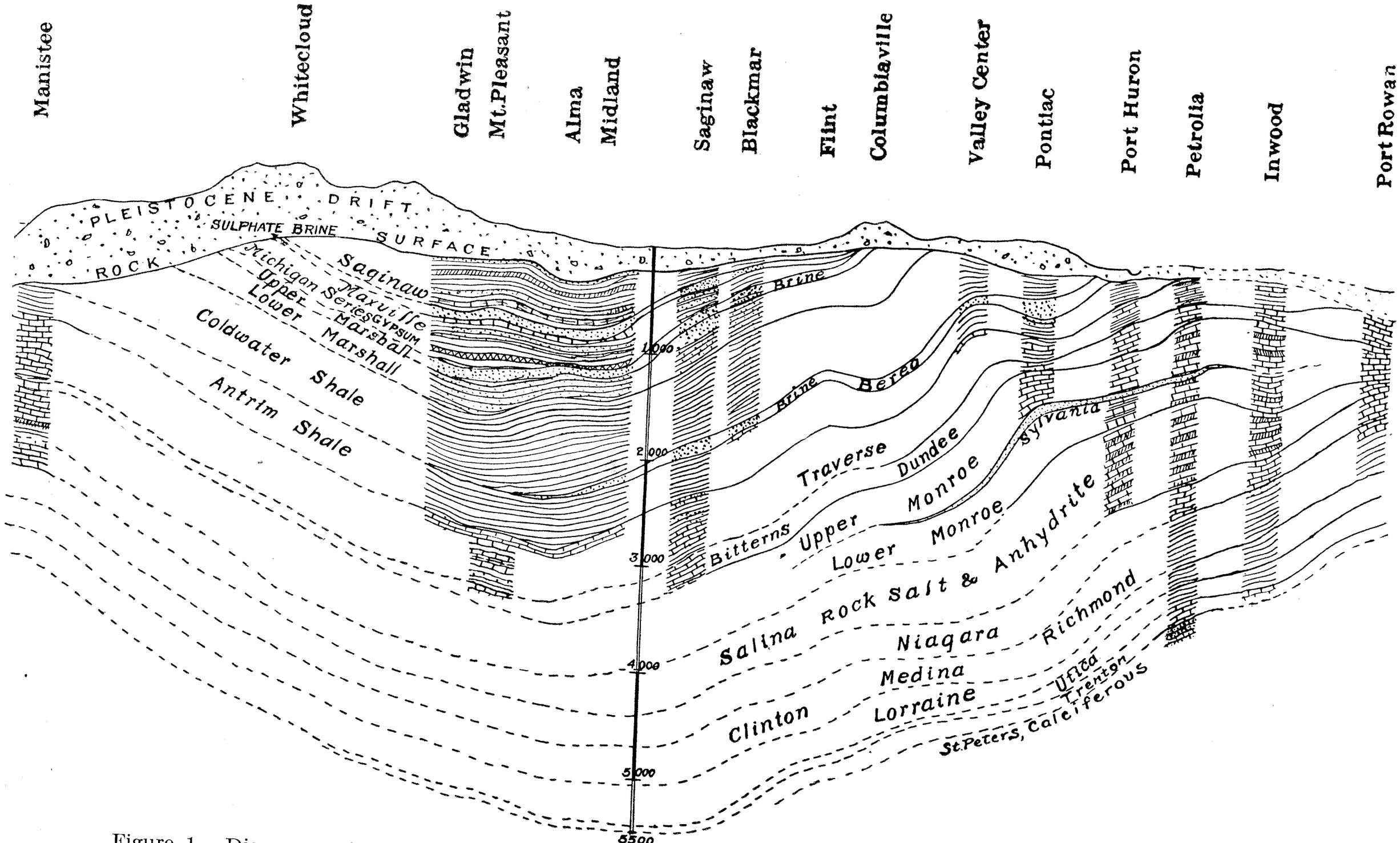


Figure 1. Diagrammatic cross section of the Michigan Basin from Port Rowan, Ontario to Manistee, Michigan.

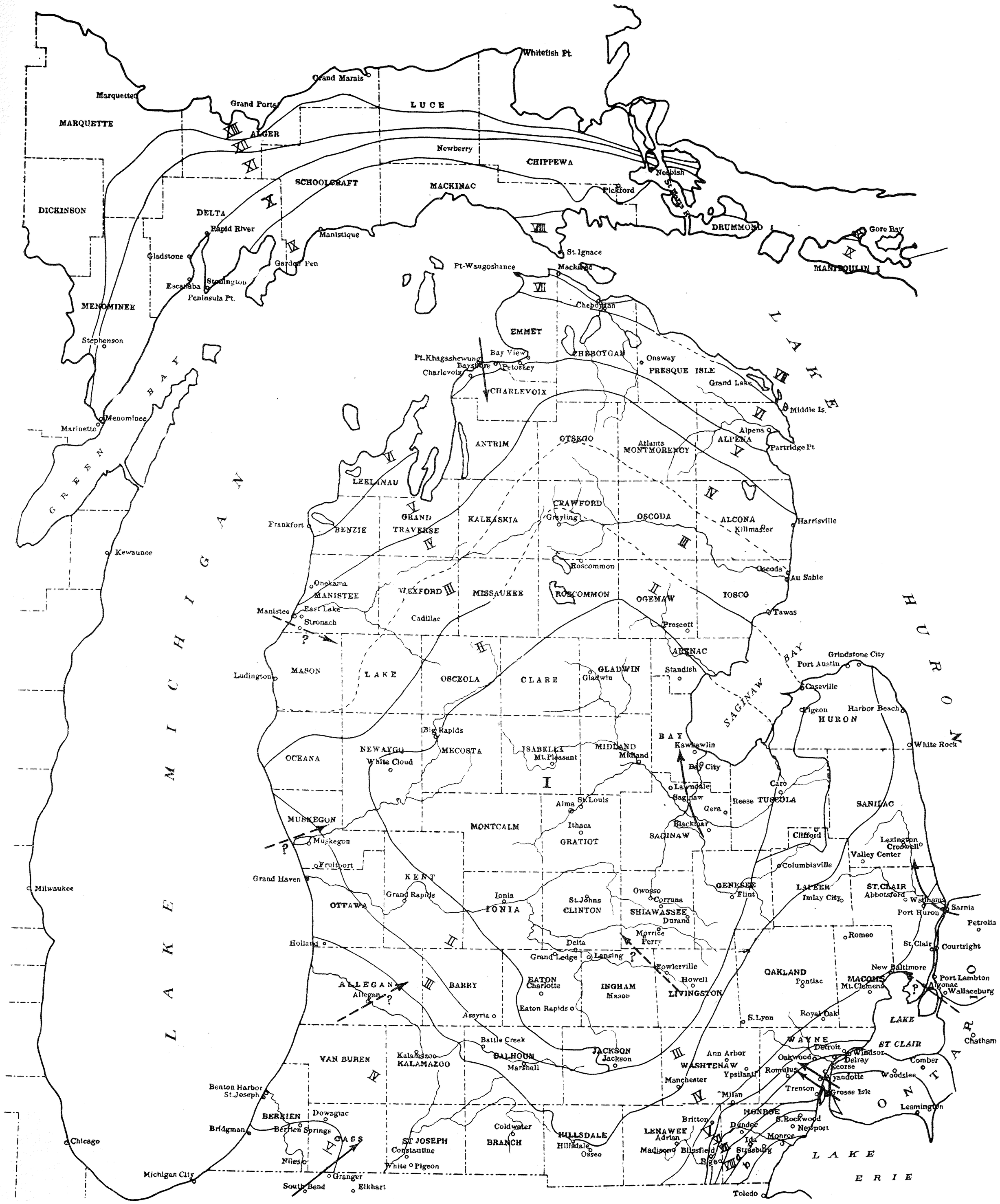


FIGURE 2. OUTLINE GEOLOGICAL MAP OF MICHIGAN SHOWING PALEOZOIC FORMATIONS AND THE LOCATION OF DEEP BORINGS.

PENNSYLVANIAN.

I. *Saginaw Formation* (Upper Pottsville) and *Parma* sandstone (Lower Pottsville).

MISSISSIPPIAN.

II. *Grand Rapids Group: Upper Grand Rapids, Bayport* or *Maxville* limestone (Upper St. Louis), and *Lower Grand Rapids* of *Michigan Series.*

III. *Marshall Formation:* (Kinderhook of Iowa, Black Hand and Logan of Ohio.) *Upper Marshall* or *Napoleon* and *Lower Marshall.*

IV. *Coldwater* shale and *Berea* sandstone.

DEVONIAN.

V. *Antrim* shale.

VI. *Traverse Formation:* (*Hamilton* and *Marcellus* Erian and Delaware of Ohio).

VII. *Dundee limestone:* (*Corniferous* and Schoharie, Ulsterian, and Upper Helderberg).

SILURIAN.

VIII. *Monroe Formation: Upper Monroe* or *Detroit River Series, Middle Monroe* or *Sylvania, and Lower Monroe* or *Bass Island Series.*

IX. *Niagara,* (*Guelph* and *Lockport*), *Rochester* shale, and *Clinton.*

ORDOVICIAN.

X. *Richmond* and overlying *Medina* of the Silurian, *Lorraine* and *Utica.*

XI. *Trenton limestone:* (Galena and Platteville?)

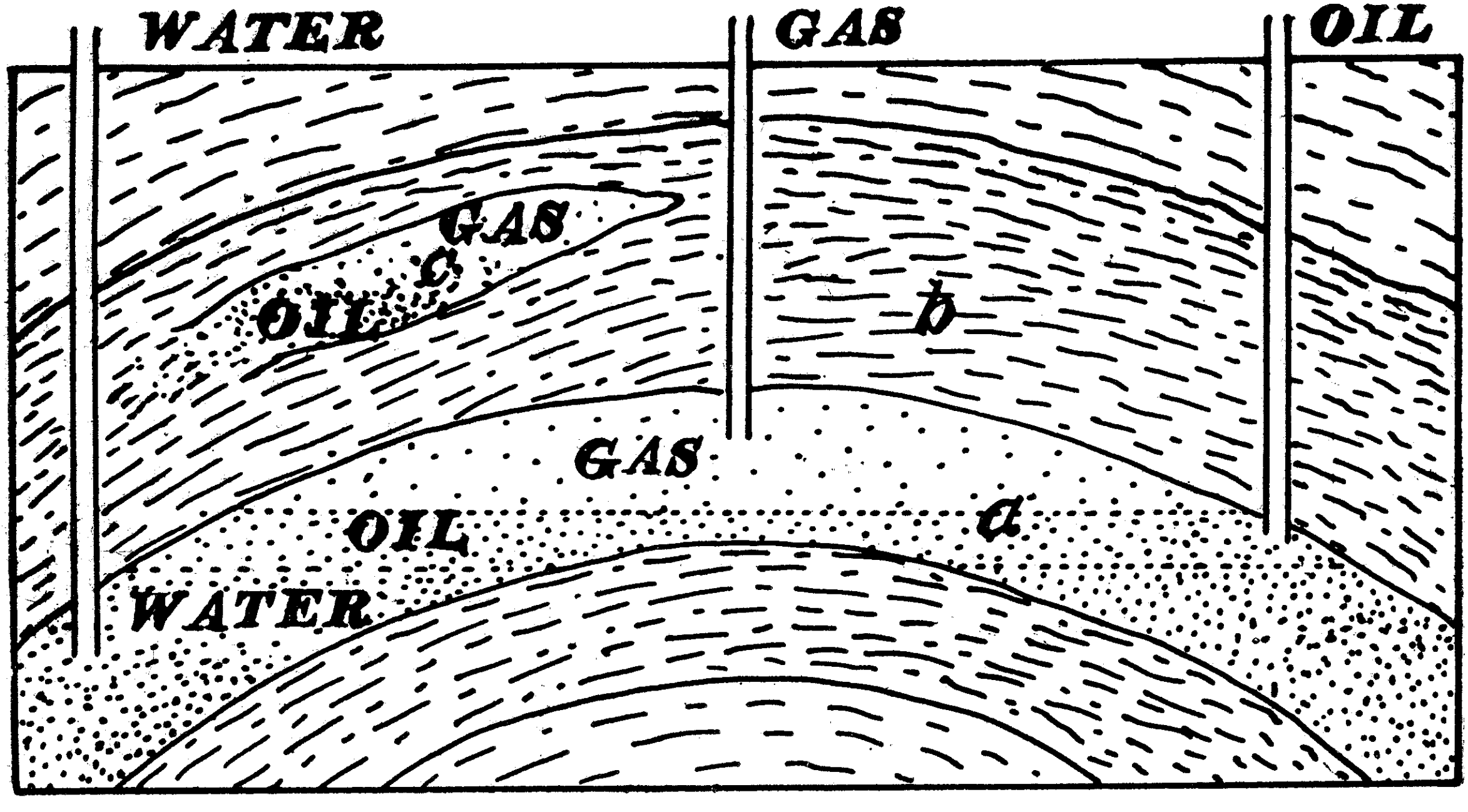
XII. *St. Peters* and *Calciferous* (Lower Magnesian).

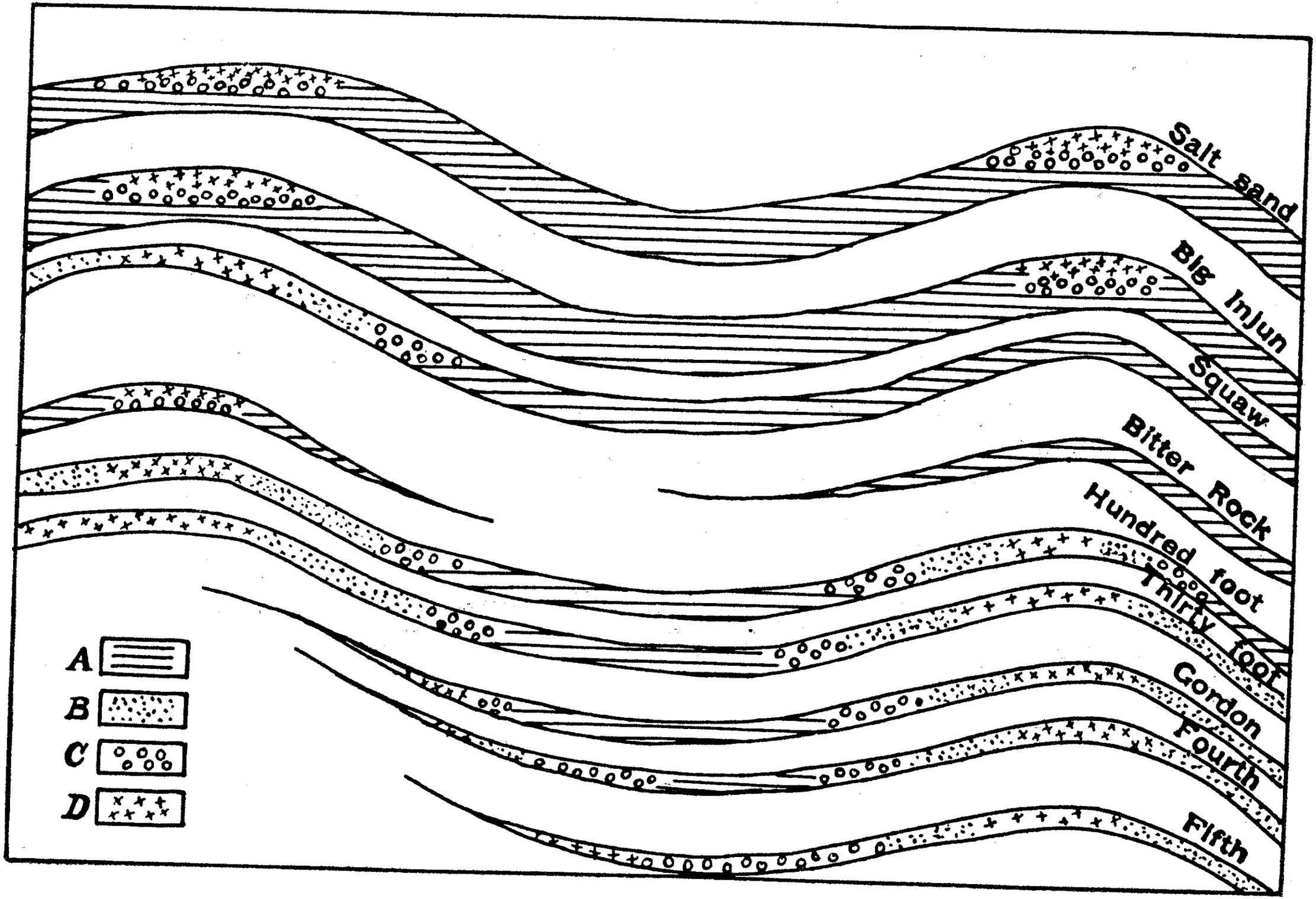
CAMBRIAN.

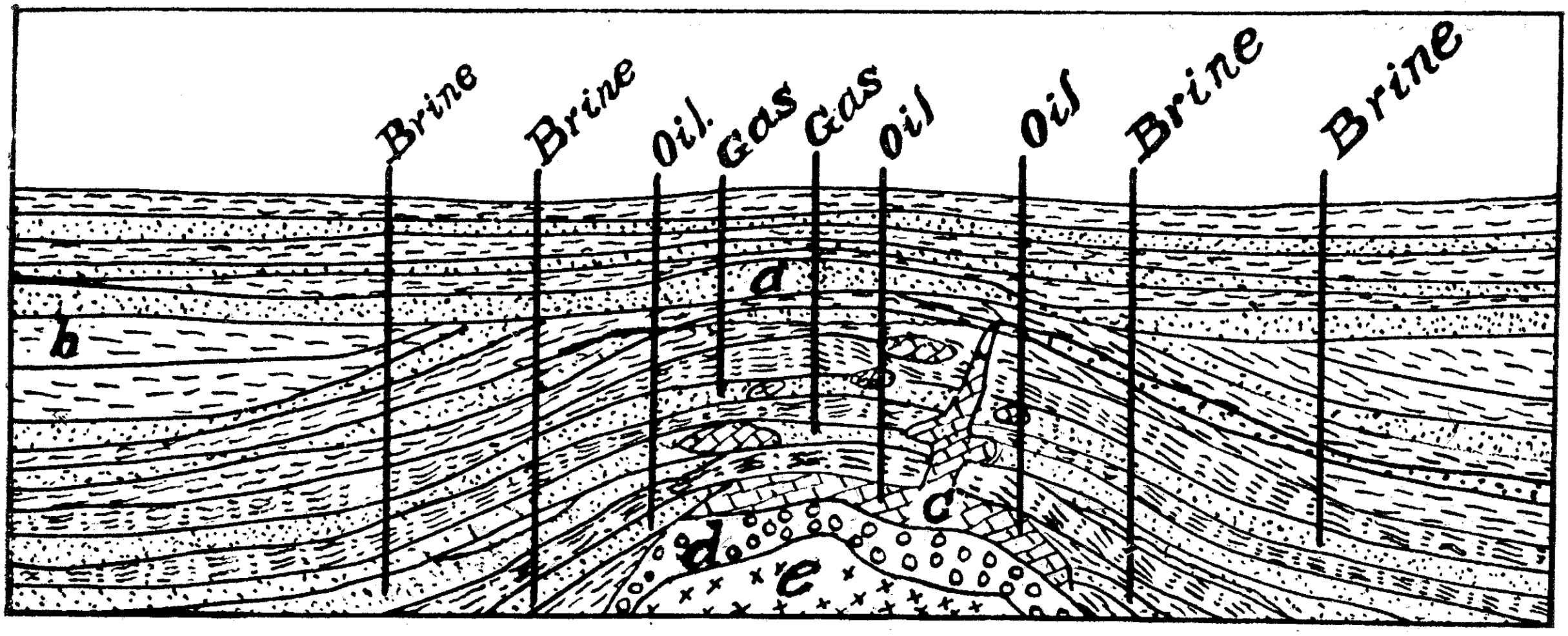
XIII. *Lake Superior* or *Potsdam* sandstone.

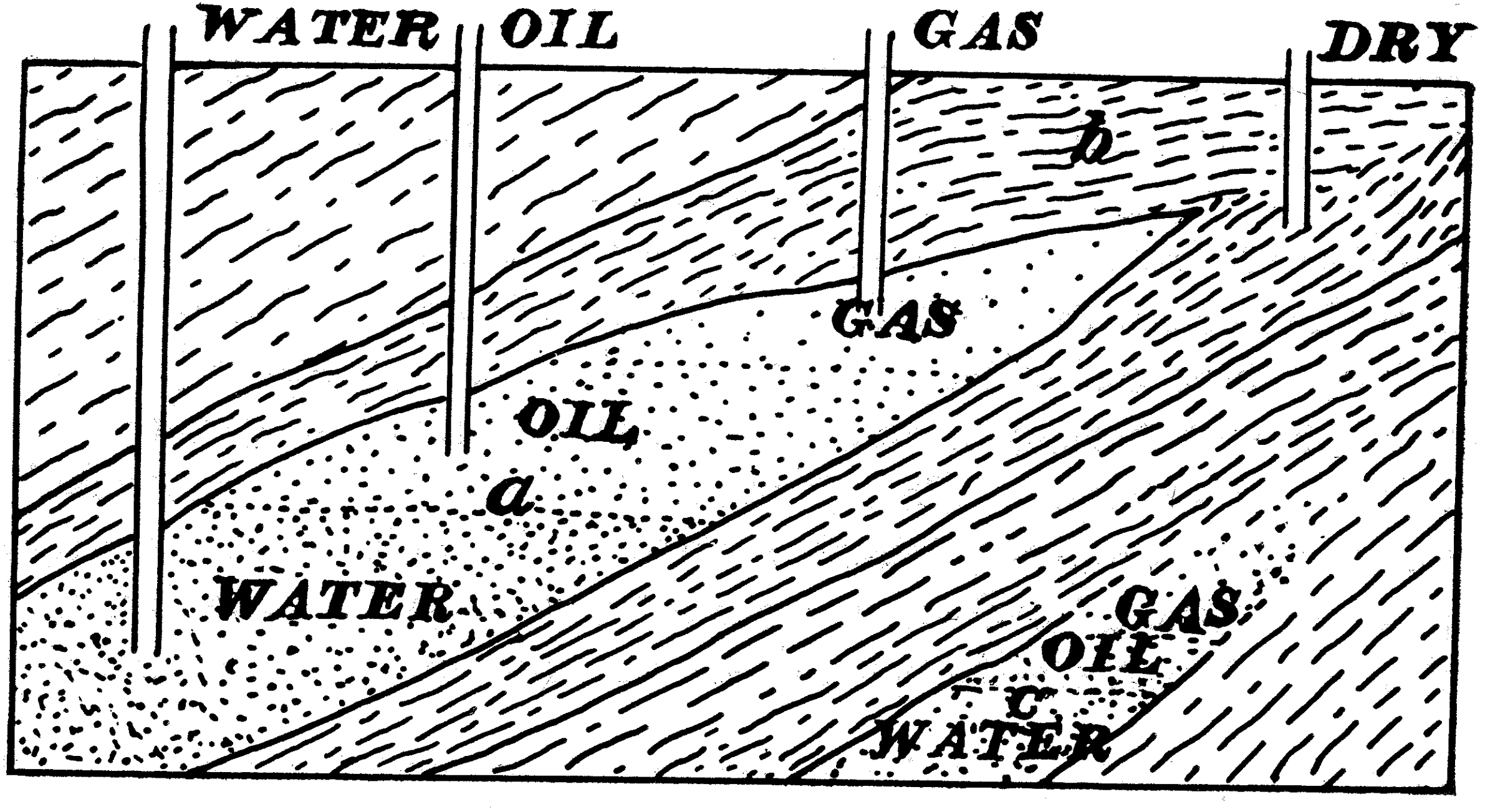
System	Series Name	Formation Name	Columnar Section	Thickness	Character of Rock
QUATERNARY	Pleistocene	Recent Champlain Wisconsin and earlier drift sheets		1110 — 0	Sand, gravel, boulder clay. Lake Superior pink clay. Till = boulder clay, sometimes very sandy, again clayey and dark. A gray and red till may in some places be distinguished, an older and a younger.
POSSIBLY LATER	Conemaugh	Woodville		110 — 0	Light reddish sandstone and sandy shales.
	Pennsylvanian (Upper Pottsville)	Saginaw		400	White sandstone, coal seams, black and white shales; then bands of limestone and of siderite rare, rarely broken up and found in fragments of the sandstone.
		Parma		170 — 0	White sandstone and conglomerates, of small white quartz pebbles; brine and sulphates.
CARBONIFEROUS	Mississippian	Bayport or Maxville Upper Grand Rapids Upper St. Louis		235 — 50	Limestones: light and bluish, cherty; also calcareous sandstones.
		Michigan Lower Gd. Rapids Lower St. Louis Osage or Augusta		300 — 0	Dark or bluish limestones and dolomites with gypsum and blue or black shales: rarely reddish or greenish shales and dark or red sandstones.
		Napoleon Upper Marshall		560 — to	White sandstone: often pyritic, brine or fresh water, sulphates low.
		Lower Marshall		260	White and red sandstones: peanut conglomerates, sandy shales, whetstones, and blur shales, much carbonate of iron, and mica in the formation; generally a red shale at the top and bottom.
		Coldwater Buena Vista		1000 — 800	Blue shale: with nodules of carbonate of iron especially at the top; sandstone; very subordinate streaks of fine grained limestone, especially on the west side; black shales at the base.
		Sunbury or Berea			
		Berea			White sandstone; brine and salt even near the surface.
DEVONIAN	Neo-Devonian	Bedford Antrim (Senecan)		480 — 140 +	Shale: mainly black and always at the base, with huge round balls of calcite; towards the top, blue and black shales.
	Meso-Devonian	Naples goniatite fauna Traverse Petosky limestone Hamilton (Erian) Acervularia beds		660 to	Bluish limestones, dolomites and shales: base a blue or black shale; top generally limestone and rarely reddish.
		Bell and (Marcellus shale)		50 60	
		Dundee (Ulsterian)		253 to 65 —	Limestone: buff and light brown, fiercely effervescent, somewhat cherty.
	Latest Ontarian possibly Eo-Devonian	MONROE: Upper Monroe or Detroit River — Lucas, Amherstberg, Anderdon, Flat Rock		275 to 0	a 200, b 20, c 50, d 47 Dolomites; mainly; the Anderdon formation is limestone; gypsum or anhydrite also occurs, with celestite and sulphur.
		MONROE: Middle Monroe, Sylvania		440 ? to 30	White sandstone: very pure, passing towards the north into calcareous sand? limestone.
UPPER SILURIAN OR ONTARIAN	Upper Ontarian	Lower Monroe or Bass Island — Raisin River, Put-in-Bay, Tymochtee, Greenfield		200 ? 100 + 100 — 100 —	Dolomites: at some levels sandy, at others oölitic, often cherty. At the Tymochtee and other levels shaly; anhydrite abundant in the lower parts of the salt basin; Celestite.
	Middle Ontarian	SALINA ? 3, 2, 1		960 to 0	Salt, anhydrite, dolomites, calcareous marls: red and green, more rarely blue and black, shales.
	Lower Ontarian (Niagaran or Manitoulin)	Guelph and Niagara		600 to 270	White dolomites: peculiar whiteness characteristic, often cherty, and with a little quartz sand which sometimes occurs in beds; pure limestone rare.
		Rochester Shale		85 to 0	Blue shale.
		Clinton		150 to 0	Reddish limestones and shales or iron ore.
		Medina and		100 to 0	Red shales; sometimes sandy or green shales.
LOWER SILURIAN OR ORDOVICIAN	Upper Ordovician (Cincinnatian) (Hudson River)	Richmond		150 to 0 ?	Shales; red and blue and sandy; gradual transition at base.
		Lorraine		343 t 215	Shales: blue, sometimes in streaks black, especially towards base.
		Utica		80 to 50	Black shales.
	Middle Ordovician	Gelena Trenton Platteville ?		271 to 100 ?	Limestone and dolomite; blue and shaly, or solid shale at base.
		St. Peter		18 to 0	White friable sandstone: or represented by red clay, residual top of underlying formation.
OZARKIAN ?	Lower Ordovician	Calciferous			

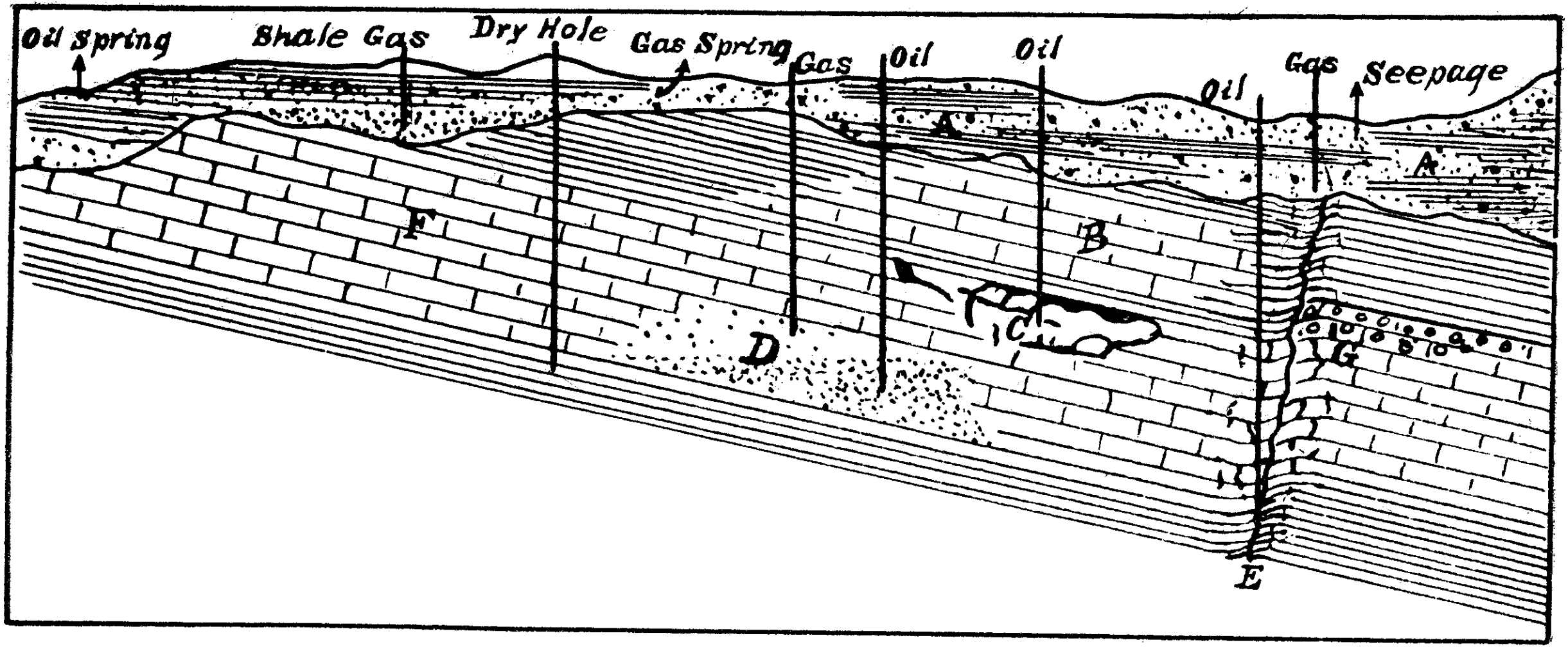
FIGURE 3.—GEOLOGICAL COLUMN OF MICHIGAN FROM THE CALCIFEROUS TO THE PLEISTOCENE (BY A. C. LANE).

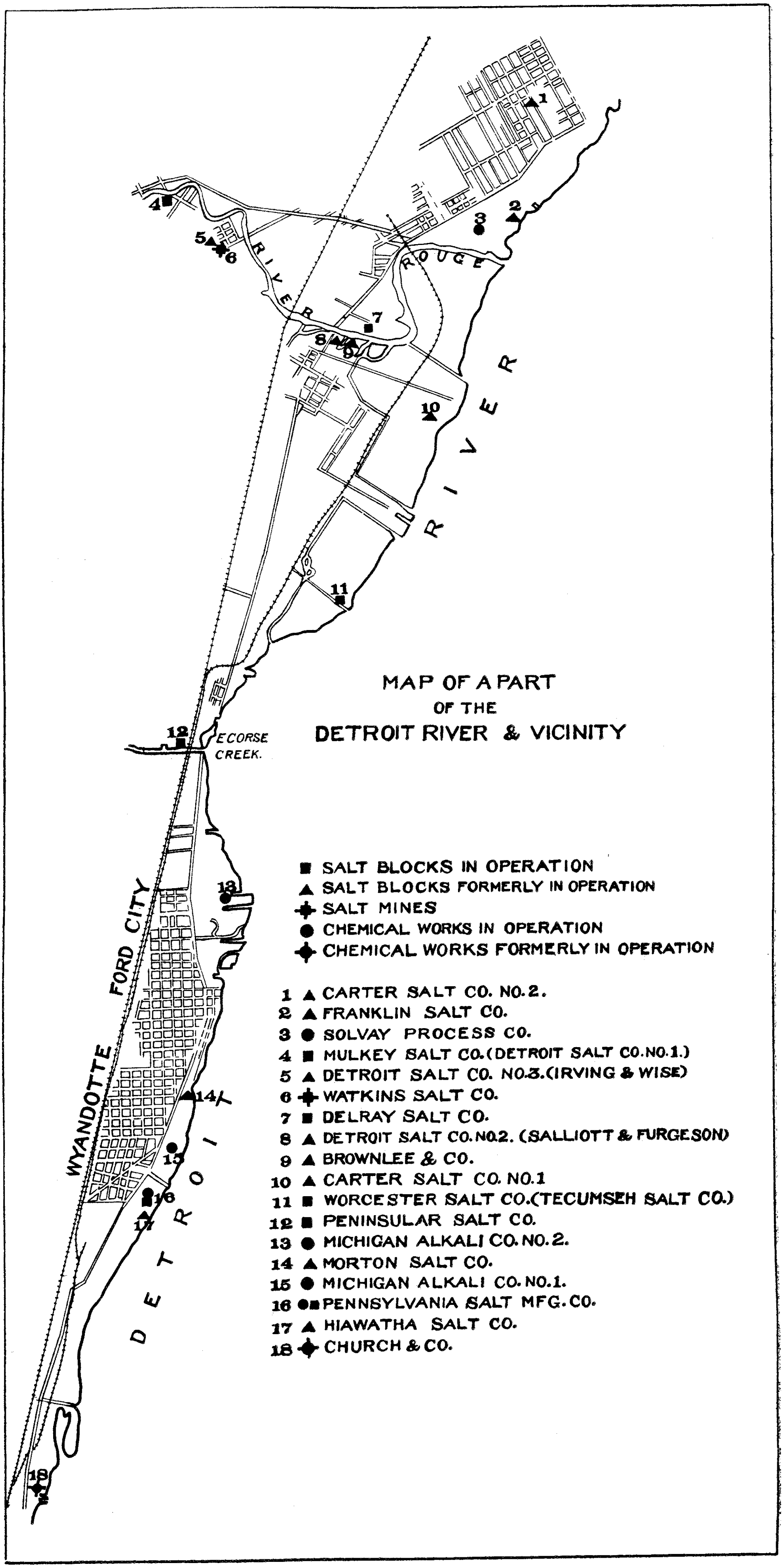

WATER
GAS
OIL
GAS
OIL
c
b
GAS
OIL
a
WATER


Salt sand
Big Injun
Squaw
Bitter Rock
Hundred foot
Thirty foot
Gordon
Fourth
Fifth
A
B
C
D


Brine
Brine
Oil.
Gas
Gas
Oil
Oil
Brine
Brine
a
b
c
d
e


WATER
OIL
GAS
DRY
b
GAS
OIL
a
WATER
GAS
OIL
c
WATER


Oil Spring
Shale Gas
Dry Hole
Gas Spring
Gas
Oil
Oil
Oil
Gas
Seepage
A
A
B
C
D
E
F
G


MAP OF A PART
OF THE
DETROIT RIVER & VICINITY
ROUGE RIVER
DETROIT RIVER
WYANDOTTE
FORD CITY
ECORSE CREEK.
SALT BLOCKS IN OPERATION
SALT BLOCKS FORMERLY IN OPERATION
SALT MINES
CHEMICAL WORKS IN OPERATION
CHEMICAL WORKS FORMERLY IN OPERATION
1 CARTER SALT CO. NO. 2.
2 FRANKLIN SALT CO.
3 SOLVAY PROCESS CO.
4 MULKEY SALT CO. (DETROIT SALT CO. NO. 1.)
5 DETROIT SALT CO. NO. 3. (IRVING & WISE)
6 WATKINS SALT CO.
7 DELRAY SALT CO.
8 DETROIT SALT CO. NO. 2. (SALLIOTT & FURGESON)
9 BROWNLEE & CO.
10 CARTER SALT CO. NO. 1
11 WORCESTER SALT CO. (TECUMSEH SALT CO.)
12 PENINSULAR SALT CO.
13 MICHIGAN ALKALI CO. NO. 2.
14 MORTON SALT CO.
15 MICHIGAN ALKALI CO. NO. 1.
16 PENNSYLVANIA SALT MFG. CO.
17 HIAWATHA SALT CO.
18 CHURCH & CO.

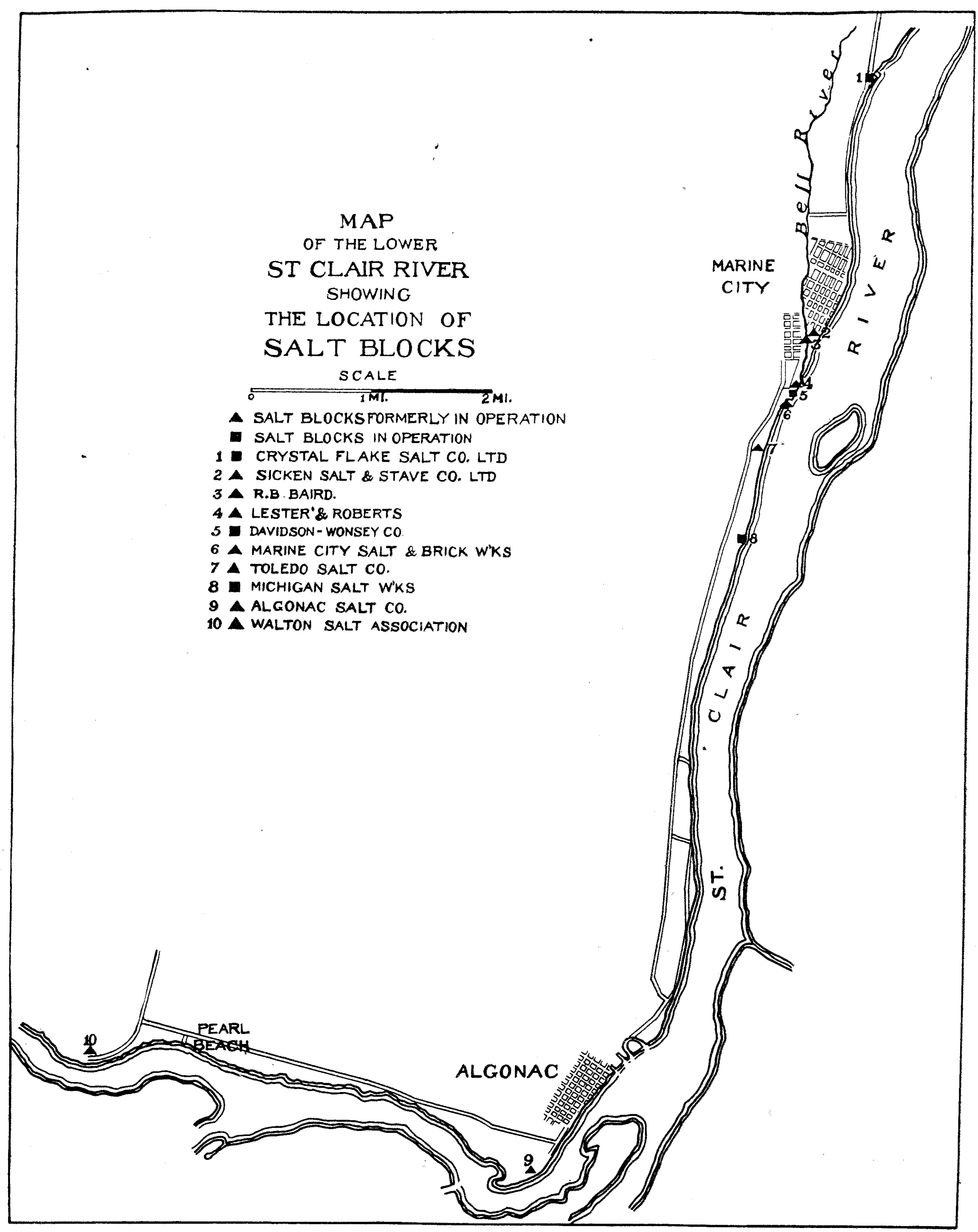
MAP
OF THE LOWER
ST CLAIR RIVER
SHOWING
THE LOCATION OF
SALT BLOCKS

SCALE

0 — 1 MI. — 2 MI.

▲ SALT BLOCKS FORMERLY IN OPERATION
■ SALT BLOCKS IN OPERATION

1 ■ CRYSTAL FLAKE SALT CO. LTD
2 ▲ SICKEN SALT & STAVE CO. LTD
3 ▲ R.B. BAIRD.
4 ▲ LESTER & ROBERTS
5 ■ DAVIDSON-WONSEY CO.
6 ▲ MARINE CITY SALT & BRICK W'KS
7 ▲ TOLEDO SALT CO.
8 ■ MICHIGAN SALT W'KS
9 ▲ ALGONAC SALT CO.
10 ▲ WALTON SALT ASSOCIATION



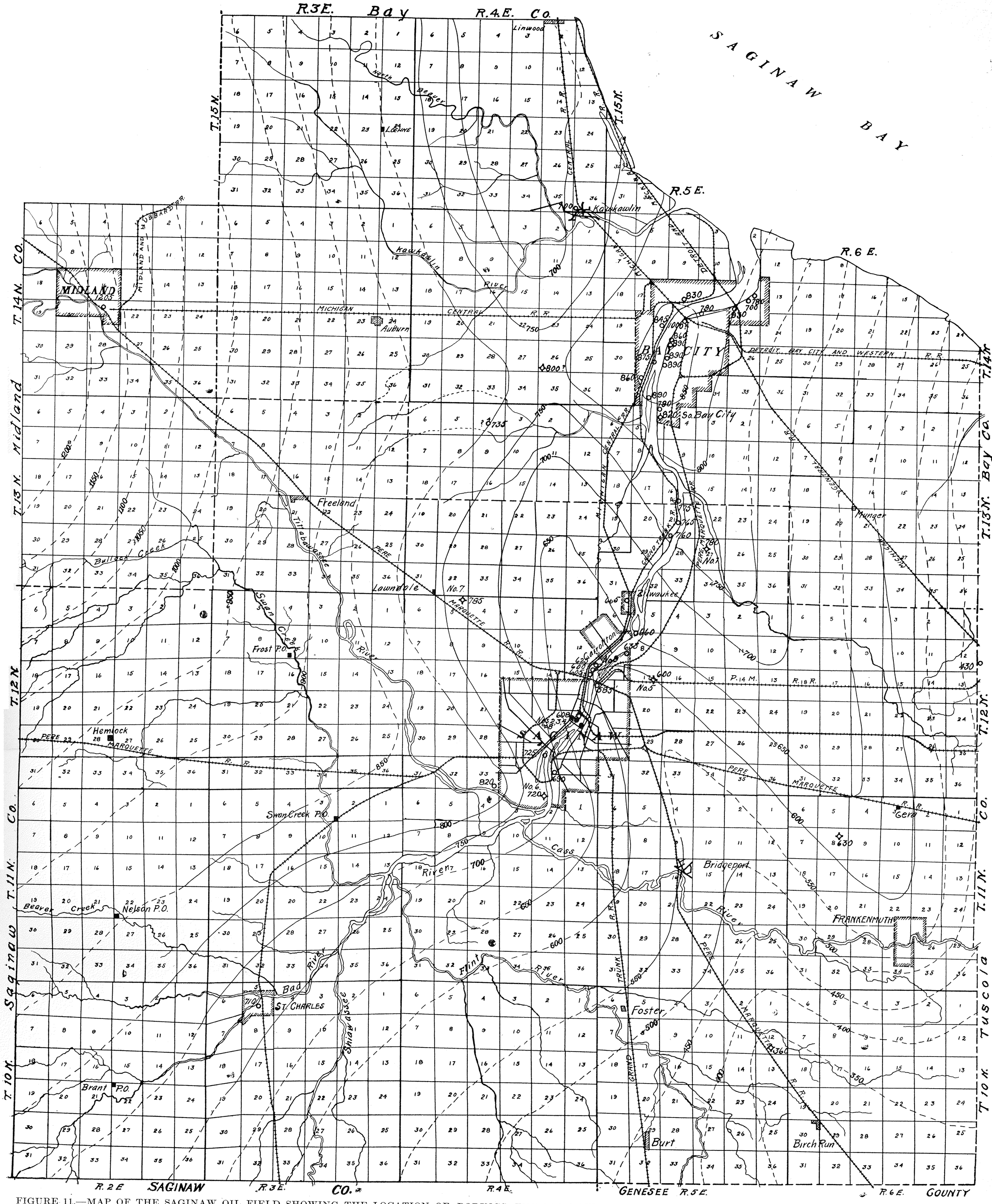


FIGURE 11.—MAP OF THE SAGINAW OIL FIELD SHOWING THE LOCATION OF BORINGS, THE SAGINAW ANTICLINE, AND THE CONTOURS OF DEPTH OF THE MARSHALL SANDSTONE BELOW THE SURFACE IN SAGINAW VALLEY.

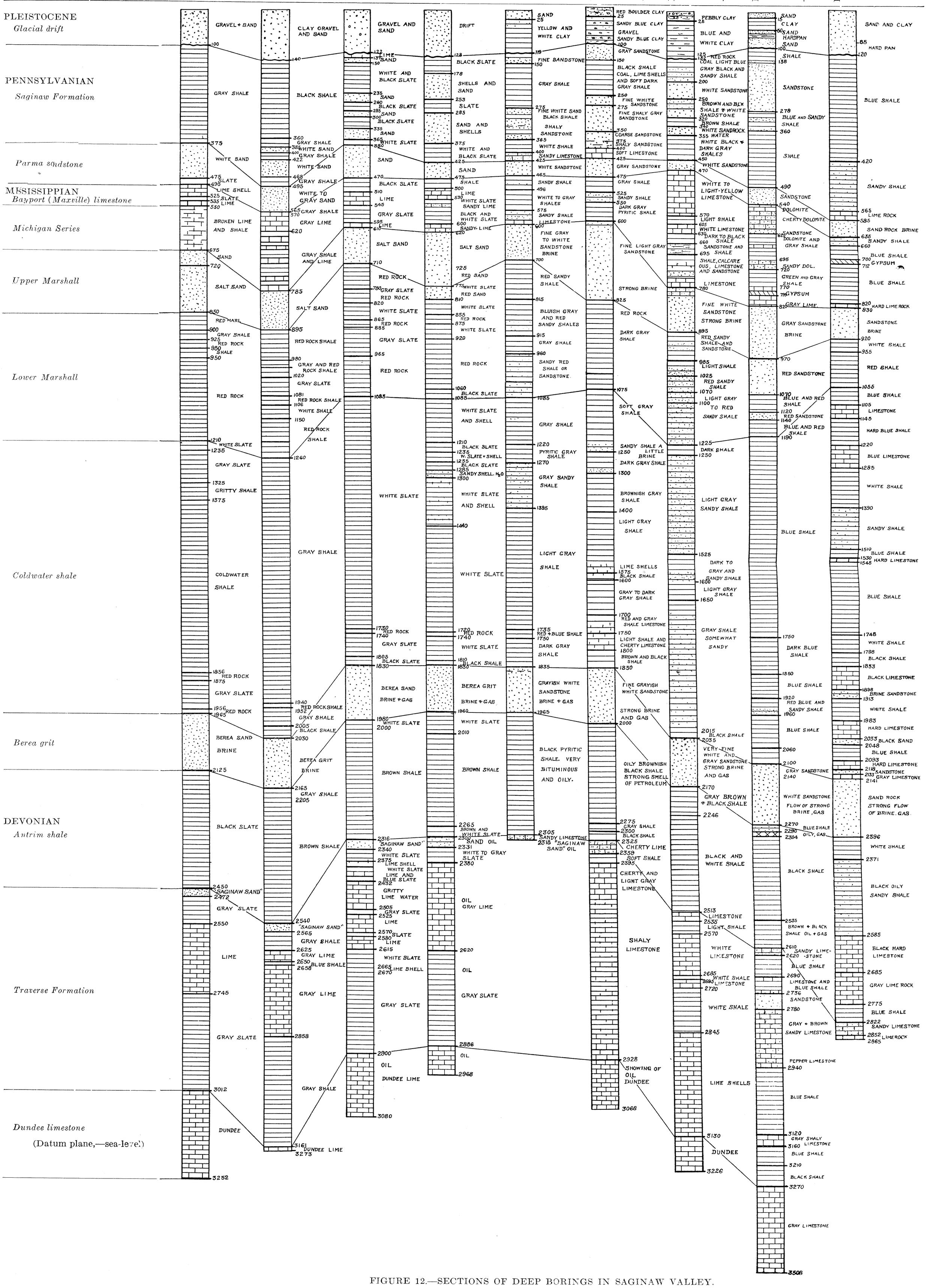
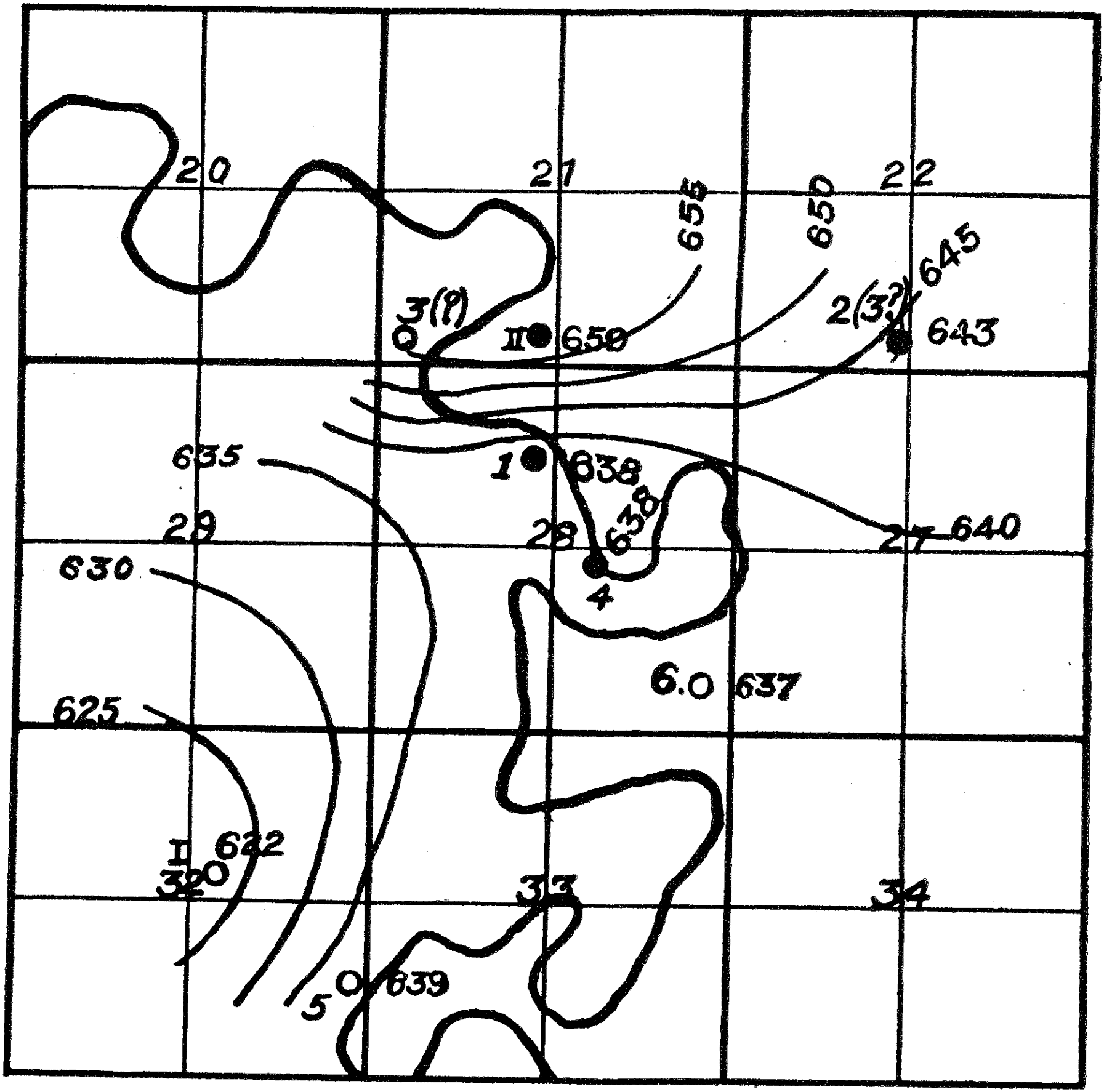
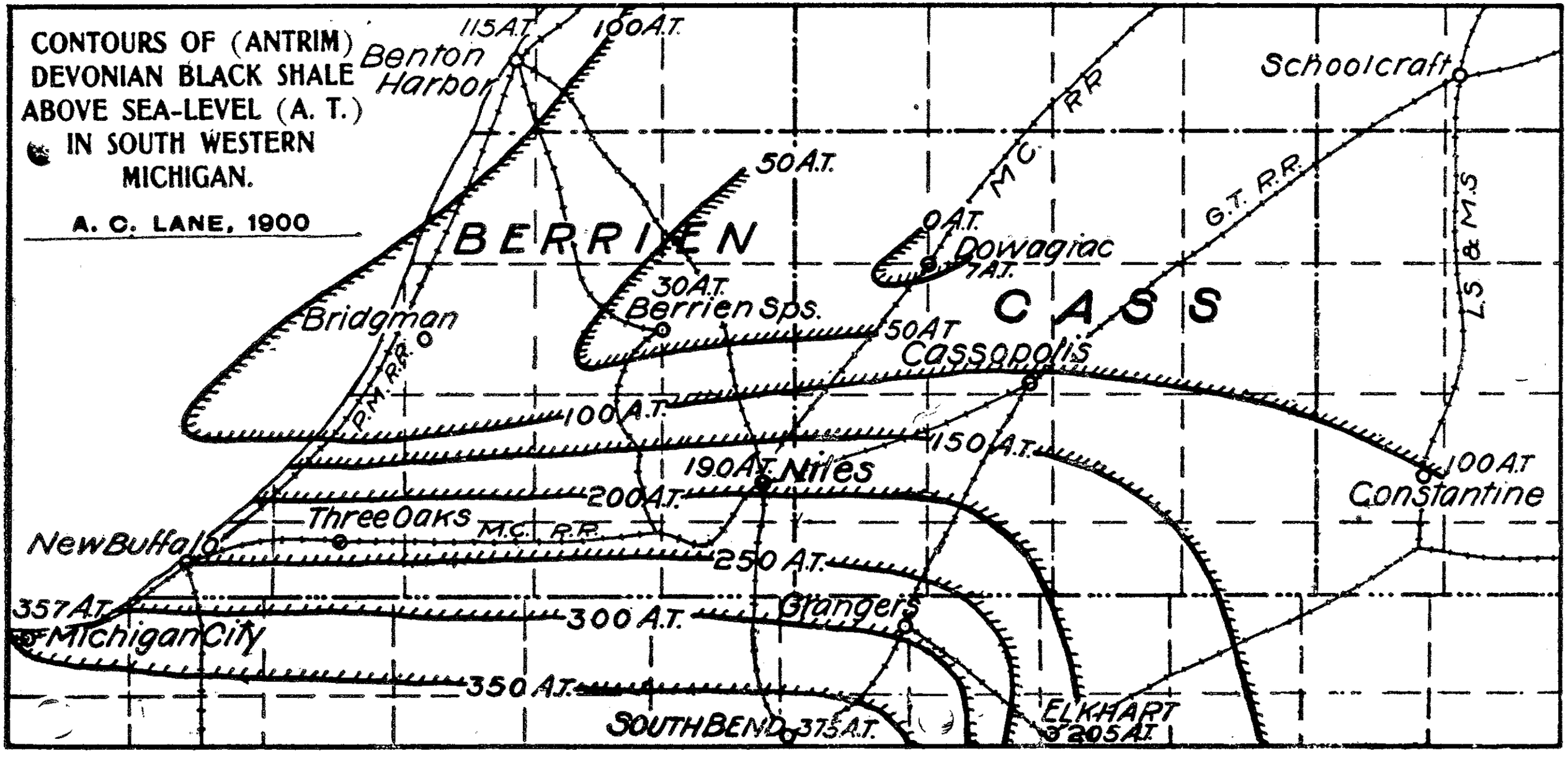
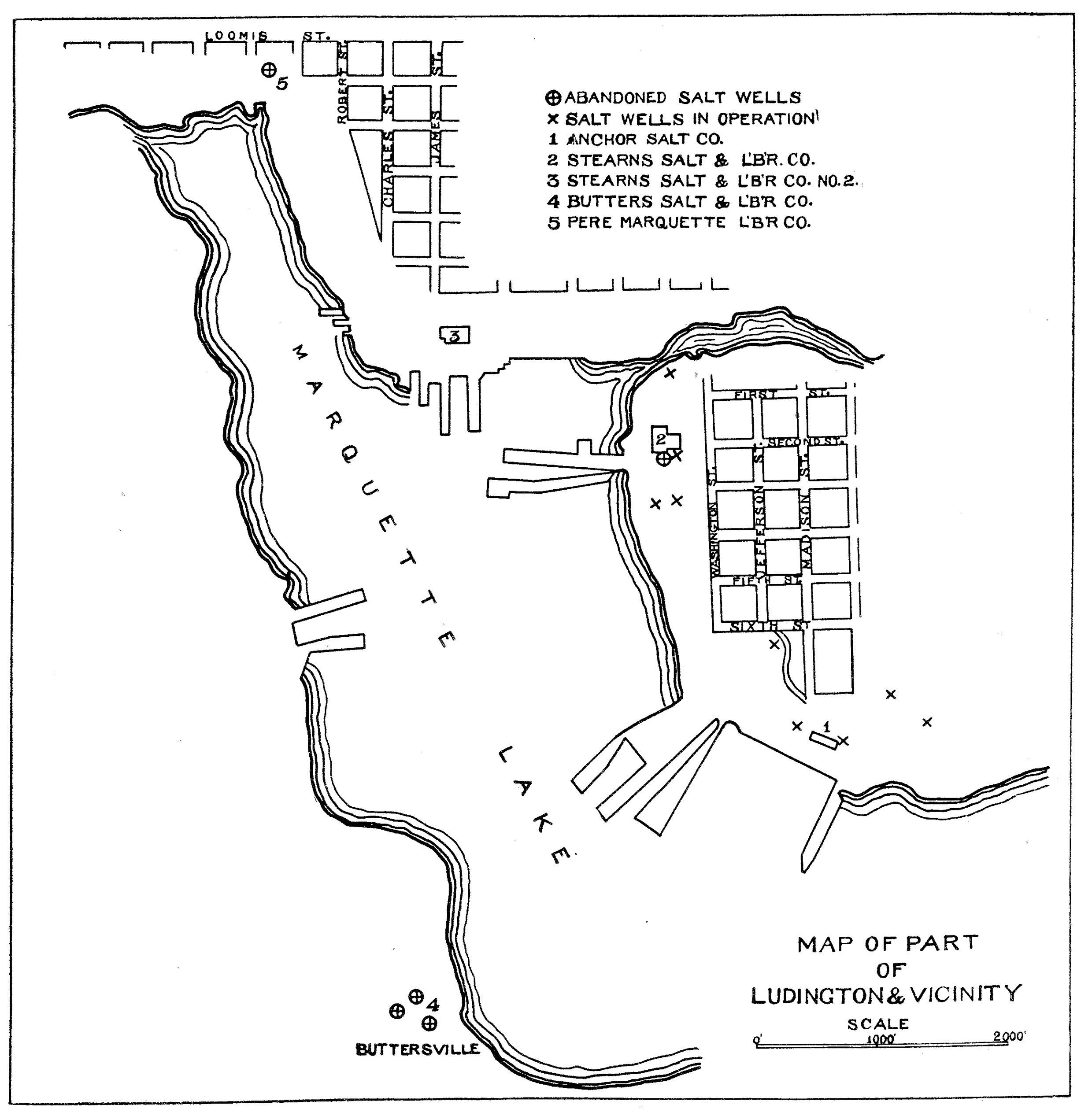
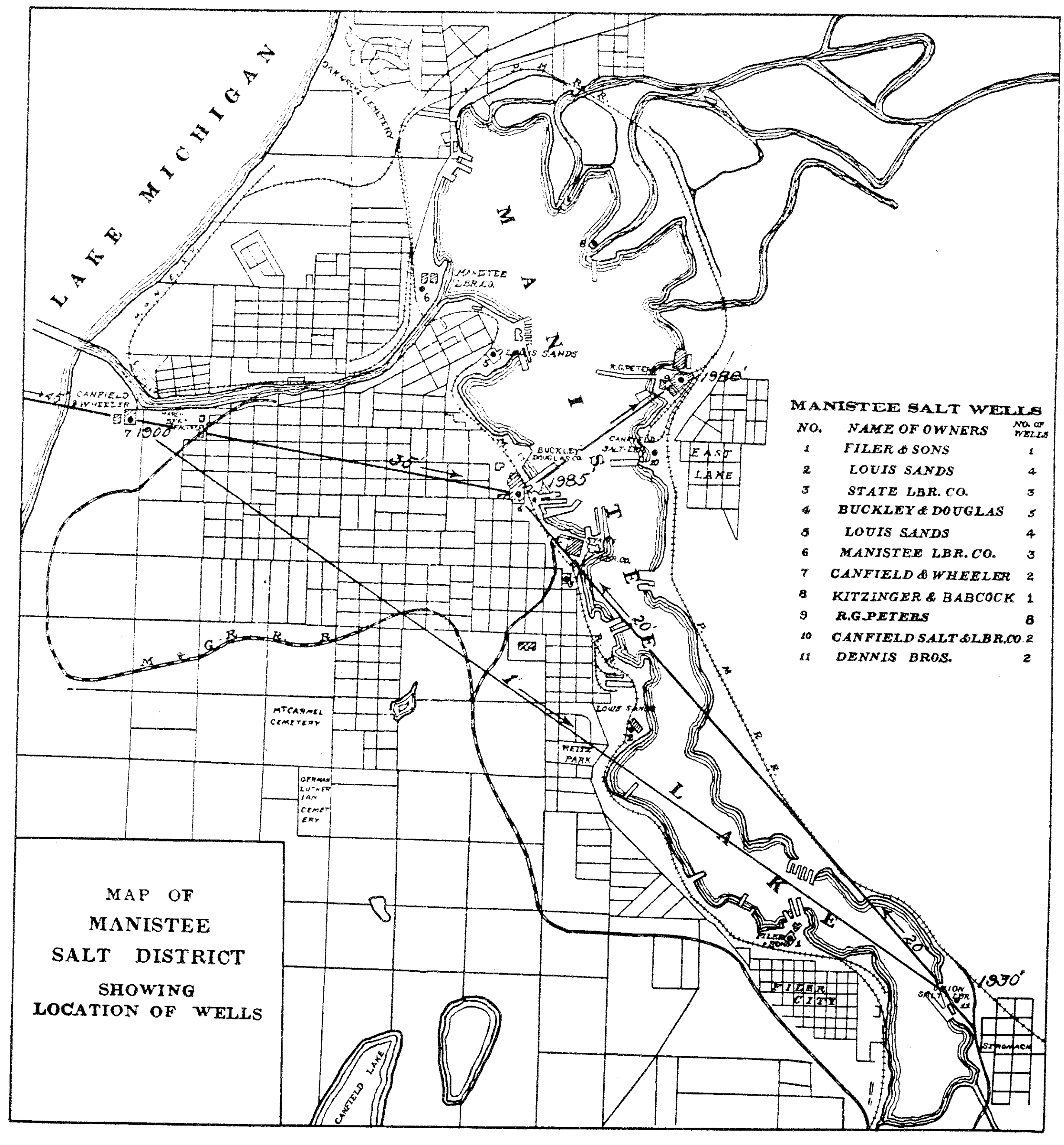


FIGURE 12.—SECTIONS OF DEEP BORINGS IN SAGINAW VALLEY.


20
21
22
655
650
645
3(?)
II 650
2(3?)
643
635
1 638
638
29
28
27 640
630
4
6.0 637
625
II 632
32 0
33
34
5 0 639


CONTOURS OF (ANTRIM) DEVONIAN BLACK SHALE ABOVE SEA-LEVEL (A. T.) IN SOUTH WESTERN MICHIGAN.
A. C. LANE, 1900
115 A.T.
100 A.T.
Benton Harbor
Schoolcraft
M.C. R.R.
50 A.T.
G.T. R.R.
L.S. & M.S.
BERRIEN
0 A.T.
Dowagiac
7 A.T.
30 A.T.
Berrien Sps.
CASS
Bridgman
50 A.T.
Cassopolis
P.M. R.R.
100 A.T.
150 A.T.
190 A.T.
Niles
100 A.T.
Constantine
200 A.T.
Three Oaks
M.C. R.R.
New Buffalo
250 A.T.
357 A.T.
300 A.T.
Grangers
Michigan City
350 A.T.
SOUTH BEND
375 A.T.
ELKHART
205 A.T.

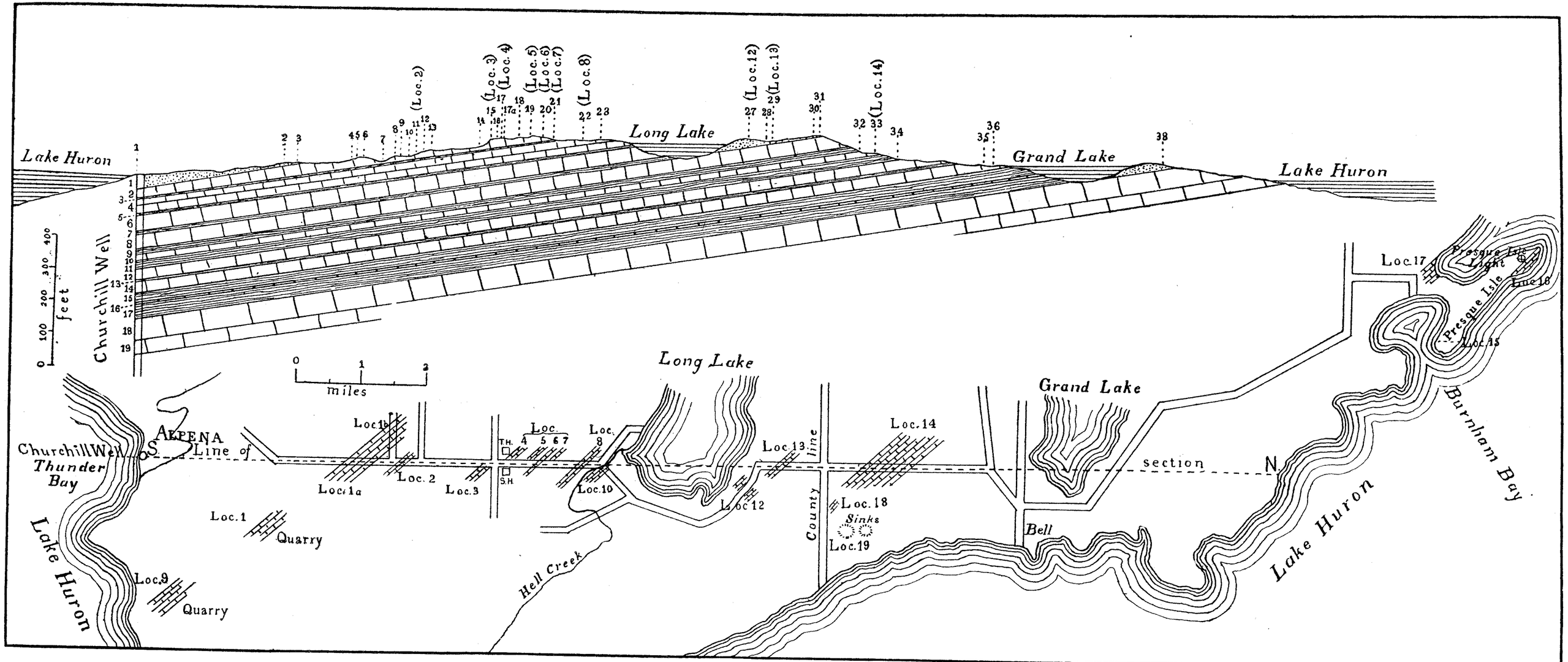

LOOMIS ST.
ROBERT ST.
CHARLES ST.
JAMES ST.
⊕ ABANDONED SALT WELLS
× SALT WELLS IN OPERATION
1 ANCHOR SALT CO.
2 STEARNS SALT & L'B'R. CO.
3 STEARNS SALT & L'B'R CO. NO. 2.
4 BUTTERS SALT & L'B'R CO.
5 PERE MARQUETTE L'B'R CO.
MARQUETTE LAKE.
FIRST ST.
SECOND ST.
WASHINGTON ST.
JEFFERSON ST.
MADISON ST.
FIFTH ST.
SIXTH ST.
BUTTERSVILLE
MAP OF PART
OF
LUDINGTON & VICINITY
SCALE
0'
1000'
2000'



MANISTEE SALT WELLS

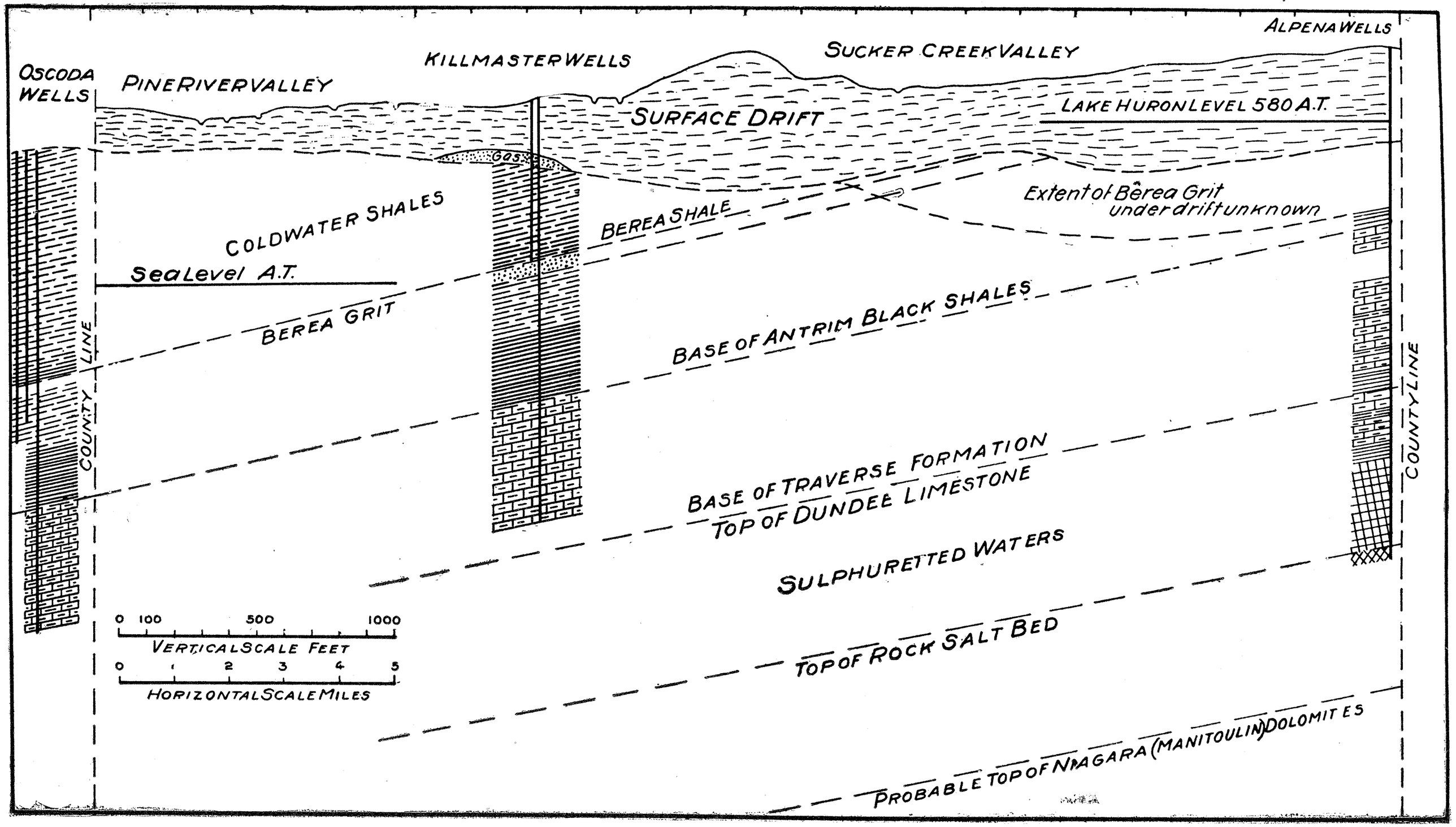
NO.	NAME OF OWNERS	NO. OF WELLS
1	FILER & SONS	1
2	LOUIS SANDS	4
3	STATE LBR. CO.	3
4	BUCKLEY & DOUGLAS	5
5	LOUIS SANDS	4
6	MANISTEE LBR. CO.	3
7	CANFIELD & WHEELER	2
8	KITZINGER & BABCOCK	1
9	R.G. PETERS	8
10	CANFIELD SALT & LBR. CO.	2
11	DENNIS BROS.	2

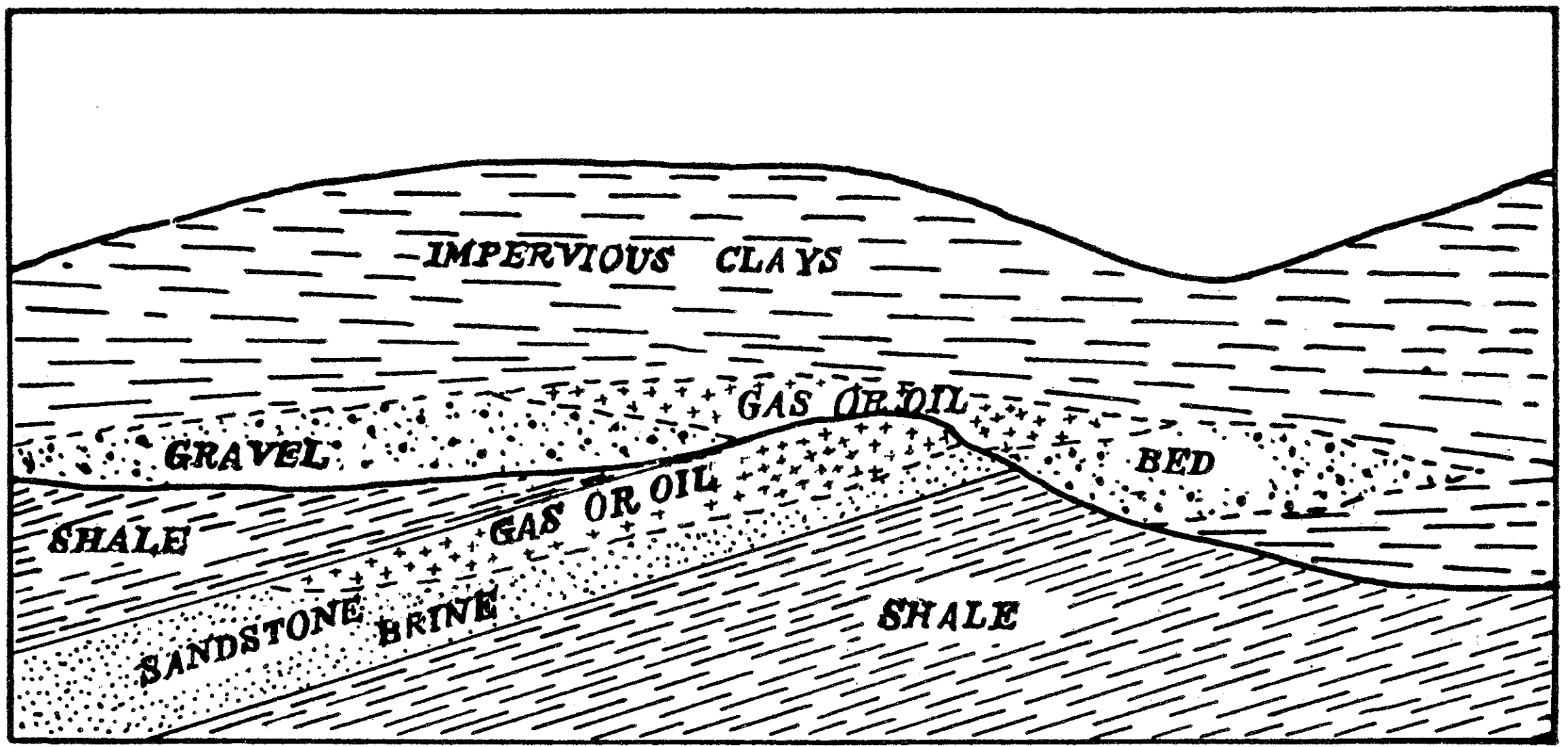
MAP OF
MANISTEE
SALT DISTRICT
SHOWING
LOCATION OF WELLS



Bed 1 = sand and gravel.
Bed 3 = thin shale bed.
Bed 5 = " " "
Bed 13 = " " "
Bed 16 = thin limestone bed.

Figure. 17. Geological section from Alpena north through Grand Lake, Presque Isle county, to Lake Huron. (Annual report Mich. Geol. Surv., 1901, Plate VII).


OSCODA WELLS
PINE RIVER VALLEY
KILLMASTER WELLS
SUCKER CREEK VALLEY
ALPENA WELLS
SURFACE DRIFT
LAKE HURON LEVEL 580 A.T.
GAS
COLDWATER SHALES
BEREA SHALE
Extent of Berea Grit under drift unknown
Sea Level A.T.
BEREA GRIT
BASE OF ANTRIM BLACK SHALES
COUNTY LINE
COUNTY LINE
BASE OF TRAVERSE FORMATION
TOP OF DUNDEE LIMESTONE
SULPHURETTED WATERS
TOP OF ROCK SALT BED
PROBABLE TOP OF NIAGARA (MANITOULIN) DOLOMITES
0 100 500 1000
VERTICAL SCALE FEET
0 1 2 3 4 5
HORIZONTAL SCALE MILES


IMPERVIOUS CLAYS
GAS OR OIL
GRAVEL
BED
GAS OR OIL
SHALE
SANDSTONE
BRINE
SHALE

INDEX.

A.

Page

Abbotsford test well, record of 51, 62
Adrian well, Lenawee county, record of 84
Alcona county, depth of drift in 32, 205
Alcona county, gas springs in 205, 221
local dip of rock strata in 223
occurrence of oil in 221
occurrence of "shale" or surface gas in 221, 222, 225
relation of oil horizons to surface signs 221
rock formations in 221
Albert shales, (Canada) oil content of 256, 257, 262
Algonac, anticline near 116, 124, 125
Algonac well, record of 116, 117
Allegan, character of Dundee "oil sand" or oil horizon at 170
explorations by the Northern Oil & Gas Co at 170, 171, 172
Allegan, Gas, Oil & Mining Company wells, record of 170, 173
occurrence of oil at 15, 170, 171, 172
structural bench or terrace at 21, 41, 172
wells, records of 170, 171, 172, 173, 174
Alma, depth of drift at 143
mineral water at 143
(Alma Sanitarium) well, record of 143, 144
Alpena county, discordant dips in 206
thickness of rock salt beds in 206
Land Company well at Grand Lake, record of 216, 217
record of Churchill well at 217, 218
wells drilled for water at 219
American Alkali Company, test well on Neebish Island for 243
Ammonium Sulphate, extraction of from oil shales and oil coals 255, 256, 257, 262
value of as a fertilizer 255, 257
yield of per ton from oil shales and oil coal 255, 256, 257, 262
Analyses of oil shales and oil coals, tables of 262
Analysis Antrim shale 259, 260
Onekama gas 203
Saginaw oil 135
Utica shale 260
Anchor Salt Co. wells at Ludington, records of 193, 194, 195
Andrews, E. B., reference to 33
Ann Arbor anticline, reference to 70, 111
wells, records of 108, 109
Anticline at Port Huron 56, 57, 58
Saginaw 19, 127, 130, 131, 134, 155
Stony Island 70, 106
Wyandotte 70, 105, 106
in Livingston county, evidence of an 163, 164
near Algonac 70, 124, 125
Ann Arbor 70, 111
Khagashewing Point 70, 207
Manistee and Stronach 202
Niles 70, 175
Anticlines, list of in Michigan 19
value of as a surface indication 49

Page

Anticlinal theory, application of the principles of ... 34
as a basis for guiding exploration for oil and gas ... 36
criticisms of ... 35
generalizations on ... 43, 44
geologic factors affecting ... 38
limitations of ... 34, 35, 38
origin of ... 33
publication of ... 33
statement of by I. C. White ... 33, 34, 35, 36, 37, 38
Antrim shale, analysis of ... 259, 260
bituminous content of ... 28, 71, 258, 259, 260
commercial possibilities of ... 259
depth of base of in Berrien, Cass, and St. Joseph counties ... 175
description of ... 28
gas in ... 32, 71
occurrence of in the Port Huron oil field ... 50, 54
oil in at Mt. Pleasant ... 146, 148
in southwestern Michigan ... 175, 179
Artesian water conditions in the Northern Peninsula ... 231
in Pickford test well ... 244, 245
relation of to rock pressure ... 45, 46
well of James Swan, Grosse Isle ... 92
Ashburner, C., reference to ... 35, 36, 37
Asphalt, occurrence of near Rapid and Whitefish rivers ... 23
and oil, occurrence of near Rapid and Whitefish rivers ... 239, 240
Asphaltum gum, analyses of ... 239, 240
occurrence of in the Trenton limestone ... 232
Assyria, depth of Berea horizon at ... 163
wells, records of ... 153, 154
Atlanta, gas springs near ... 205
Atlantis well at Ypsilanti, record of ... 107
Au Sable, brine horizon at ... 226
wells at ... 226, 227

B.

Bailey, C. A., explorations of for oil at Port Huron ... 50, 56
oil wells, typical record of one of ... 57
Banner Oil and Gas Co. well at Ypsilanti, record of ... 107, 108
Bass Island Series (Lower Monroe), description of ... 25
Battle Creek wells, reference to ... 162
Bay City, brine horizon at ... 137
record of wells at ... 137, 138, 139, 140
syncline ... 130, 135
Bayport (Maxville) limestone, description of ... 30
Bay View well, record of ... 208, 209
Beard's well at Abbottsford, record of ... 63
Bell (Marcellus) shale, description of ... 27, 71
Benton Harbor, depth of base of Antrim black shale at ... 175
Benton Harbor Natural Gas & Oil Co. well, record of ... 181
Benton Harbor, record of Salzman Mineral Bath Co. well at ... 182
Benzie county, occurrence of gas in ... 205
Berea sandstone, brine horizon of in Iosco county ... 226
Sanilac and Huron counties ... 67
Berea sandstone, brines of ... 128, 130, 133, 137, 140
depth of along Saginaw river ... 127, 128, 129, 130, 138, 139
at Adrian ... 84
Blackmar ... 127
Columbiaville ... 163
Flint ... 142, 163
in Central Basin ... 136, 163
description of ... 28, 72
occurrence of gas in ... 29, 72, 128, 130, 133
Berea sandstone, exceptional thickness of at Pontiac ... 111
Berrien county, local structures in ... 175

Page

Berrien Springs, depth of base of Antrim black shale at ... 175
syncline ... 175
well, record of ... 179
Big Rapids well, notes on ... 152
"Big Salt" bed, thickness of at Delray ... 97
Wyandotte ... 95
Bituminous or "oil rock," analyses of ... 262
"oil rock," occurrence of ... 49
"oil shales," analyses of ... 262
extraction of oil from ... 255
Blackmar, depth of Berea at ... 163
well, record of ... 141
reference to ... 126, 127
Black River Oil Company at Port Huron, explorations of ... 51
Blissfield well, record of ... 86
Boghead mineral or coal, extraction of oil from ... 255
Borings, previously published, records of ... 15
Bradt, E., reference to ... 99
Braun, W. F., oil well driller, reference to ... 138, 146, 148, 149, 150
Braun well (Mt. Pleasant), record of ... 146, 148, 149, 150
Brecciation in the Monroe Formation ... 21
of the rock strata in Presque Isle county ... 206
Bridgman, borings for oil near ... 180
Bridgman, Oil & Gas Co. well, record of ... 180
Brine bearing sandstones, occurrence of in the Coldwater shale ... 29, 137
Brine horizon of the Marshall, depth of along Saginaw river ... 126, 127
Brines, character of at Midland ... 142
pollution of by oil and gas wells ... 17
abandoned salt wells along Saginaw river ... 248
Britton, occurrence of oil at ... 68
Britton well, record of ... 85
Brominiferous brines, occurrence of at Midland ... 142
Brownlee & Co. wells at River Rouge, reference to ... 99
Buckley & Douglas Lumber Co. well at Manistee, record of ... 199
Bullock (Christiancy) quarry, Monroe county, dip of strata in ... 106
Bureau of Mines, U. S., reference to ... 36
Burning Springs (West Virginia) anticlinal, reference to ... 36
By-products resulting from the distillation of oil shale, list of ... 257

C.

Cadillac, depth of drift at ... 211
Cadillac Oil & Gas Co. well, partial record of ... 211
Calciferous sandstone, description of ... 22
California, laws regulating the drilling and care of oil and gas wells in ... 249, 250
Campbell, Prof. H. D., reference to ... 108
Campus well, Ann Arbor, record of ... 108, 109
Canada, occurrence of oil shale in eastern ... 256
Canadian Pacific Railway well at Windsor, Ontario, record of ... 103
Canfield & Wheeler well at Manistee, record of ... 197, 198, 199
Cannel coal, extraction of oil from ... 255, 256
Carman well at Petrolia, record of ... 54, 59
Caseville, salt wells at ... 67, 126
Casings, corrosion of in oil and gas wells ... 247
Cass county, local structure in ... 175
Central Michigan oil district defined ... 136
explorations in ... 136
geographic and geologic relations in ... 136
preglacial rock valley in ... 136
surface deposits in ... 136
uniformity in character of formations in ... 146
Central Paper Co. well of Muskegon, record of ... 186, 189, 190
Charlevoix well, record of ... 209, 210
Charlotte, depth of Berea horizon at ... 163
well, record of ... 154, 155

Page
Cheboygan well, record of ... 211, 212
Chief well inspector, appointment and powers of ... 253
Christiancy (Bullock) quarry, Monroe county, dip of strata in ... 106
Church & Co. wells at Trenton, records of ... 91, 92
Churchill well at Alpena, record of ... 218
Cincinnati anticline, course of in Ontario ... 52
description of ... 41, 52
occurrence of oil and gas along the ... 52
reference to ... 36, 52, 105
Clinton formation, character of in the Northern Peninsula ... 231
description of ... 24
Closed pressure in oil and gas wells, measurement of ... 44
Coal beds, danger to from oil and gas wells ... 248, 249
determination of workable ... 251
protection of ... 249, 250, 251, 254
Coal Measures, occurrence of oil in ... 165
Coal mines, danger to from oil and gas wells ... 248, 249
Coal mines, flooding of in Illinois ... 249
Coals of Michigan, content of oil in ... 258, 259, 262
Coal operators, antagonism of against oil and gas prospectors ... 249
Coal seams, difficulties of protecting workable ... 251
Cobb, M. A., analyses of Antrim shale by ... 259
Coldwater shale, brine bearing sandstones in ... 29, 72, 159
calcareous nature of at Charlotte ... 154
description of ... 29
Colorado, oil shale resources of ... 258
Columbiaville, depth of Berea at ... 163
Concretions, occurrence of in Antrim shale ... 28
Conglomerate, "peanut," occurrence of ... 29
Conference for framing regulations governing the drilling and care of oil and gas wells ... 253
Constantine, depth of base of Antrim black shale at ... 175
Constantine well, record of ... 184
Cornwell well at Ypsilanti, reference to ... 107
Cooper, W. F., reference to ... 137, 139
Coste, E., reference to ... 52
Court House well at Ann Arbor, reference to ... 107, 108
Courtright well, Ontario, record of ... 52, 55, 121
Creswell well, Saginaw, notes on ... 129

D.

Davis, W. W., well driller, reference to ... 202, 203, 204
De ta, Eaton county, depth of Berea at ... 163
Dundee at ... 157
record of well near ... 156, 157
Delray wells, records of ... 97, 98, 99, 100
Department of Mines of Canada, investigations of the commercial possibilities of the oil shales of eastern Canada by the ... 256
Detroit, records of wells in ... 104, 105
Detroit Natural Gas Co. well, North Detroit, record of ... 104
River Series (Upper Monroe), description of ... 26
synclines along ... 21
Devonian formations, bituminous character of ... 49
relation of "shale" or surface gas to ... 49, 71, 205, 221
DeWitt, C. M., mineral well at Osseo, record of ... 88, 89
Diamond Crystal Salt Co. wells at St. Clair, records of ... 121, 122, 123
Dicken's well, Sarnia (Ontario), record of ... 54, 55
Dip of Dundee limestone from Osseo to Jackson ... 89
Dip of strata, average in the Central Basin ... 143, 151
Dip, irregularities of in southeastern Michigan ... 106, 113, 124, 125
of strata from Detroit to Ann Arbor ... 105
Milwaukee across Lake Michigan ... 232
Petrolia to Port Huron ... 55
in the eastern half of the Northern Peninsula ... 242, 246
Monroe county ... 74

Page
Dip of strata in the northern half of the Southern Peninsula ... 211, 216, 219, 221, 223, 227
Wayne county ... 105
western Michigan ... 189, 197
Dips, local discordant ... 106, 113, 124, 125, 206, 207, 219
Domes or cross arches, definition of ... 37
occurrence of oil and gas in the vicinity of ... 37
saline ... 41
Dos Bocas oil well No. 2 near Tampico, Mexico, difficulty of capping ... 252
Dowagiac, depth of base of Antrim black shale at ... 175
Dowagiac, syncline near ... 21
well, record of ... 175, 177
Dow Chemical Co. wells at Midland, records of ... 143
"Dry holes," danger f om ... 16, 247
proportion of in oil and gas fields ... 247
Dundee limestone, absence of at Muskegon ... 186
Dundee limestone, exceptional thickness of at Jackson ... 159
depth of at Allegan ... 170, 171
Alpena ... 216
Mt. Pleasant ... 136, 146, 150
Port Huron ... 50, 51
Valley Centre ... 63
in Saginaw Valley ... 128, 129, 130, 131
South Bay City ... 140
description of ... 26
dip of along St. Clair river ... 114
from Osseo to Jackson ... 89
in Wayne county ... 105
gas in ... 32, 51
occurrence of oil in ... 27, 51, 71, 88, 129, 130, 131, 170, 171
sulphate bitterns or mineralized brines of ... 27
surface signs along the strike of ... 71
Dundee oil, character of at Allegan ... 171
character of at Port Huron ... 56
character of at Saginaw ... 135
horizon at Petrolia ... 53
Port Huron ... 50, 51, 57
well, record of ... 79, 81
Durand well, record of ... 166, 167

E.

Earseman, Wm. A., reference to ... 33, 34
"Eastern" sandstone, description of ... 22
East Lake, records of borings at ... 199, 200, 201
Eaton Rapids, depth of Berea horizon at ... 163
well, record of ... 156
"Edge water," increep of in oil and gas pools ... 247
Edison Power & Light Co. wells at Fort Wayne, Detroit ... 102, 103
Eloise or Wayne County Infirmary well, reference to ... 105
Emanations, relation of magmatic to rock pressure ... 48
Enniskillen township (Lambton county, Ontario) local anticlines in ... 53
Erosion of Bayport limestone ... 31
Escanaba Brewing Co. well, record of ... 235
Escanaba Manufacturing Co. well, reference to ... 235
"Expansion hypothesis" of Prof. Lesley as an explanation of rock pressure ... 47

F.

Fair well at Wadham's station, record of ... 62
Faults in Paleozoic rocks of Michigan, occurrence of ... 21
Ferry & Co., D. M., wells in Oakland Co ... 115
Fletcher well at Alpena, reference to ... 219
Flint, depth of Berea at ... 142, 163
well, record of ... 142
reference to ... 126, 127, 143

Page
Ford, J. B., wells (Michigan Alkali Co.) at Wyandotte 96
Fort Gratiot township, St. Clair Co., explorations in 51, 66
Fort Wayne well (Edison Power & Light Co.), record of 102
Fowlerville, anticline near 19, 164
occurrence of oil near 31, 165
test wells near 165
Fox, Perry, reference to 172
Frankfort, records of wells at 207, 208
Franklin well at Kawkawlin, record of 141
Fresh waters, pollution of 248
Frueauff, Mr., of Ann Arbor Argus, reference to 108
Fruitport, wells at 207, 208

G

Garey-Casamer well No. 1 at Saginaw, notes on 128
No. 2 at Saginaw, notes on 131
Gas, accumulations of in West Virginia and Pennsylvania 34
relation of to anticlinal structures 34
analysis of 203
escape of H_2S 49
geologic conditions favorable for the accumulation of 33
occurrence of at Killmaster 221, 222
Manistee 201
Onekama 32
Osseo 88
Port Huron 50
Saginaw 130, 133
St. Ignace 242
Stronach 202
in Antrim shale 28
Berea sandstone 28, 72, 128, 130, 133
Devonian formations 32, 71, 221
Surface deposits 32, 71, 202, 204, 221, 222, 225
vicinity of Portage Lake 202, 203, 204
near Niles 178
reservoirs, character of 34
rock pressure of in New York fields 46
sands, flooding of 247, 248, 249
seepages of 48
springs, occurrence of in Michigan 49, 71, 221
surface indications of 48, 49, 71, 85, 221
wells, necessity for the charting of 248
in Michigan, list of shale 73
Geological columns of Huron and Sanilac counties 68, 69
Survey of U. S., investigation of oil shales of Colorado and Utah by 258
Gera (C. G. McClure) well, reference to 132, 150
Gladwin, depth of drift at 150
Gladwin, probable depth of the Dundee at 151
Gladwin well (C. G. McClure), record of 150, 151
Gladstone, St. Paul & Sault Ste. Marie railway well at 237
Glacial drift in Michigan, thickness of 21
Globe-Blaisdell (Green Point) well, notes on 130
Goguac Lake well, record of 162
Gordon, C. H., report on Port Huron oil field by 50
Gore Bay (Manitoulin island) well, record of 246
Grand Lake well, record of 216, 217
Grand Ledge, Taber well at 156
Grand Rapids, depth of Marshall sandstone at 152
Artesian Well Co., well of 152
Grand Trunk Junction well, record of 58
Gravity as a factor in causing rock pressure 47
Grayling (Hanson, R.) wells, records of 213
Green Point (Globe-Blaisdell) well, notes on 130

Page
Grindstone City, salt wells at 67
Grosse Isle or Swan well, artesian flow from 92
(Swan) well, notes on 92
Guelph limestone, description of 24
Guano deposits of South America, exhaustion of 257

H.

Hall well at Bay City, reference to 137
Hacker (Whitney or Truesdell) well at Muskegon, reference to 186
Hanson wells at Grayling, records of 213
Harbor Beach salt wells, notes on 67
Harrisville well, record of 222, 223
Hermansville limestone, equivalency of with the Calciferous sandstone 22
Hillsdale wells, records of 88
Hindshaw, H. R., ablation theory on the formation of the Great Lakes basins 206, 207
Hoefer, H., reference to 33
Holly, record of well at 112
Hubbard, L. L., reference to 15
Hunt, T. S., reference to 33
Huron county, early salt wells in 67
Huron county, geological section in 68
Hydrogen sulphide gas, occurrence of 49

I.

Ida well, Monroe county, notes on 82, 83
Illinois, laws regulating the drilling and care of oil and gas wells in 249, 250
Imlay City well, record of 65
Indiana, laws regulating the drilling and care of oil and gas wells in 249, 250
Industrial (State) School well at Lansing, record of 158
Ionia, record of well at 153
Iosco county, local dip of rock strata in 227, 228
Iron oxide, occurrence of iridescent films of 49
Ithaca well, records of 144, 145

J.

Jackson-Church well, Saginaw, notes on 129
occurrence of Berea sandstone at 159, 163
occurrence of Marshall sandstone at 159
Parma sandstone at 159
Woodville sandstone near 31
wells, records of 159, 160, 161, 162
Jacobsville sandstone, description of 22
Jahncke, F., well driller, reference to 228
Jason-Shumway well near Fowlerville, record of 165
notes on 163, 164
"Junction" well at Port Huron, record of 57, 58

K.

Kalamazoo Natural Gas Co., well of 185
oil at 185
well, record of 185
Kawkawlin, anticline west of 140
brine horizon at 127
record of Franklin well at 141
Kentucky, occurrence of Boghead coal in 255
"Kerosene" shale, occurrence of in New South Wales 256
Khagashewing Point anticline 19, 207
Killmaster, gas springs at 71, 205, 221
oil and gas at 221, 222
wells, records of 222
King's grist mill well, Sarnia, Ontario, record of 55

L.

Page

Laingsburg, possible anticline near ... 164
Lake Park well (Milwaukee), record of ... 232
Lake Superior sandstone, description of ... 22
Lane, A. C., reference to ... 15, 126
Lansing, wells at ... 158
Lasalle well, Monroe county, record of ... 76
Laws, difficulties in the application of protective and remedial ... 252
in framing protective and remedial ... 251
in Michigan, mining ... 250, 254
necessary provisions of, for the protection of natural resources ... 250, 251
proposed general mining ... 253, 254
protecting coal mines and coal reserves in Ohio and Indiana, passage of ... 249, 250
regulating the drilling and care of oil and gas wells ... 249, 250
Lennard well at South Rockwood, Monroe county, reference to ... 83
Leonard, H. W., gas well at Onekama, Manistee county ... 202, 203
Lesley, Prof., "Expansion hypothesis" of ... 47
Lester & Roberts well at Marine City ... 117, 118
Little Traverse bay or Khagashewing Point anticline ... 19, 207
Livingston county, absence of Grand Rapids Group in ... 164
apparent anticline in ... 163, 164
possible absence of Marshall sandstone in ... 164
"Locators" of oil bodies ... 6
Lockport limestone, description of ... 24
Lorraine shale, character of in Northern Peninsula ... 231
description of ... 23, 231
Loud wells at Au Sable ... 226
Louis Sands Salt & Lumber Co. wells at Manistee, reference to ... 201
Lower Grand Rapids series, description of ... 30
Magnesian (Calciferous) sandstone, description of ... 22
Monroe or Bass Island series, description of ... 25
Ludington, occurrence of oil at ... 193
thickness of drift at ... 202
salt beds at ... 193, 195
wells, records of ... 190, 191, 192, 193, 194, 195
Lyons Lumber Co. well at Ludington, occurrence of oil in ... 193

M.

MacLean's well at Bay City, reference to ... 137
Macomb county, explorations in ... 113
Madison Oil & Gas Co. well, record of ... 87
township (Lenawee county) well ... 87
Manchester well, record of ... 86, 87
Manistee, anticline near ... 19, 202
county, dip of rock strata in ... 197
discordance of dip in ... 202
list of borings in ... 196
presence of rock valley in ... 136
thickness of drift in ... 32, 202, 205
Manistee, occurrence of oil and gas at ... 200, 201, 202
wells, records of ... 197, 198, 199, 200
Manistique, artesian wells at ... 240, 241
possibilities for the occurrence of oil and gas near ... 241
Manitoulin Island, Gore Bay oil well on ... 246
Map of salt block along St. Clair river ... 113
in Ludington and vicinity ... 191
Wayne county ... 91
Marcellus (Bell) shale, description of ... 27, 71
Marine City salt wells, records of ... 117, 118, 119, 120, 121
Marinette Water Works wells, records of ... 234
wells, notes on ... 232, 233, 234

Page

Marshall brine and water horizons, description of ... 30, 126, 137
sandstone, depth of in central Michigan ... 127, 128, 130, 131, 140, 141, 143, 145, 150, 152, 157, 159, 164, 166, 167
description of ... 29
"paint rock" in ... 30
Marysville well, record of ... 61
Mason county, thickness of drift in ... 32, 205
E. Strope well at ... 159
John, reference to ... 137
record of well at ... 159
"Mason" well at Muskegon, record of ... 186, 187
Maxville limestone, description of ... 30
erosion of ... 31
McClure, C. G., well near Gera ... 132, 150
Gladwin ... 150, 151
McLaughlin, R. P., State Mining Bureau of California, reference to ... 253
Medina, character of in the Northern peninsula ... 231
formation, description of ... 23
oil horizon in Ontario ... 67, 106
Menominee wells, reference to ... 234
Mercer, C. F., of Northern Oil & Gas Co., reference to ... 172
Michigan Alkali Co., wells of at Wyandotte ... 96
Michigan Basin, description of ... 19
center of ... 19, 126
local folding and faulting in ... 19
rock formations comprising ... 21
Central Oil Company, explorations by the ... 51
Development Company, wells of at Port Huron ... 51
Oil Company well at Muskegon, record of ... 188
Salt Co., well at Marine City, record of ... 121
Series, description of ... 30
gypsum beds in ... 30
sulphate waters in ... 30, 248
Middle Monroe (Sylvania), description of ... 26
depth of along Detroit River ... 92, 97, 99, 103, 105, 106
Midland (Midland Chemical Co.) brine wells, records of ... 142, 143
Midland Chemical Co., reference to ... 142, 145
well at Mt. Pleasant, record of ... 147
depth of Marshall brine horizon at ... 140
preglacial rock valley near ... 136
salt wells ... 126, 142, 143
Milan well, record of ... 80, 81
Milwaukee, record of Lake Park well at ... 232
Mineral resources, protection of from oil and gas wells ... 250, 252, 254
waters, pollution of ... 17, 247, 248
well at Lansing, reference to ... 158, 163
Mining laws pertaining to the drilling and care of oil and gas wells ... 249, 250, 253, 254
Minshall, F. W., reference to ... 33
Missouri, occurrence of oil shale and oil coal in ... 255
Moeller, H. F., reference to ... 214
Moench & Sons well at Alpena, reference to ... 219
Monroe county, dip of rock strata in ... 74
explorations in ... 74
Formation, brecciated dolomites of ... 21, 206, 207
Formation, description of ... 25
wells at ... 74, 75
Montmorency county, gas springs in ... 205
thickness of drift in ... 32, 205
Moore well at Monroe, record of ... 74, 75
Moorman well at Ypsilanti, notes on ... 107
Morley well at Marine City, record of ... 120
Morrice, notes on well near ... 163
Morton Salt Co. well at Wyandotte, record of ... 95, 96
Mount Clemens well, record of ... 113, 114

Page
Mount Pleasant, record of Braunwell at ... 146, 148, 149, 150
Mount Pleasant, depth of Dundee limestone at ... 136
Marshall sandstone at ... 145
thickness of drift at ... 136, 147, 148
wells, records of ... 145, 146, 147, 148, 149, 150
Mundy-Fifield well near Saginaw, notes on ... 128
Muskegon, absence of the Dundee limestone at ... 186
Muskegon, evidence of an anticline near ... 189
Muskegon, occurrence of oil at ... 186, 187, 188, 189
Muskegon, oil horizon at ... 186
Muskegon wells, notes on and records of ... 186, 187, 188, 189
Mutual Oil & Gas Co. of Detroit, proposed exploration of at Royal Oak ... 110

N.

Napoleon sandstone, depth of in central Michigan ... 127, 128, 130, 131, 140, 141, 143, 145, 150, 152, 157, 159, 164, 166, 167
description of ... 29
"paint rock" at the base of ... 30
water and brine supplies of ... 30, 126, 137
National Salt Co. well at Marine City, record of ... 119
Natural resources, conservation of ... 249
Neebish, record of test well near ... 243, 244
Neff, A. E., well near Rapid River, record of ... 239
Newaygo county, thickness of drift in ... 32, 205
New Baltimore, anticline near ... 19, 124, 125
well, record of ... 114, 115
New Brunswick, occurrence of oil shale in ... 256
Newport well (Monroe county), record of ... 82
New River (Huron county) salt wells, brine horizon of ... 67
New South Wales, "oil shale" industry in ... 256
Niagara escarpment in the Northern Peninsula ... 231
limestone, character and distribution of in the Northern Peninsula ... 231
depth of in Monroe county ... 83
description of ... 24, 231
possibilities of as an oil horizon ... 231
probable depth of at Mt. Pleasant ... 146
Nickerson, R. A., reference to ... 200
Niles, anticline near ... 19, 175
depth of base of Antrim black shale at ... 175
explorations in vicinity of ... 178
occurrence of oil in "bastard" Trenton in vicinity of ... 178
Oil & Gas Co. well, record of ... 179
oil horizons in vicinity of ... 175, 176
occurrence of oil and gas near ... 178
Nogard well (Monroe county), record of ... 79
Norn, Jas., well at Standish, record of ... 229, 230
North American Chemical Co. (South Bay City) well, record of ... 138, 139, 140
North Bay City well, record of ... 137, 138
North Detroit well, record of ... 104
Northern Lower Michigan district, bed rock geology of ... 205
surface deposits in ... 205
signs in ... 205
Northern Oil & Gas Co., explorations of at Allegan ... 170, 171, 172
Peninsula, artesian water conditions in ... 231
dip of Paleozoic formations in ... 231
Paleozoic area of ... 231
Nova Scotia, occurrence of oil shale in ... 256

O.

Oakland county, shale gas wells in ... 111
Oakwood (Detroit Salt Co.) salt Shaft, description of ... 99, 100, 101
flows of water in ... 99, 100

Page
Oakwood (Wis.) wells, notes on ... 233
Ohio, development of oil shale industry in ... 255
laws regulating the drilling and care of oil and gas wells in ... 249, 250
Oil, analysis of ... 135
analyses of ashphaltic ... 240
and asphalt, occurrence of ... 239, 240
gas fields, danger to from improperly cased or unplugged wells ... 247, 248
horizons at Port Huron ... 67
in Alcona county ... 225
Saginaw Valley ... 128, 129, 130, 131, 132, 133, 134, 135
southwestern Michigan ... 175, 176
and gas, geologic conditions controlling the accumulation of ... 7, 34, 35, 37, 38, 39, 40, 41, 42, 43, 44
horizons in central Michigan ... 136, 140, 141, 146, 149, 153, 163, 165
occurrence of in Pennsylvania ... 39, 40
saline domes ... 41
western Ontario ... 106, 107
operators, antagonism of to restrictive laws ... 249
reservoirs, description of ... 39, 40, 41, 42, 43
sands, flooding of ... 247
of Pennsylvania, character of ... 40
seepages of ... 48, 49
surface indications of ... 48
unfavorable areas for the occurrence of ... 7
wells, regulation of the drilling and care of ... 16, 247, 249, 250, 251, 252, 253, 254
for the capping of ... 250, 251, 252
wells, charting of ... 248
menace of mining operations to ... 248, 249
character of at Allegan ... 171
Port Huron ... 56, 57
Saginaw ... 129, 135
districts and fields of Michigan ... 16
estimated content of in petroliferous formations ... 259
occurrence of at Abbottsford ... 62
Allegan ... 170, 171, 172
Kalamazoo ... 185
Killmaster ... 222
Ludington ... 193
Manistee ... 200
Mt. Pleasant ... 146
Muskegon ... 187, 188, 189
Ossoo ... 188
Port Huron ... 5, 15, 50, 51, 56, 57
Saginaw ... 18, 128, 129, 131, 132, 134
films of ... 49
in Coldwater shale at Goguac lake ... 162
Ft. Gratiot township, St. Clair County ... 65
Monroe county ... 74
Saginaw formation ... 31
near Fowlerville ... 165
Niles ... 178
Rapid River ... 237
reservoirs, sealed ... 42
shale as a future source of oil and gas ... 258, 259, 262
by-products, value of ... 256, 257
deposits, future value of ... 258, 262
industry, development of in Scotland ... 255
destruction of in United States ... 255, 258
in Scotland, investigation of by the Dept. of Mines of Canada ... 256, 258
profits from in Scotland ... 255
occurrence of ... 18
plants in United States previous to 1860 ... 255
production of in Scotland for 1904 and 1913 ... 255, 256
yield of crude oil per ton from ... 255, 256, 258, 259, 261, 262

Page
Oil "smellers," operations of ... 6
Springs oil field (Ontario), discovery of ... 50
wells, menace of abandoned or improperly cased ... 247, 248
Oklahoma, passage of remedial and protective oil and gas laws in ... 249, 250
Onaway, probable depth to Trenton at ... 215
Onaway, thickness of rock salt beds at ... 214, 216
Onaway (Presque Isle Development Co.) well, record of ... 214, 215, 216
Onekama (Leonard, H. W.) gas well, reference to ... 32
description of ... 202, 203
thickness of drift in the vicinity of ... 202
well, analysis of gas from ... 203
Ontario, local anticlines in ... 52, 56, 106, 125
"Open pressure," definition of ... 44
measurement of ... 44
Orton, E., reference to ... 37, 38, 39, 41, 45, 46
Oscoda salt wells ... 226
Osseo, occurrence of oil and gas at ... 88
well, record of ... 89
Otsego county, thickness of drift in ... 32, 205
Owosso well, record of ... 166

P.

Pabst well near Lexington, reference to ... 66
Pack salt wells at Oscoda ... 226
Paleozoic rocks, exposures of ... 21, 136, 231, 232
"Paint rock," occurrence of in the Marshall formation ... 30
Parma sandstone, brine horizon of at Bay City ... 137
description of ... 31
occurrence of at Jackson ... 159
sulphate brines and waters of ... 31
"Peanut" conglomerate, occurrence of in the Marshall formation ... 29
Penalties for the infraction of oil and gas laws ... 250, 252
Pennsylvania, development of oil shale industry in ... 255
laws regulating the drilling and care of oil and gas wells in ... 249
Percy, T., well driller, reference to ... 197
Pere Marquette Lumber Co. salt well at Ludington, record of ... 191, 192
Perry well, notes on ... 164
Peters, R. G., Salt & Lumber Co. wells at East Lake, records of ... 200, 201
Petoskey well, record of ... 208
Petrolia oil field, discovery of ... 50
oil horizons in ... 53
long life of ... 51
production of ... 53
record of Carman well near ... 53
"Test well," record of ... 53
Phillips, O. N., wells drilled in Oakland county by ... 115
Pickford well, record of ... 244, 245
Pleistocene deposits, description of ... 32
occurrence of shale gas in ... 32, 43, 71, 72, 73, 74, 85, 109, 111, 202, 203, 204, 205, 221, 222, 225
Plugging of abandoned wells, methods and means of ... 250, 251, 252, 253
Pollution of brines, and mineral and potable waters ... 17, 247, 248
Pontiac well, reference to ... 105
Pontiac Natural Gas & Oil Co. well at Pontiac, record of ... 111, 112
Portage lake (Manistee county), list of surface gas wells in vicinity of ... 204
occurrence of gas in vicinity of ... 202, 203
Port Austin salt wells, reference to ... 67
Port Crescent salt wells, reference to ... 67
Port Hope salt wells, reference to ... 67
Port Huron, anticline ... 19, 56, 57, 66, 67
Bailey oil wells in ... 56
explorations in the vicinity of ... 50, 51, 56, 57, 58, 59, 60, 61, 62, 65, 66

Page
Port Huron oil field, reference to ... 5
early history and development of ... 50, 51
horizon at ... 50, 53, 67
possibilities for the occurrence of oil near ... 67
Salt Co. well, record of ... 59, 60, 61
Potsdam (Lake Superior) sandstone, description of ... 22
Potter oil well, Monroe county ... 74
Pre-Cambrian rocks, depth of at Escanaba ... 235
Marinette (Wis.) ... 233, 234
Neebish ... 243, 244
Rapid River ... 237, 238
near Stonington, Delta county ... 235, 236
Prescott well, record of ... 228, 229
Presque Isle county, thickness and depth of rock salt beds in ... 206, 214
Development Company well at Onaway, record of ... 214, 215, 216
Projects, "community" oil and gas ... 6
Promoter, the role of the professional ... 6
Pumpherston Oil Company near Uphall in Mid-Calder, Scotland, test of oil shales by ... 256

Q.

Quebec, occurrence of oil shales in the province of ... 256

R.

Ralston well, (Bay county), anticlinal fold in Coal Measures near ... 127, 141
reference to ... 127
Rapid River, artesian wells near ... 237, 238, 239
depth of pre-Cambrian rocks in the vicinity of ... 237, 239
occurrence of oil near ... 237
test wells for oil northeast of ... 237, 238, 239
Records of deep borings, reference to ... 15
Regulation of the drilling and care of oil and gas wells ... 16, 247, 249, 250, 251, 252, 253, 254
Reservoirs, cause of rock pressure in ... 45, 46, 47, 48
forms of oil and gas ... 39, 40, 41, 42, 43
sealed reservoirs ... 42
Richter Brewing Co. (Escanaba) well, record of ... 235
Richmond shale, description of ... 23
Richmondville sandstone, brines of ... 67, 228
Richmondville sandstone, occurrence of ... 29, 152, 228
Riga well (Monroe county), reference to ... 83
River Rouge, salt wells in ... 99
Rochester shale, character of in the Northern Peninsula ... 231
description of ... 24
Rock pressure, abnormal in New York gas fields ... 46
causes of ... 45, 46, 47, 48
defined ... 44
measurement of ... 44
structures in the Port Huron field ... 56, 57
southeastern district ... 70, 71, 105, 106, 107, 124, 125
western Michigan ... 172
Ontario ... 52, 53
Romeo well, record of ... 115, 116
Rominger, C., publication of well records by ... 15
Romulus township (E. Twark) well, Wayne county, record of ... 92, 93
Round Oak Gas & Fuel Co. well at Dowagiac, record of ... 177
Roscommon, fraudulent exploration for oil at ... 214
Royal Oak, proposed test well of the Detroit Mutual Oil & Gas Co. at ... 110, 111
well, record of ... 109, 110
Ryerson-Hills well at Muskegon, record of ... 186, 187

S.

Saginaw anticline ... 19, 126, 127, 130, 132, 134, 135
Formation, description of ... 31
occurrence of oil in ... 165

Page
"Saginaw oil," analysis of ... 135
field, reference to ... 126
Saginaw, occurrence of gas at ... 128, 130, 133, 135
oil at ... 15, 128, 129, 130, 131, 134, 135
"Saginaw sand," reference to ... 45, 128, 131, 133, 134
Saginaw Valley Development Co., organization of ... 126
well No. 1 (Mundy-Fifield) ... 128
No. 2 (Garey-Casamer No. 1) ... 128
No. 3 (Jackson-Church) ... 129
No. 4 (Cresswell) ... 129
No. 5 (Watson) ... 129, 130
No. 6 (Green Point or Globe-Blaisdell) ... 130
No. 7 (Garey-Casamer No. 2) ... 131
No. 8 (Lawndale) ... 131
No. 9 (Mershon) ... 131, 132
No. 10 (Ring) ... 132
St. Clair salt wells, records of ... 121, 122, 123
St. Ignace, record of wells at ... 242, 243
peninsula, dip of rock strata in ... 242
water supplies in ... 242
St. Johns municipal wells, records of ... 167, 168, 169
depth of the Marshall at ... 167
St. Joseph county, rock structure in ... 175
(Vincent and Blake) well, record of ... 184
St. Joseph's Island, test well on ... 243
St. Louis, preglacial rock valley near ... 136
wells, reference to ... 144
St. Peters sandstone, description of ... 22
Salina formation, description of ... 25
Saline domes, description of ... 41
as oil reservoirs ... 49
Salt beds, character and distribution of ... 25
occurrence of along Detroit river ... 91, 92, 95, 96, 97, 99, 106
St. Clair river ... 58, 59, 117, 121
at Ludington ... 193, 195
in Alpena county ... 206
Manistee county ... 196, 199, 200, 201
Presque Isle county ... 210
southern limit of in Wayne county ... 91, 92
Salt blocks in the vicinity of Ludington, map of ... 191
Manistee, map of ... 197
in Wayne county, map of ... 90
Salt industry in Michigan, laws protecting the ... 250, 254
Salt wells, distribution of along Saginaw river ... 126, 127, 131
in Sanilac and Huron counties ... 67
Sands, Louis, Lumber Co. salt wells at Manistee, occurrence of gas in ... 201
Sandstone reservoirs, sealed in by shale ... 42
Sanilac county, early salt wells in ... 67
geological section in ... 69
Saxony, extraction of oil from lignite in ... 256
Salzman Mineral Bath Co. well at Benton Harbor, record of ... 182
Sarnia township, Lambton county, Ontario, explorations in ... 53
Schemes, fraudulent oil and gas ... 6
Schoolcraft, E. J., of the Michigan Development Co., reference to ... 56
Scotland, development of oil shale industry in ... 255
Sealed oil and gas reservoirs ... 41, 42
Seepages of oil and gas, significance of ... 48
"Shale" gas, occurrence of ... 48, 49, 70, 72, 73, 85, 111, 202, 203, 204, 205, 221
Shaw well near Port Huron, record of ... 66
Sherzer, W. H., reference to ... 70
Sibley quarry, discordant dip of strata in ... 106
Signs of oil and gas ... 48, 49, 70, 205, 221
Sinks, limestone, in Alpena and Presque Isle counties ... 206
Slumping of strata in abandoned coal mines ... 248, 249

Page
Slumping of strata, superjacent to the salt beds ... 207
Smith salt wells at Oscoda ... 226
Smith, Wallis Craig, of the Saginaw Valley Development Co., reference to ... 126
Solvay Process Co. wells at Delray, records of ... 97, 98, 99, 100
"Sour" waters of the Gulf Coastal Plain, reference to ... 49
South Bay City (North American Chemical Co.) well, record of ... 138, 139, 140
Southeastern district, defined ... 70
anticlines in ... 106, 124, 125
South Lyon, record of well at ... 112
South Rockwood, record of Lennard well at ... 83
Standish well (Jas. Norn), record of ... 229
Stearns Salt & Lumber Co. well at Ludington, record of ... 193
Stephenson, S. M., wells at Menominee, reference to ... 234
Stock, G. B., explorations for oil at Port Huron by ... 51
Xylite Grease & Oil Co. of Port Huron, reference to ... 56
wells, typical record of ... 57
Stonington, depth of pre-Cambrian rocks near ... 235, 236
Stonington, A. Wagner explorations near ... 235, 236
Stony Island, anticline at ... 19, 106, 107
Strasburg well (Monroe county), record of ... 76, 77, 78
Stroh's Brewery well, Detroit, record of ... 104
Stronach, (Manistee county), anticline near ... 202
Lumber Co. wells, reference to ... 201, 202
occurrence of oil and gas at ... 202
Strope, E., well at Mason, reference to ... 159
Structural "benches," occurrence of ... 41, 172
Structures governing oil and gas accumulations ... 39, 40, 41, 42, 43
Sunbury shale, description of ... 29, 72
Surface deposits, depth of in Central Michigan ... 32, 136
Northern Lower Michigan ... 32, 205
Mason and Manistee counties ... 32, 202
Swan, Jas., artesian well, Grosse Isle, reference to ... 92
Sweitzer well, Port Huron, record of ... 66
Syncline at Bay City ... 130, 135
Port Huron ... 62, 67
St. Clair ... 121, 125
near Chatham, Ontario ... 125
Berrien Springs ... 175
Synclines in Michigan, reference to ... 21
Sylvania sandstone, depth of at Ann Arbor ... 109
Delray ... 97
Detroit ... 102, 106
Dundee ... 80
Grosse Isle ... 92, 105
Mt. Clemens ... 114
River Rouge ... 99, 105
Royal Oak ... 110
Trenton ... 91, 105
Windsor, Ontario ... 103, 106
Wyandotte ... 94, 95, 105
Ypsilanti ... 108
in Oakwood salt shaft ... 101

T.

Taber well at Grand Ledge, record of ... 156
"Tannery" well at Alpena, reference to ... 219
Tawas City well, record of ... 227, 228
Tecumseh Salt Co. salt wells, River Rouge, reference to ... 99
Terraces or arrested anticlines, occurrence of ... 41
Test holes, necessity for the charting of ... 248
Torbanehill mineral (torbanite), occurrence of in Scotland ... 255

Page
Traverse Formation, description of ... 27
occurrence of gas in ... 32, 50
oil in ... 71, 128, 129, 135
thickness of in the northern part of the Southern peninsula ... 216
Trenton, "bastard," reference to ... 88, 178
limestone, character, thickness and distribution in the Northern Peninsula .. 23, 231, 232, 237, 239
depth of along the crest of the Cincinnati anticline ... 52
depth of at Monroe ... 74
Dundee ... 79, 80
Lasalle, Monroe county ... 76
Strasburg, Monroe county ... 76, 77
in the "Potter" well, Monroe county ... 74
Wyandotte ... 93
description of ... 22
exposures of ... 232
probable depth of at Mt. Pleasant ... 136
Onaway ... 215
Port Huron ... 59
occurrence of asphaltum "gum" in the ... 232
oil formation ... 23, 67
(Church & Co.) wells, record of ... 91
Twark, Emil, well near Romulus, record of ... 92, 93

U.

Umholz Oil Co. well near Berrien Springs, reference to ... 179
Unconformity at the top of the Bayport or Maxville limestone ... 30
United Alkali Co. wells in River Rouge, reference to ... 99
United States Bureau of Mines, reference to ... 253
development of oil shale industry in the ... 255
Geological Survey, investigations of the oil shales of Colorado and Utah by the ... 258
Unplugged wells, danger to oil and gas sands from ... 247, 248
Upper Monroe or Detroit River series, description of ... 26
Utica shale, description of ... 23
distillation of oil from ... 260, 261
character, thickness, and distribution of in the Northern Peninsula ... 231
exposures of ... 23, 231
oil content of ... 258, 260

V.

Valley Centre well, Sanilac county, record of ... 63, 64
Vincent & Blake well in St. Joseph, record of ... 184
Virginia, occurrence of oil shale and oil coal in ... 255

W.

Wadham's station, record of the Fair well at ... 51, 62
Wagner, A., explorations of near Stonington ... 235, 236
Wallaceburg well (Ontario), record of ... 124
Washtenaw county, anticline in ... 164
explorations in ... 107
Water, flooding of oil and gas fields by ... 247
occurrence of in oil and gas fields ... 247
Watson well at Saginaw, reference to ... 129, 130
Wayne county, dip of strata in ... 105
Wells, F. L., test hole at Port Huron, record of ... 50, 57, 58
Wells, unplugged or improperly cased ... 16, 247, 248
West Virginia, laws regulating the drilling and care of oil and gas wells in ... 249
White, I. C., anticlinal theory of ... 33
reference to ... 35, 37, 38, 39, 45
White Cloud, depth to bed rock at ... 136

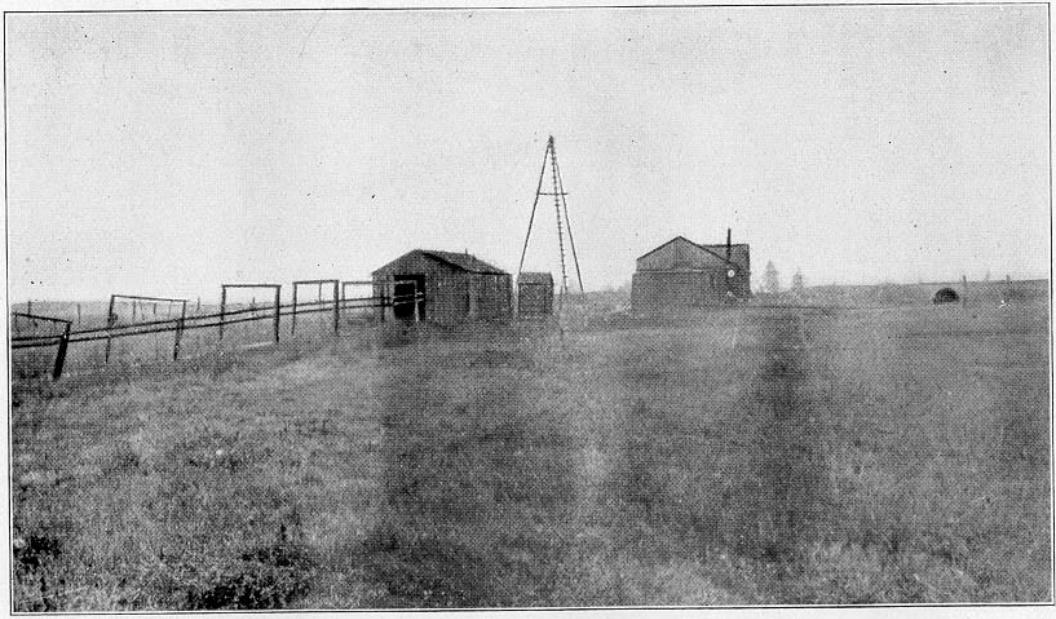
Page
White Pigeon, depth of base of Antrim black shale at ... 175
Oil & Shale Gas Co., well of ... 182, 183
well, record of ... 183
Rock, salt wells at ... 67
Whitney or Truesdell well at Muskegon, reference to ... 186
Winchell, A., publication of well records by ... 15
Windsor wells, Ontario, records of ... 103
Woodville sandstone, description of ... 31
Woodworth (Jackson) well, record of ... 161
Worthington & Cooley Mfg. Co. well (Jackson), record of ... 160
Wyandotte anticline ... 19, 105, 106
wells, records of ... 93, 94, 95, 96
Wylie well at Saginaw, reference to ... 127, 128
Wyoming, laws regulating the drilling and care of oil and gas wells ... 249, 250

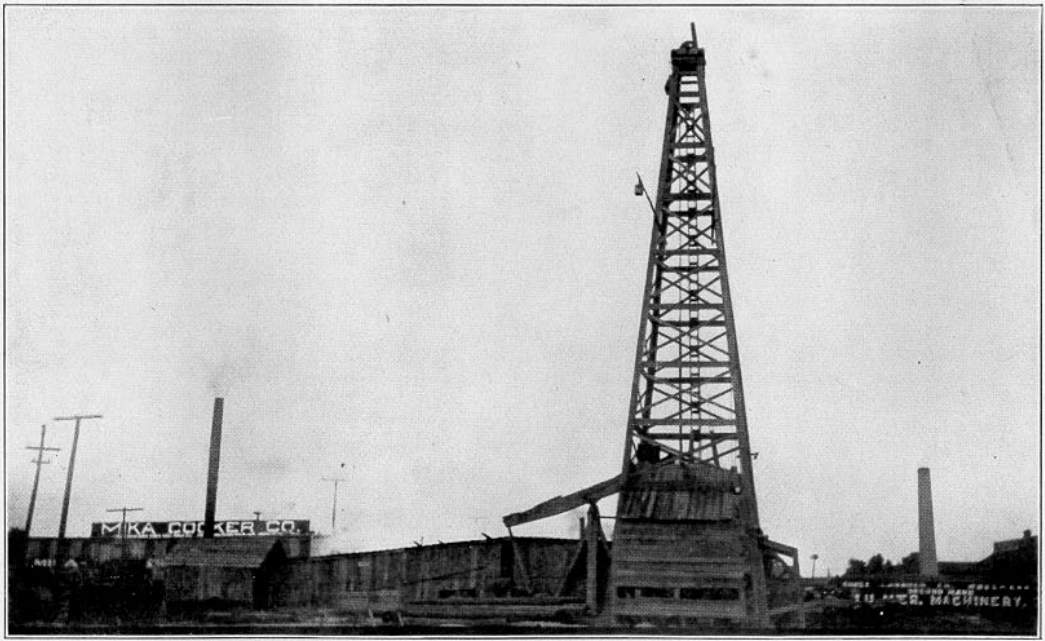
Y.

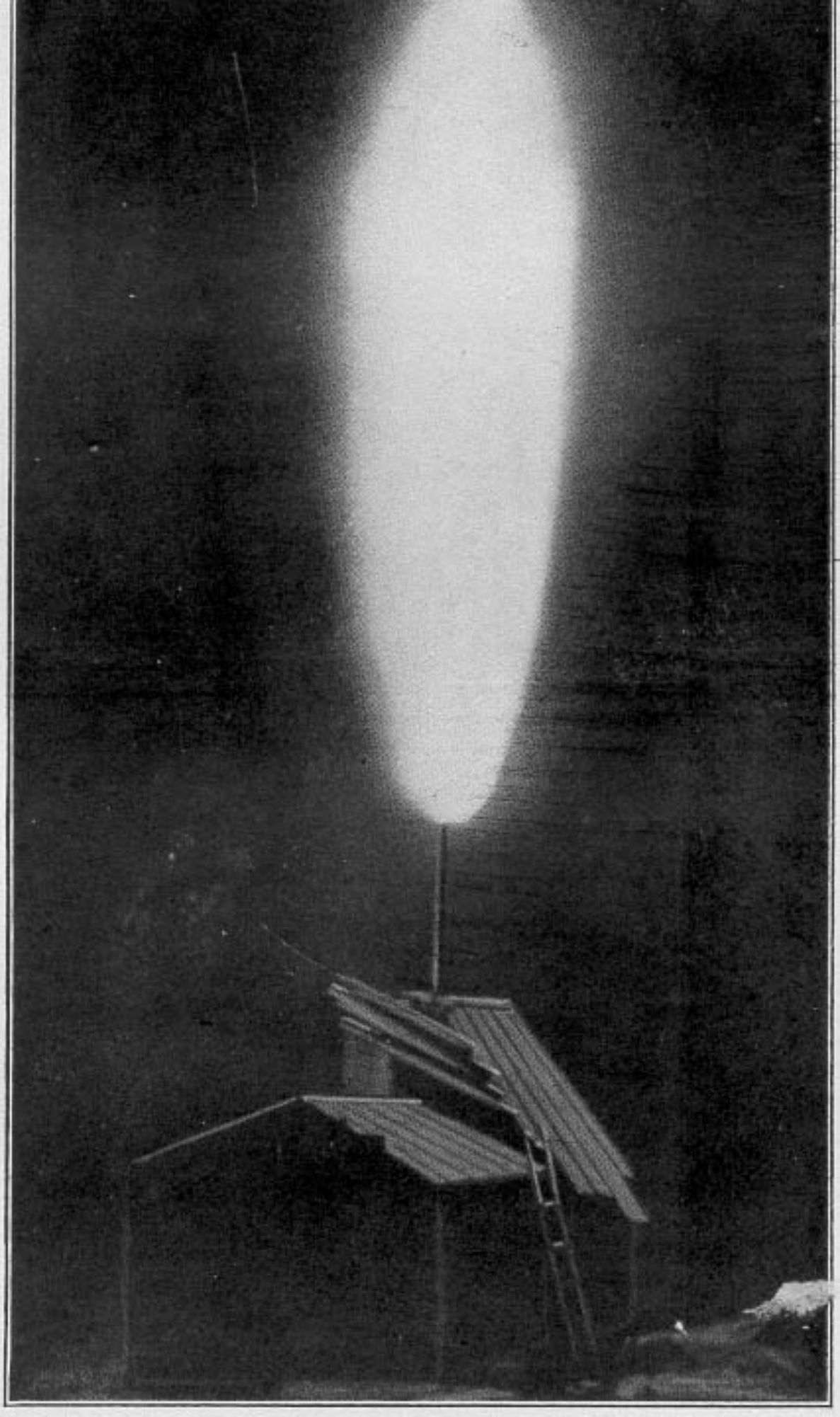
Young, Jas., discovery of method for distillation of oil from bituminous shales by ... 255
Ypsilanti wells, records of ... 107, 108
Ypsilanti Development Co., well of ... 108

Z.

Zug Island well, Detroit river, record of ... 99




MIKA COOKER CO.
MACHINERY.



TEST WELL, PETROLIA.

Loc.—Near Imperial Refinery. Record by H. P. H. Brummell, Geol. Survey Can. E. Rawlings, driller.

Elevation 667 ft. A. T.	Thickness, feet.	Depth, feet.
Surface	104	104
Traverse:		
Limestone (''upper lime'')	40	144
Shale	130	274
Limestone (''middle lime'')	15	289
Shale	43	332
Dundee:		
Limestone (''lower lime'')	68	400
Limestone, soft	40	440
Limestone, gray	160	600
Monroe:		
Limestone, hard, white with hard streaks of sandstone from 2 to 5 feet in thickness	500	1100
Gypsum	80	1180
Salina:		
Salt and shale	105	1285
Gypsum	80	1365
Salt and shale	140	1505

CARMAN WELL, PETROLIA.

Lot 11, Concession 11, Enniskillen, Lambton Co., Ontario, Drilled in 1900.

Elevation 667 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene or surface:		
Blue clay	90	90
Traverse (Hamilton)	240	330
Streaks lime and shale. At St. Clair, 775 ft.:		
Dundee (Corniferous) limestone	190	520
Streaks of brown. At St. Clair about 900 ft.:		
Monroe Beds	690	1210
Brown, gray and black dolomite. At St. Clair, about 1630 ft.:		
Salina, gray and black dolomites:		
Salt	65	1275
Dolomite	20	1295
Salt and light streaks dolomite	170	1465
Salt	90	1555
Salt and dolomitic lime	50	1605
Salt	25	1630
Gray dolomite	10	1640
Salt	67	1707
Dolomite and salt	40	1747
Salt	138	1885
Dolomite and lime shale	130	2015
Salt	90	2105
Guelph and Niagara lime	275	2380
Rochester (Niagara) shale (red and dark)	60	2440
Clinton	90	2530
Red Medina	275	2805
Lorraine or Hudson River shale (light)	205	3010
Utica (dark)	165	3175
Trenton (Trenton, Birdseye and Chazy), 1015 ft. 6½ in. casing, no salt water or pressure of any kind found in Trenton, Finished December, 1900	602	3777

DICKEN'S WELL.

Loc.: Southern part of Sarnia near cor. Rose and Tecumseh streets. H. Mitchel, driller. Record by H. P. H. Brummell.

Elevation 590± ft. A. T.	Thickness, feet.	Depth, feet.
Surface:		
Sand and clay	130	130
Hard pan	55	185
Gravel	15	200
Traverse (Hamilton):		
Limestone	90	290
Shale	100	390
Limestone	5	395
Shale	68	463
Dundee (Corniferous):		
Limestone	77	540

KING'S GRISTMILL WELL.

Loc.: One and one-half miles north of Dicken's well, Sarnia. Drilled in 1875 by E. Rawlings. Record by H. P. H. Brummell, Geol. Sur. Can.

Elevation 589 ft. A. T.	Thickness, feet.	Depth, feet.
Surface:		
Sand	9	9
Blue clay	109	118
Hard pan	2	120
Antrim:		
Black shale	36	156
Traverse:		
Limestone	30	186
Shale	263	449
Limestone	5	454
Shale	40	494
Dundee:		
Limestone	60	554
Gray limestone	100	654
Monroe:		
Hard limestone	546	1200
Hard and flinty limestone	200	1400
Limestone with gypsum	105	1505

COURTRIGHT WELL, ONTARIO.

Record by H. P. H. Brummell, Geol. Surv. Can., E. Rawlings, driller.

Elevation 588 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Surface sand and clay	132	132
Hard pan	28	160
Antrim:		
Shale, black	32	192
Traverse:		
Limestone	40	232
Shale and limestone	310	542
Dundee:		
Limestone, white	50	592
Limestone, gray	100	692
Monroe:		
Limestone, hard, white	370	1062
Sandstone (Dolomite, probably—B), (Sylvania—Lane)	32	1094
Limestone	400	1494
Limestone and gypsum	136	1630
Salt	22	1652
Gypsum	13	1665

BAILEY WELL NO. 1.

Loc.: 500 ft. N., 1000 ft. W., sec. 9 T. 6. N., R. 17. About ½ mile southwest of the Stock wells.

Elevation 605 ft. A. T.	Thickness, feet.	Depth, feet.
Surface	100	100
Antrim shale:		
Black shale	100	200
Traverse (Hamilton) formation:		
Streak hard argillaceous limestone with FeS_2	2	202
Soapstone (argillaceous marl)	15	217
Limestone (top) blow of odorless gas at 280 ft	80	297
Soapstone (argillaceous marl)	147	444
Limestone (middle)	9	453
Soapstone with streaks of limestone at 518 and 525 ft	90	543
Dundee (Corniferous) limestone:		
Limestone (lower)	125	668

THE STOCK WELLS.

Loc.: S. ½, N. W. ¼, sec. 9, T. 6 N., R. 17.

Elevation 605 ft. A. T.	Thickness, feet.	Depth, feet.
Surface:		
Blue clay	100	100
Antrim:		
Black shale	87	187
Traverse (Hamilton):		
Limestone (''top lime'')	43	230
Soapstone, soft	70	300
Limestone (''middle lime'')	15	315
Slate or shale, dark	85	400
Soapstone	120	520
Dundee (''Lower lime''):		
Limestone, sandy, oil bearing	47	567
Limestone	33	600

GRAND TRUNK JUNCTION WELL.

Loc.: At Grand Trunk Junction near the N. E. corner, sec. 18, T. 6 N., R. 17 E.

Elevation 618 ft. A. T.	Thickness, feet.	Depth, feet.
Surface	124	124
Antrim shale:		
Black shale, small amount of gas at 300 ft	183	307
Traverse (Hamilton) formation:		
Limestone (top)	128	435
Soapstone	77	512
Limestone (middle)	8	520
Soapstone	105	625
Dundee (Corniferous) limestone:		
Limestone (lower)	147	772

WELL'S BORE HOLE.

Loc.: On bank of Black River near Seventh St. bridge, Port Huron. F. L. Wells, owner. Drilled in 1886-7. Record from samples.

Elevation 585 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Surface, mostly clay	102	102
Antrim:		
Black slate and shale	83	185
Traverse:		
Limestone (top)	105	290
Soapstone with seams of limestones	225	515
Limestone (middle)	.....	.....
Soapstone	.....	.....
Dundee:		
Limestone (lower) cherty at top with show of oil and gas	133	648
Monroe:		
Dolomitic limestone with indications of salt and gypsum	68	716
Marl and marly limestone	54	770
Hard dolomitic limestone	75	845
Bluish black marl with gypsum	58	903
Hard dolomitic limestone with show of brine and oil	42	945
Argillaceous marl with streaks of dolomitic limestone and gypsum	205	1150
Hard gray calcareous sandstone. (Oriskany?)	95	1245
Bluish black argillaceous marl	10	1255
Dolomite and gypsum	300	1555
Alternating beds of salt limestone and shale	130	1685

PORT HURON SALT CO. WELL.

Elevation about 600 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Glacial drift	110	110
Antrim shale:		
Black bituminous shale; no effervescence	190	300
Traverse (Hamilton) Formation:		
Bluish gray dolomitic limestone; slight eff	15	315
Mixed bluish and gray dolomitic limestone, probably thin bedded; eff. brisk in spots, owing perhaps to fossils	50	365
Bluish calcareous shale somewhat plastic; eff. free	70	435
Even more shaly and plastic; dark rather than blue, yet not as dark as the Antrim	135	570
Dundee (Corniferous) limestone:		
Light brown, limestone sharp, clear fragments; eff. very slow	30	600
Brownish, more granular; eff. fierce	50	650
Similar, with a little darker shaly matter, perhaps accidental	20	670
Same; with a sandy granular character, probably more porous	5	675
Same; eff. fierce	50	725
Almost similar, but a shade darker; no eff	45	70
Similar; slight to slow eff	25	795
Upper Monroe or Detroit River Series:		
Dolomite in light buff chips and white grains of anhydrite	20	815
Dark brown and granular; moderate eff	40	55
Mainly similar to previous samples, but with a few white specks of gypsum as the same is damp, it may have been altered from anhydrite	15	870
Mainly anhydrite	10	880
Dolomite, no eff	5	885
Dolomite; moderate eff	30	915
Dolomitic limestone evidently highly banded, fragments in pieces sometimes nearly 1 cm square x 1 mm thick at 915 ft.; light buff dolomitic limestone, same hue since 885; no eff	30	945
Brown dolomitic limestone; moderate eff.; somegrains of anhy drite?; no quartz	40	985
Light buff dolomite, brisk eff. a moment only	15	1000
Mixed dark brown and brown bituminous dolomitic limestone; some of the grains eff. moderately, others not at all	5	1005
Dark dolomitic limestone; moderate eff	25	1030
Similar	50	1080
Slightly lighter and with some anhydrite; slight eff	35	1115
Dolomite with a little anhydrite	10	1125
Dolomite with anhydrite, and a gassy smell	25	1150
Dolomite; at first brisk and then slight eff	10	1160
Sylvania?:		
Cherty dolomite; blue gray, oxidizes brown; a few grains eff moderately; many grains of chert	5	1165
Largely a white cherty dolomite	20	1185
Lower Monroe or Bass Island Series:		
Apparently a light buff dolomite	25	1210
Darker dolomitic limestone; moderate eff	5	1215
Light dolomitic limestone; moderate eff. with some anhydrite at 1235 ft.	20	1235
Light dolomitic limestone; moderate eff., rather more than at 1235	10	1245
Darker dolomitic limestone; moderate eff., strong gassy smell	20	1265
Dark, evidently thin bedded dolomite; slight eff	20	1285
Lighter dolomite, moderate eff	15	1300
Slate colored dolomitic limestone; moderately brisk eff	5	1305
Bluish slate colored dolomitic limestone; moderately brisk eff	20	1325
Dark bluish gray, and vari-colored dolomitic limestone: moderate eff.; gassy	20	1345
Dark dolomitic limestone, more granular, less slaty; moderate eff	20	1365
Brownish dolomitic limestone; moderate eff	5	1370
Color about like 1370; very moderate eff	25	1395
Yellow; a very sharp change in color; slow eff	13	1408
Dark slate colored dolomite; very slight eff.; like 1395	8	1416
Dark slaty dolomite; very slightly eff.; like 1395	24	1440
Equally dark, but with more of a brown tone, and white specks; with moderate eff. and greenish and reddish specks	20	1460
Dark slate colored anhydrite; very slight eff	33	1493
Salina:		
Brownish salt	3	1496
Dark, slate colored, with impure salt and anhydrite	6	1502
Salt; while this appears impure and brownish, microscopic examination shows that the impurity is in separate particles, probably derived from the overlying bed	4	1506
Blue and brown dolomitic anhydrite; slow eff. The color of the bands is like that of 1345 to 1395	28	1534

Elevation about 600 ft. A. T.	Thickness, feet.	Depth, feet.
Gray salt	10	1544
Like 1534; slight eff	35	1579
Brown salt at 1574 ft. Buff dolomitic anhydrite; slow eff.; color about like 1408, nearly white to light buff	4	1583
Bluish gray slaty anhydrite, one large piece; no eff	17	1600
Salt, white; anhydrite mixed in from above	15	1615
Brownish salt; mixed with anhydrite	14	1629
Clear white, coarsely crystalline salt	11	1640
White and brown salt	26	1666
Dark gray slate colored anhydrite; color same as at 1345 ft	29	1695
Clear white salt; specks of gray anhydrite probably from the overlying bed	5	1700
Brownish, impure salt	25	1725
Grayish salt with bands of anhydrite	10	1735
Dark gray salt and anhydrite	25	1760
Varicolored dolomite, green, reddish and buff grains, which effervesce slowly	20	1780
Varicolored dolomite; slow eff.; shaly and with anhydrite	25	1805
Buff dolomite; rather a dark buff in thin chips indicating original banding; some dark grains mixed in	20	1825
Slate colored salt and anhydrite	30	1855
Clear white salt	5	1860
Buff dolomite; slow eff.; with large pieces (1 cm) of a green slate with anhydrite	10	1870
Nearly clear salt	5	1875
Mixed green, reddish and colorless salt, anhydrite	10	1885
Gritty clay, plastic when wet, no eff	30	1915
Slate colored anhydrite, about color of 1345; no eff.; some clay	5	1920
Nearly clear white salt; partly gray	62	1982
Salt and anhydrite	.....	2013
Gray salt with anhydrite	.....	2022
Dark gray anhydrite, color of 1345	.....	2027
Gray salt with anhydrite	.....	2044
Gray salt with anhydrite	.....	2048
Impure dolomite; slow eff. Varicolored	.....	2260

There are many typographical errors in the depths as given for the samples from 2012 to 2044 ft.

THE FAIR WELL.

Loc.: Three-fourths mile southeast of Wadham's station, S. E. ¼, sec. 2, T. 6. N., R. 16 E.

Elevation about 655 ft. A. T.	Thickness, feet.	Depth, feet.
Surface:		
Gravel		
Blue clay	4	4
Antrim:		
Black shale	110	114
Traverse (Hamilton) Formation:		
Limestone (top)	122	236
Soapstone	230	466
Limestone (middle)	105	271
Soapstone	45	616
Dundee (Corniferous) limestone:		
Limestone (lower)	95	711
	122	833

MARYSVILLE WELL.

Loc.: Four miles south of Port Huron on the Binic farm. Drilled by Church & Company.

Elevation about 600 ft. A. T.	Thickness, feet.	Depth, feet.
Surface, or Pleistocene:		
Clay		
Gravel (dry)	107	107
Antrim shale:	3	110
Dark blue shale, streaks of black		
Traverse (Hamilton) Formation:	188	298
Gray limestone		
Argillaceous marl thinly laminated and fissile	97	398
Dundee (Corniferous) limestone:	193	588
Sandy limestone, porous, indications of gas		
Limestone, gray (Upper Monroe in part)	37	625
Monroe Formation:	390	1015
Limestone, sandy (Sylvania?)		
Limestone, dark gray, hard in places	80	1095
	55	1150

BEARD'S WELL.

Loc.: Abbottsford, near S. E. corner sec. 8, T. 7 N., R. 16 E. F. A. Beard farm. Drilled by G. B. Stock.

Elevation about 655 ft. A. T.	Thickness, feet.	Depth, feet.
Surface:		
Marly clay	30	30
Tough blue clay	86	116
Wash gravel	22	138
Antrim:		
Black shale (heavy flow of mineral water at 140 ft.)	100	238
Traverse (Hamilton) Formation:		
Limestone (top)	217	455
Soapstone	122	577
Limestone (middle)	4	581
Soapstone (brine at 587 ft.)	156	737
Dundee (Corniferous) limestone:		
Limestone (lower); slight flow of oil at 813 ft	96	833

VALLEY CENTER WELL.

Loc.: S. E. ¼, N. E. ¼, sec. 27, T. 9 N., R. 13 E.

Elevation 805 ft. A. T.	Thickness, feet.	Depth, feet.
Surface:		
Red sand and loam	5	5
Quicksand	90	95
Clay	22	117
Sand and gravel with plenty of pure water	32	149
Coldwater shale:		
Sandstone	5	154
"Conglomerate"	20	174
Sandstone	30	204
(This sandstone and conglomerate may be the Richmondville or another stray sandstone horizon at some distance above the base of the Coldwater.)		
Slate (blue shale)	10	214
Soapstone	175	389
Slate (shale)	150	539
Berea sandstone:		
Limestone	10	549
Sandstone	20	569
Antrim shale:		
Shale changing to soapstone below	272	841
Traverse (Hamilton) Format on:		
Limestone	35	876

IMLAY CITY WELL.

Walker & Co., owners. Record from driller's notes and from samples.

Elevation 830 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Red sand	11	11
Quicksand (mostly)	60	71
Hardpan	4	75
Gravel	16	91
Lower Marshall? and Coldwater:		
Blue argillaceous shale; quite soft and somewhat calcareous	19	110
Blue shale. (no samples)	80	190
Flow of fresh water at 190 ft.		
Red shale (no sample)	8	198
Light gray argillaceous shale, very sandy. Under microscope about equal parts of somewhat rounded grains of sand and of clay; sand 1-500 in. in diameter	202	400
Light bluish gray argillaceous shale, almost gritless	30	430
Very sandy argillaceous shale, light gray, almost gritless. A few partly rounded grains of sand 1-1000 in in diameter	90	520
Argillaceous shale, light bluish gray, almost gritless. A few partly rounded grains of sand 1-1000 in. in diameter	75	595
Limestone	7	602
Argillaceous shale, light gray; few very minute shale grains at 602 ft.		
Argillaceous shale, light gray	28	630
Argillaceous shale, bluish gray, gritless	20	650
Argillaceous shale, bluish gray	20	670
Argillaceous shale, grayish drab	40	710
Weak brine at 708 ft.		
Argillaceous shale, dark gray	30	740
Argillaceous shale, very dark drab, gritless	15	755
Argillaceous shale, gray	15	770
Argillaceous shale, dark blue	12	782
Argillaceous shale, dark blue, gritless	8	790
Sandstone	10	800
Argillaceous shale, light blue, somewhat sandy	5	805
Argillaceous shale, light blue, gritless	9	814
Argillaceous shale, light blue	51	865
Argillaceous shale, dark bluish drab, somewhat slaty, hard	10	875
Argillaceous shale, light bluish, soft	25	900
Argillaceous shale, light bluish, gritless, soft	15	915
Argillaceous shale, dark blue, gritless soft	10	925
Argillaceous shale, light blue, gritless soft	35	960
Argillaceous shale, gritless, soft	15	975
Argillaceous shale, gritless, soft, light blue	10	985
Argillaceous shale, light blue, gritless, soft	25	1010
Argillaceous shale, dark bluish drab, slaty and rather hard and gritless	5	1015
Reddish shale	5	1020

SHAW WELL.

Loc.: Fort Gratiot Twp., S. E. ¼, sec. 8, T. 7 N., R. 17 E.

Elevation about 600 ft. A. T.	Thickness, feet.	Depth, feet.
Surface:		
Sand and gravel	5	5
Purple clay or mud	30	35
Gravel	3	38
Blue clay	79	117
Antrim shale:		
Black shale	45	162
Traverse (Hamilton) Formation:		
Limestone	203	365
Soapstone	95	460
Limestone (middle)	15	475
Soapstone	65	540
Dundee limestone:		
Limestone (lower)	115	655

SWEITZER WELL.

Loc.: Fort Gratiot Twp., S. W. ¼, sec. 33, T. 7 N., R. 17 E.

Elevation about 610 ft. A. T.	Thickness, feet.	Depth, feet.
Surface:		
Soil and sand	5	5
Clay	100	105
Hard pan and marl	15	120
Antrim shale:		
Black shale	100	220
Traverse Formation:		
Limestone, white with thin strata of soapstone	60	280
Soapstone	278	558
Dundee (Corniferous) limestone:		
Limestone (lower)	62	620

GEOLOGICAL COLUMN IN HURON COUNTY.

	Thickness, feet.
Surface:	
Lake sands, clays and till	0–50
Saginaw Coal Measures (Present only in extreme southwestern part of county):	
Black, white and blue shales, coal and sandstone	75
Maxville limestone (Present along western shore):	
Sandy yellow limestone, crossbedded sandstone and a little dolomite	50
Michigan Series (Present in western quarter only):	
Light gray shale with gypsum and pyrite; salty bluish shales; argillaceous hydraulic limestones	230
Napoleon or Upper Marshall (Absent from most of eastern half):	
Clean white sandstone, sometimes with an olive tint or brown from specks of pyrite	300
Lower Marshall (Absent along eastern margin of county):	
Flags and sandstones, green weathering red, with beds of blue micaceous shale, white sandstone, nodules of iron carbonate, and thin seams of "peanut" conglomerate	260
Coldwater shales:	
Blue shales with sandy streaks, often ripple-marked, frequently charged with carbonate of iron	896
Sunbury (Berea) shale:	
Black shales	75
Antrim shale:	
Black shales	456
Traverse (Hamilton) Formation:	
Limestones and shales with black Bell (Marcellus) shales at the base	615
Dundee (Corniferous) limestone:	
Limestones locally bituminous; water bearing near the base	120
Monroe (including the Salina):	
Dolomites, anhydrite, shales and salt beds; dolomites heavily water bearing at several horizons	1200 +
Niagara (Guelph and Lockport):	
Dolomites with some limestone and shale and occasional sandstone lenses; water bearing expecially at some distance below the top; yields oil in Ontario	400
Rochester, Clinton, Medina, and Lorraine shales:	
Mainly shales, red green, and black and locally sandy down to the heavy blue shales of the Lorraine	700
Utica shale:	
Black and bituminous shales	50
Trenton limestone:	
Dolomites and limestone with oil horizons near the top and water farther down	300 +

GENERALIZED SECTION FOR SANILAC COUNTY.

	Thickness, feet.
Pleistocene or glacial drift:	
Sand, clay and till	0–200
Lower Marshall (absent in eastern and southern part of county):	
Sandstone and "grindstones"	60–100
Coldwater shales:	
Blue shales	100–200
Sandstone (Richmondville)	50–80
Blue shales	200–250
Black shales (Sunbury)	50–150
Berea sandstone	30–50
Antrim shale:	
Darker below	100–150
Traverse (Hamilton) Formation:	
Blue calcareous shales and limestones frequently dolomitic	100–150
Dundee limestone	125 +
Monroe Formation including Salina:	
Dolomite, calcareous and argillaceous marls, anhydrite and rock salt	800 +

THE FOLLOWING TABLE GIVES A NUMBER OF THE SHALE GAS WELLS OF MICHIGAN, THE OWNERS, LOCATIONS AND PRESSURES OF THE WELLS AND THE ROCK FORMATIONS IMMEDIATELY BENEATH THE DRIFT.

Owner.	County.	Township and range.	Depth.	Pressure lbs. per sq. in.	Rock formations below.
C. L. Rowe, Buelah	Benzie	N. E. ¼ of Sec. 28, T. 26 N., R. 15 W	205	?	Antrim.
Franz Elwart, Warren	Macomb		69	?	Antrim.
Wm. H. Hanekow, Warren	Macomb		72	?	Antrim.
Wm. L. Hartsig, Warren	Macomb		90	72	Antrim.
Otto Jacob, Warren	Macomb	Sec. 20, Warren Twp	60	?	Antrim.
August Mielke, Warren	Macomb		98		Antrim.
A. R. Peters, Warren	Macomb		93	45	Antrim.
Alex. Smith, Warren	Macomb		71	?	Antrim.
Henry Vohs, Warren	Macomb		50	?	Antrim.
Max Wolgast, Warren	Macomb	Sec. 18, Warren Twp	68	25	Antrim.
Jno. Dobberowsky, Grosse Point Farm, Warren	Macomb		?	25	Antrim.
H. W. Leonard, Onekama	Manistee	Sec. 22, Onekama Twp	437	185	Antrim.
Robt. Jackson, Ravenna	Muskegon		?	?	Coldwater.
Louis Granzow, Royal Oak	Oakland		108	39	Antrim.
Frank Grosjean, Southfield	Oakland		105	?	Berea or Sunbury.
Wm. Hilzinger, Royal Oak	Oakland	Sec. 22, Royal Oak Twp	115	39	Antrim.
Edw. Landau, Royal Oak	Oakland		95	?	Antrim.
Henry Langer, Royal Oak	Oakland		102	43	Antrim.
E. McHugh, Redford	Oakland	Southfield Twp	Well exhausted.	20	Berea or Sunbury.
Wm. J. Purdy, Redford	Oakland	Sec. 24, Southfield Twp	105	Weak now.	Berea or Sunbury.
E. A. Starr, Royal Oak	Oakland	N. E. ¼, Sec. 8, T 1 N., R. 8 E.	?	?	Berea.
N. E. Springsteen, Royal Oak	Oakland	Sec. 9, T. 1, N. R. 11 E	116	Gas with water.	Antrim or Berea.
Frank Parmenter, Royal Oak	Oakland	Royal Oak Twp	108	¼	Antrim.
M. J. & L. J. Harrow, Algonac	St. Clair		300	16	Antrim.
H. E. Harman Willis	Washtenaw	Sec. 26, Augusta	65	10	Antrim.
Irving Becker, Detroit	Wayne	Redford Twp	65	?	Antrim.
Jno. Desgrandchamp, North Detroit	Wayne		122	Exhausted now.	Antrim or Traverse.

MOORE WELL.

Loc.: Monroe, Monroe County. Record from samples.

Elevation 585 ft. A. T.	Thickness, feet.	Depth, feet.
Surface	40	40
Lower Monroe:		
Bluish shale, with only a small amount of eff. calcareous matter	5	45
Bluish shaly dolomite, with quite a little slowly eff. matter, and a large residue in lower part	35	80
Yellowish limestone, briskly effervescing	230	310
Here and at 35,500 and 650 ft., samples of a white earthy powder of calcite and dolomite, with a trace of gypsum (probably a chemical precipitate from underground water.)		
Water, 3000 gallons per hour between 280 and 297 ft.		
Dolomite at 340 ft.; effervesces slowly when in fine powder; contains much anhydrite of a dark buff color	170	480
Buff dolomite at 450 ft. like the sample above, eff. moderately fast, with an occasional fragment of the green shale, little or no sulphate of lime.		
Light colored dolomite	200	680
Eff. moderately at 500 ft. with much anhydrite.		
Eff. slowly at 500 and 650 ft.; an occasional grain of sand; no anhydrite.		
Light gray dolomite; eff. slowly; reacts for gypsum	20	700
Niagara—Guelph and Lockport:		
Light yellowish to bluish gray dolomite; eff. slowly; quite ferruginous, no gypsum	130	830
White arenaceous dolomite; eff. slowly; with grains of quartz, sand and a very little magnetite	70	900
Gray dolomite, eff. slowly with a trace of quartz. Last limestone before shale	160	1060
Rochester, Medina?		
Greenish and reddish shales, eff. slightly; mostly clay	90	1150
Lorraine or Maysville:		
Bluish gray, somewhat ferruginous shales, slight eff	420	1570
With minute granules of quarts at 1400 ft.		
Green and red ferruginous shales, slightly eff. with a trace of magnetite. (Particles of the drill?)	85	1655
Utica:		
Next above Trenton, black bituminous shale, eff. slightly, fusing with an aromatic odor and intumescence to a blebby enamel; a little finely divided quartz	80	1735
Trenton:		
First screw, buff colored dolomite; hard, with slow eff. At 1742 gas, odorless, with white flame; considerable salt water?		
Third, fourth, fifth and sixth screws in Trenton, buff colored limestones	15	1750

LASALLE* WELL.

Loc.: Gadfry Saul Farm, LaSalle, Monroe county. Owners, Bengood Oil Co., Fostoria Michigan. Drilled in 1914 by Schrier & Kerr, Lancaster, O. Record furnished by Geo. T. Bench, Fostoria, Michigan. Reported by H. L. Osborne.

Elevation between 590 and 600 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Drift	40	40
Drive pipe 40 ft.		
Lower Monroe or Bass Island Series:		
Hard gray lime (dolomite).		
Small stream of water at 50 ft., large at 100 ft	260	300
White lime (dolomite)	60	360
Gray lime (dolomite)	30	390
Niagara (Guelph and Lockport):		
White lime	490	880
Rochester shale and Clinton?		
Blue shale and shells	165	1045
8 inch casing to 885 ft.		
Richmond and Medina:		
Red rock	45	1090
Gray shell	10	1100
Pink rock	50	1150
Lorraine or Maysville shales:		
Gray shell	325	1475
Utica shale:		
Brown shale	160	1635
Trenton rock (Trenton, Birdseye and Chazy?)	850	2485
Little salt water at 2485 ft.		
St. Peters? sandstone:		
White sandstone	31	2516
"Big salt" water at 2510 ft.		

* Record received as this report went to press.

STRASBURG OIL & GAS CO. WELL NO. 1.

Loc.: Hansberger farm, Monroe county. J. P. Harnden, Driller, 1907.

Elevation 625 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene drift:		
Soil, sandy loam, light clay and gravel	18	18
Lower Monroe (below Sylvania) Bass Island Series:		
Raisin river and Put-in-Bay dolomites	357	375
300–375, hard with moderate eff.		
Water at 25 ft.		
Water at 45 ft. 10 gallons a minute.		
Flow at 68 ft. 160 gallons a minute.		
Flow at 345 ft. 240 gallons a minute.		
Tymochtee shale horizon:		
Dolomite and gypsum or anhydrite	20	395
375-385, hard, moderate eff. A little anhydrite.		
385-395 with anhydrite and much gypsum. Slow eff.		
Greenfield dolomite. Dolomitic limestone	90	485
395-415, a lutite.		
455-485, the upper samples not so hard; the rest pure, light colored, hard, massive, dolomitic limestone with moderate eff., except the last which contains blue shale and grit as well as dolomite.		
Cased well to 485 feet—no water.		
Anhydrite, hard blue shale and dolomite, a little anhydrite, which may have come from layer below?	55	540
485-510 "Hard" blue shale, almost no eff.		
510-540, "Hard," moderate eff.		
Salina Horizon?		
Anhydrite	20	565
540-565, slow eff., under the microscope mainly anhydrite, light brownish.		
Dolomite mainly, all "hard"	35	600
565-585, slow eff. A little anhydrite which may have dropped in from above.		
Anhydrite	25	625
600-625, moderate eff., "a little water at this depth;" under the microscope, gypsum as well as anhydrite, the former probably produced from the latter by water, as the bed is reported "hard."		
Dolomite (with water)	65	690
625-655, is a brown sandy looking kind of dolomite that often occurs near water course, but there is really only about 1 per cent sand. Compare Morton well, Wyandotte, 230-240, 410, 460, 720 and 780 ft.		
655-690, is also dark and "very hard," more water, filled within 200 ft. of the top, pulled casing, sample of water taken.		
Somewhere from here down should be put the base of the Monroe and Salina and the top of the Niagara or Guelph, the brown sandy looking oily dolomites which occur in this well between 625 ft. and 900 ft. being represented at—		
Wyandotte, between 1235 ft. and 1510 ft.		
Dundee, between 618 ft. and 1193 ft.		
Nogard well, between 569 ft. and 1420 ft.		
Britton, between 1200 and 1550. ft.		
Milan, between 1400 ft to 1540 ft.		
With rock salt at the bottom.		
Monroe, from 500 down.		
Cheboygan, from 1460 down.		
Niagara (Guelph and Lockport):		
Brown dolomite	110	800
690-695, brownish, sandy, "dry, no water," crystalline enough for Guelph.		
695-800, dolomitic limestones with moderate (at 775 ft.) eff. and bluish light colors.		
Light dolomitic limestone	20	820
800-820, is light colored with brisk eff. and under the microscope a clear limestone.		
Brown dolomite	80	900
820-900 are "very hard," brown, sandy looking, almost exclusively carbonate with slow to moderate eff.		
Compare Nogard "oil limestone" at 1269-1420 ft.		
Wyandotte, 1475-1510 ft.		
White dolomitic limestone (Guelph)	200	1100
900-950 "softer," is white, with moderate eff.		
950-1100 is very white, slow eff., the typical "Guelph," western Niagara or Manitoulin dolomite.		

Elevation about 600 ft. A. T.	Thickness, feet.	Depth, feet.
Compare: Monroe, 850-900 ft. Dundee, 1208-1343 ft. Nogard, 1420-1520 ft. Britton, 1550-1643 + ft. Riga, 1165-1275 ft. Wyandotte, to 1860 ft. Kalamazoo, 1730-1875 ft.		
Rochester shale?	70	1170
1100-1140 "no sample saved." 1140-1170 "was broke or mud." 1170-1180 is impure mixed with greenish and rusty brownish fragments of limestone; eff. moderate to brisk, with marked iron stain. This is properly a part of the Clinton but seems to have some of the overlying shale mixed with it, and an unconformity may well be suspected here. Compare: Monroe, 1110 ft. Wyandotte, 1870 ft. Swan, Grosse Isle well, 1400-1500?		
Clinton	130	1300
Ferruginous dolomite and limestone: Ferruginous dolomite 10 ft., 1180 ft. Described above. Swan, Grosse Isle at 1550 ft., is similar. 1180-1230, eff. slow to moderate; pink. 1230-1300, dark, moderate eff. 1300, white dolomitic limestone, brisk eff. "No sample saved, was very red in color and soft shale. We call it 'red rock' in Ohio oil fields, always found just below Clinton lime."		
Clinton Iron Ore, Medina and Richmond Shales	40	1340
This band of red rock marks the base of the Silurian and the top of the Ordovician. As no sample has been preserved it is impossible, and probably would be so anyway to subdivide it, and it is a matter of taste whether it is to be reckoned with the one or the other. It may be correlated with— Monroe, 1110 ft. Dundee, 1563-1623 ft. Nogard, 1640 ft. Wyandotte, somewhere between 1890 and 2200 ft., probably about 2100 ft. Cheboygan, 2265-2407 ft.		
Lorraine or Maysville shales	320	1660
1340-1660 ft., all the same bluish slightly greenish shale, not eff.		
Utica (Eden) shales	224	1884
1660-1700 ft., slight eff., dark shale. 1700-1800 ft., similar. 1800-1884 ft., no eff., yet darker bituminous shales. These Lorraine and Utica shales appear above the Trenton in all the wells cited below. Probably the lower part above is the typical Utica of most wells, i. e., Strasburg, 1880-1884 ft., with Pickford 475-525 ft.		
Trenton limestone	105	1989
Limestone: 1884, "Top of Trenton rock; hard." Moderate eff. 1884-1890, "Top of Trenton rock; hard." Moderate to brisk eff. The dolomitization of the Trenton is confined to the very top. 1890-1937 ft., all effervesce freely and are a mixed pepper and salt in color. At 1937-1950 ft. is noted "a very light showing of oil and gas." The well was shot with 200 quarts of nitroglycerine. The top of the Trenton corresponds well with: Monroe, 1734 ft., with 80 ft. of black shale above. Dundee, 2133 ft., with 300? ft. of black shale above. Nogard, 2150 ft., with 200? ft. of black shale above. Wyandotte, 2610 ft. Note that it changes to limestone in about 10 feet also at Monroe, and the gas is a few feet down. The black shales also appear above, but the thickness assigned is very irregular.		

NOGARD WELL.

Loc.: In the Nogard (Macon or Christiancy) quarry, N. W. ¼, N. W. ¼, sec. 8, T. 6 S, R. 7 E.

Elevation 660 ft. A. T.	Thickness, feet.	Depth, feet.
Dundee and Monroe:		
Gray limestone	59	59
Monroe (including Salina) and Lower Dundee?		
Buff and white limestone	100	159
Blue limestone	150	309
Buff and blue limestone	260	569
Oil limestone	100	669
Buff limestone and brown marble	600	1269
Oil limestone	151	1420
Niagara:		
Snow white marble	100	1520
Red, white and blue marble	400	1920
Medina:		
Shale	30	1950
Utica:		
Gray, black and brown slate	200	2150
Trentone limestone:		

DUNDEE WELL.

Loc.: A. Wilkenson farm 1 mile south of village, N. E. ¼, N. E. ¼ sec. 25, T. 6 S. R. 6. E.

Elevation 680 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene or surface:		
Quicksand	8	8
Clay	30	38
Dundee and Upper Monroe?:		
Gray oil limestone	65	103
Upper Monroe or Detroit River Series:		
Sulphur limestone	70	173
Dark limestone	20	193
Fine gray sandstone, (Sylvania?) gas	12	205
Blue gray limestone	30	235
Sylvania:		
Gray sandstone	18	253
Fine limestone	105	358
Hard shell limestone	40	398
White sandstone	7	405
Lower Monroe or Bass Island Series:		
Dark limestone	48	453
Hard shell limestone	45	498
White putty limestone	70	568
White putty limestone, very hard	50	618
Buff limestone	220	838
Alternating blue, gray and brown limestone	315	1153
Fine buff limestone	10	1163
Gray limestone	7	1170
Buff limestone	23	1193
Niagara:		
Guelph dolomite—		
Light gray marble	15	1208
Snow white marble	135	1343
Lockport limestone:		
Dark blue marble	80	1423
Red marble	15	1438
Pinkish gray marble	35	1473
Rochester shale:		
Blue slate	30	1503
Clinton:		
Gray limestone (mineral water)	60	1563
Medina:		
Red slate	60	1623
Lorraine (Hudson River) or Maysville:		
Gray slate	100	1723
Blue slate	110	1833
Utica shale:		
Brown slate	300	2133
Trenton limestone	144 +	2277

MILAN WELL.

Loc.: At Milan a few rods south of the Washtenaw-Monroe county line. Depth, 1643 ft.

Elevation 685 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene or surface:		
Clay, quicksand about 60 ft. and clay	130	130
Traverse:		
Cherty limestone	30	160
Blue shale	45	205
Blue shaly limestone	65	270
Limestone (fissure?)	28	298
The top of the Dundee cannot be clearly made out owing to the caving. It is surely somewhere between 165 and 298 ft , more probably at or near the latter figure.		
Dundee:		
Limestone quite fine, H_2S water (brecciated and caving)	97	395
Upper Monroe or Detroit River Series:		
Dolomite acicular, caving to 425 ft	30	425
Dolomite sandy	10	435
Dolomite with gypsum	20	455
Gypsum, mainly	80	535
Sylvania or Middle Monroe:		
Sandstones, pebbly at 820	288	823
Lower Monroe or Bass Island Series:		
Various veins of water, calcareous shale	7	830
Dark oily dolomite, more sulphuretted water	15	845
Cherty dolomite	45	890
Blue with mineralized water at 890 ft.		
With some black specks mixed	100	990
Blue clay shale	5	995
(Compare Britton 1015 ft.).		
Dolomite	30	1025
Salina?		
Anhydrite	75	1100
Dolomite	110	1210
Anhydrite	90	1300
Red, then blue shale	100?	1400
Brown, oily dolomite, fine, laminated	75	1475
Dolomite	65	1540
Rock salt	5	1545
Niagara?:		
Dolomite	98	1643

NEWPORT WELL.

Loc.: N. E. ¼, S. W. ¼, sec. 1, T. 6 S., R. 9 E. Depth 910 ft.

Elevation 585± ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene or Surface:		
Rusty pebbly clay	3	3
Lower Monroe. (Salina not separated off):		
Drab dolomite, considerable muddy residue. Fragments of calcite, and considerable anhydrite	80	83
Light drab dolomite, with dark shaly fragments. Considerable muddy residue. Anhydrite and sand grains present	10	93
Samples not saved	72	165
Dark dolomite with carbonaceous flakes, which burn with flame. Brisk effervescence. Anhydrite and sand grains present	30	195
Bluish-drab dolomite. Anhydrite is present. Flow of fresh water from 195 to 220 ft.	52	247
Samples wanting	58	305
Bluish gray dolomite, carrying anhydrite and some selenite. Much muddy residue. Further flow of fresh water	10	315
Bluish gray, argillaceous dolomite. Some anhydrite present throughout	57	372
Buff dolomite with much yellow residue. The insoluble portion contains numerous rounded grains of quartz, some horn-blende and some black non-magnetic grains, which are probably some form of titanic iron oxide. Anhydrite	48	420
Bluish dolomite. Drillings are coarse. Lumps of anhydrite with fragments of dolomite	15	435
Quite similar to the bed 372 to 420 ft. Drillings are fine and looser as contrasted with the beds just above and just below. Much anhydrite is present	13	448
Practically identical with bed 420 to 435 ft. A bluish dolomite, drillings coarse. Anhydrite present in lumps	19	467
Bluish, dolomitic shale. Slow eff. Much bluish, muddy sediment. Some anhydrite	33	500
Bluish drab, argillaceous dolomite. Lumps of anhydrite and black flakes	20	520
Bluish, dolomitic shale, essentially similar to that occurring from 467 to 500 ft. Fragments of anhydrite with shale	40	560
Blue and drab dolomite. Drillings fine. Fragments of anhydrite	38	598
Drab to gray dolomite. Anhydrite and some sand grains. Lower portion of bed is more impure	17	615
Drab to gray dolomite, with varying amounts of anhydrite	105	720
The fine samples from this bed are all alike and more buffish than those from above bed. The rock is a dolomite also, containing seams of carbonaceous matter, fragments of anhydrite and scales of selenite. For some reason, the rusty iron grains are exceedingly abundant in all samples. (Rusted fragments of steel from drill?)	95	815
Drillings have a gray color and under the magnifier look much like pure anhydrite. Slow eff. The rusty grains are not quite so abundant, but are numerous	10	825
The drillings from this bed are a purer white than above. Little eff. Much anhydrite	8	833
Gray to drab dolomite with fragments of anhydrite and scales of selenite	11	844
Samples missing	16	860
Bluish gray dolomite. Drillings relatively coarse containing bluish flakes and fragments of anhydrite	50	910

LENNARD WELL.

Loc.: Near swinging bridge over Huron river, South Rockwood.

	Thickness, feet.	Depth, feet.
Surface	30	30
Sylvania?:		
White sand	30	60
Black	30	90
Record missing from 90-950 feet,		
Sand	100	1050
Lime	80	1130
Sand	155	1285
Clinton?		
Red rock (Cf. Strasburg 1300-1340 ft. or 1140-1170, which is 584 ft. above Trenton.)	10	1295
Lorraine and Utica:		
Slate	45	1340
Sand, water	65	1405
Shale	.....	2045
Dark at bottom. Smell.		
Trenton at 2430 ft.		

ADRIAN GAS CO. WELL.

Loc.: Adrian. No samples.

Elevation 810 ft. A. T.	Thickness, feet.	Depth, feet.
Pleistocene:		
Surface	20	20
Quicksand	18	38
Gravel	60	98
Gravel and quicksand	82	180
Coldwater shales:		
Sandstone, light gray	4	184
Soft white "slate" or sandstone	330	514
Sunbury (Berea):		
Brown "slate" (shale)	40	554
Berea:		
Gray sandstone	30	584
Antrim:		
Brown "slate"	80	664
Brown shale	141	805
Traverse (Hamilton) Formation:		
Mineral water at 805 ft.		
Reddish hard limestone. (Mouth of driving pipe 180 ft.; casing to 500, then the second time to 885 ft.)	80	885
Black slate or shale. Regular limestone at 900 ft	15	900
Dundee (Corniferous) and Monroe:		
Limestone, hard, dark drab to gray	750	1650 +
Sulphur water at 940, brine at 1135 and 1520 ft.		
Lorraine:		
Slate rock, white and soft (or anhydrite?)		

BRITTON WELL.

Elevation 705 ft. A. T. (Approx.)	Thickness, feet.	Depth, feet.
Pleistocene:		
Surface clay and gravel	93	93
Antrim shale:		
Black shales	67	160
Pyritiferous gray shale	15	175
Pyritiferous black shale	35	210
Traverse Group:		
Cherty dolomite	25	235
Green shale	30	265
Cherty dolomite	40	305
Blue calcareous shale	95	400
Dundee (Corniferous, Onondaga) limestone:		
White or brownish crinoidal limestone with water and traces of oil and gas	100	500
Upper Monroe or Detroit River series:		
Gypsiferous dolomite	75	575
Gypsum (Anhydrite)	50	625
Dolomite	50	675
Dolomitic limestone	33	708
Dark cherty dolomite	37	745
The same, bluer	5	750
Sylvania:		
Dolomitic sandstone	25	775
Gypsiferous dolomites	50	825
The same with a little chert and sand	75	900
Dolomitic sandstone, salt water	100	1000
Shale	15	1015
Casing to 1012 or 1015 ft.		
Dolomite, dark blue at 1180 ft.	485	1500
Rope black, and H_2S at 1200, where there is a slow very salt seepage. There was said to be 30 ft. of brown oily dolomite at 1400 ft.?		
Dark brown oily dolomite	50	1550
Niagara:		
Light white sugary dolomite, typical Guelph	84	1634
Mineral water at 1600 ft.		

BLISSFIELD WELL.

Loc.: Sec. 30, T. 7 S., R. 5 E.

	Thickness, feet.	Depth, feet.
Drift	100	100
Gravel; water rose and filled first 8 inch casing	20	120
First limestone about [to ? dark slate and black water]	300	420
Water in limerock at 1600 ft.		
Struck Trenton at 2342 ft.		
Trenton rock	60	2402

MANCHESTER WELL.

(U. S. Geological Survey Well No. 25).

Loc.: Six miles southeast of Manchester, Washtenaw county. Manchester Oil Co., owners. C. A. Elliot, driller.

Elevation about 830 ft. A. T.	Thickness, feet.	Depth, feet.
Surface	174	174
Coldwater:		
Blue shale	153	327
Berea:		
Horizon of Berea? Red shale	2	329
This red shale clay might represent a weathered surface, or some other zone of special oxidation. The banding upon it is quite distinct. Compare Bedford shales. Compare Hillsdale at 1030-1033, Osseo 800, Adrian, 514.		
Antrim:		
Usual shale	12	341
Black shale. This looks very much like the Ohio black shale, and would seem to indicate that the horizon of the Berea here is at 327-329	11	352
Bluish shale	48	400
Blue shale	90	490
Brown shale	110	600
Compare Hillsdale 1350, Osseo 1145-1214, Adrian 805, Madison Oil and Gas Co. 665.		
Traverse (Hamilton):		
Gray shale; non-eff	60	660
Gray shale; slightly eff	30	690

MADISON OIL AND GAS COMPANY WELL.

Loc.: N. E. ¼ of sec. 15, T. 7 S., R. 3 E.

	Thickness, feet.	Depth, feet.
Pleistocene:		
Sand	20	20
Clay and sand	60	80
"Sand and gravel, dark and light"	115	195
Coldwater:		
Shale, with shaly till? "clay and gravel, dark"	55	250
Blue and light shale, with occasional calcareous streaks	165	415
Gritty shale	15	430
Sunbury shale:		
Black shale	20	450
Berea grit:		
Very fine grained sharp white sandstone or flagstone, salty	50	500
Antrim:		
Bituminous black shale with pyrite	112	612
At 612 to 618 ft. main water, with a trace of illuminating gas. About 14 per cent salts, sulphates low.		
Sandy black shale	53	665
Brown limestone (oily)	15	680
Dark or black shale	20	700
Traverse:		
Brown dolomitic limestone, with white chert	64	764