ADDITIONAL DEEP WELLS

by

JAMES H. LEES

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In addition to the wells, the records of which have been studied and described by Doctor Norton, information regarding a number of wells has been sent to the office of the Geological Survey at Des Moines. These samples were studied by James H. Lees, the Assistant State Geologist. In some cases he was aided by Dr. A. C. Tester, of the State University of Iowa. These wells are described in the following pages. The interpretation of drillers' logs was made by the author.

By far the deepest boring in this list, and also the deepest well in the state, is the oil and gas prospect which was drilled about four miles south of Clarinda. This well was described in part in Volume XXXIII, pp. 137 and 428, and in condensed form in Volume XXXV, p. 548; because of the interest attaching to this well, however, the complete record is given here.

Dallas Center, Dallas County

This well was drilled for the Dallas Center school by F. S. McCutcheon of Des Moines, Iowa, in March 1931. The elevation at the curb is 1,073 feet. The static head stands at 180 feet but draws down to 300 feet when being pumped at 15 gallons per minute. The Kinderhook shale was reached at 800 feet and was penetrated 10 feet. Samples were collected below the Des Moines shales.

Driller's Log	Depth in Feet
Mississippian —	
Limestone, dark gray, crystalline, contains much fine sand	580
Sandstone, dark gray, mingled fine and coarse, some white and reddish quartz, some black fragments of fine sandstone; a little limestone	650
Shale, very dark gray, finely gritty, slightly limy; a little pale bluish chert; bag says "film of oil on shale"	665
Shale, similar to above, quite limy	680
Shale, limy, or limestone, shaly, dark gray, in finely granular chips, action in acid slow but long continued, much fine white siliceous residue	690
Sandstone, dark gray, firmly cemented, fine-grained; also shale, very dark gray, slightly limy, in small amount	695
Sandstone, similar to above, some glassy quartz	700
Sandstone, similar to above, many clear glassy and white grains; some response to acid, indicating presence of lime	710–720
Sandstone, as above, but with large amounts of bluish and white chert; a small perfect crystal of glassy quartz was observed at 730; rather brisk response to acid below 750; several small geodic cavities in	

fragments from 760; a fragment from 770 is deeply etched by acid but retains its firm texture; lighter gray and in smaller chips at 790; much clay at 800; 8 samples 730–800

Eagle Grove, Wright County

This well was drilled for the Chicago & Northwestern Railway Co. It is located 2,200 feet northwest of the passenger station, near the enginehouse. Its depth is 248 feet. It was drilled 12 inches in diameter and is cased with 142 feet of 12-inch steel casing. The water rises within 14 inches of the surface and draws down to 30 inches below curb while pumping 400 gallons per minute. It rises to its former elevation of 14 inches below curb immediately upon stopping the pump. The altitude of the top of this well is approximately 1,126 feet. This well was begun in October 1929 and completed in March 1930; it was drilled by E. C. Archibald of Sioux City.

Driller's Log	Thickness in Feet	Depth in Feet
Pleistocene and Recent:		
Cinders	4	4
Loam, black	2	6
Clay, blue	68	74
Sand and gravel, water	3	77
Clay, blue, sandy	18	95
Sand	5	100
Clay, blue	37	137
Sand	2	139
Mississippian: undifferentiated —		
Limestone	4	143
Limestone, soft, water	2	145
Sandstone	8	153
Rock, solid	6	159
Limestone, hard	8	167
Limestone, soft	3	170
Limestone and clay	3	173
Limestone, hard	3	176
Limestone, soft	24	200
Limestone and sand	3	203
Limestone and clay	2	205
Limestone, hard	38	243
Dakota sandstone, water	5	248

Chemical analysis of water from Eagle Grove well. Lake Michigan water is used as a standard for comparison.

			Eagle Grove	Lake Michigan Water
	Total solid matter	Grains per gallon	25.29	7.78
	This solid matter consists of:			
A	Carbonate of Lime	" " "	13.88	4.46
A	Carbonate of Magnesia	" " "	6.64	2.20
A	Sulphate of Lime	" " "	0.00	0.30
A	Sulphate of Magnesia	" " "	0.00	
A	Oxides of Iron & Aluminum	" " "	0.07	0.02
A	Silica	" " "	0.70	0.30

B	Alkali Chlorides	"	"	"	0.27	0.22
	Alkali Sulphates	"	"	"	2.07	0.28
	Alkali Carbonates	"	"	"	1.66	

A = Incrusting Solids. B = Nonincrusting Solids.
Pounds of incrusting solids in 1,000 gallons of Lake Michigan water — 1.04.
Pounds of incrusting solids in 1,000 gallons of Eagle Grove, Ia., water — 3.04.
This is fair water for boiler use.

(Signed) H. D. BROWN, Engineer of Tests,
Chicago & Northwestern Railway Company.

Estherville, Emmet County

In May 1932 a gravel pack well was drilled for the City of Estherville by Thorpe Bros. Well Co. of Des Moines. Four wells were dug to a depth of 400 feet. The static head stands at 109 feet, with a drawdown of 28 feet when the well pumps 2,045 gallons per minute. Water was first encountered at 260 feet in sandstone, yielding an approximate amount of 4,000 gallons per minute. The well was cased as follows: 323 feet of 20-inch pipe in all four holes to a depth of 323 feet; 249 feet of 8-inch pipe was used in the south hole, 242 feet of 8-inch pipe in the west hole, 239 feet of 8-inch pipe in the north hole, and 237 feet of 6-inch pipe in the east hole. The elevation is approximately 1,290 feet above sea level.

Driller's Log	THICKNESS IN FEET	DEPTH IN FEET
Pleistocene and Recent:		
Black dirt	2	2
Gravel	19	21
Clay, blue	42	63
Clay, yellow	37	100
Clay, blue	12	112
Clay, yellow	35	147
Cretaceous(?):		
Rock	3	150
Clay, blue	24	174
Rock	1	175
Clay, blue	6	181
Clay, brown	9	190
Mississippian:		
Shale, gray	12	202
Shale, brown	9	211
Shale, gray	3	214
Shale, brown	13	227
Limestone	4	231
Shale, gray	12	243
Sandstone	17	260
Sandstone	10	270
Sandstone	11	281
Sand and sandstone	34	315
Sand and shale	3	318
Sandstone	24	342
Rock	1	343
Shale	3	346
Sandstone, hard	54	400

Farnhamville, Calhoun County

This well was drilled by Frank McCutcheon, Des Moines, in June 1932. It was drilled on the site of an older well, 165 feet deep. This well is yielding 35 gallons per minute in daily use.

Driller's Log	Depth in Feet
Old well, all in drift	165
Sand, fine, muddy	198
Shale, black	214
Sandstone	216
Shale, mixed	280
Limestone, broken, with shale	290
Limestone	330
Shale, strip	333
Limestone	405
Limestone, soft streaks	413
Limestone	732
Sandstone, water-bearing	770
Shale	776

Fort Dodge, Webster County, Well No. 9

In August 1931 Well No. 9 for Fort Dodge was completed by Thorpe Bros. Well Co. of Des Moines. The well was drilled to a depth of 269 feet with diameters of 20 and 16 inches. The static level is above surface, and the well yields 1,925 gallons per minute with a draw-down of 89 feet. Water was first encountered at 262 feet in sandstone, the approximate amount being 6 gallons per minute. After Well No. 12 was completed it was the opinion of the driller that Well No. 9 should be drilled down to 541 feet, the same depth as No. 12. The well was cased as follows: 69 feet of 20-inch pipe from the surface to 69 feet; 236 feet of 16-inch pipe from 3 feet above surface to 239 feet; 60 feet of 12-inch pipe from 207 to 267 feet.

Driller's Log	Thickness in Feet	Depth in Feet
Pleistocene and Recent:		
Soil, black and yellow clay	20	20
Gravel, fine, and sand	10	30
Pennsylvanian:		
Shale, blue and black	46	76
Mississippian:		
Limestone	4	80
Limestone, argillaceous	22	102
Shale, black	18	120
Limestone, argillaceous	59	179
Limestone	3	182
Shale, red	24	206
Limestone	5	211
Shale, red	4	215
Limestone	4	219
Shale, green	8	227
Shale, red	6	233

Shale, green	7	240
Limestone	21	261
Sandstone	6	267
Limestone, arenaceous	2	269

Fort Dodge, Webster County, Test Hole

In September 1931 a test hole was dug for the City of Fort Dodge by Thorpe Bros. Well Co. of Des Moines. The depth of the well was 422 feet, and the diameters were from 10 to 6 inches. It was a flowing well with a yield of 200 gallons per minute. Water was first encountered at 254 feet in sandstone. The flow increased about fifty percent from 391 to 410 feet. The well was cased as follows: 18 feet of 10-inch pipe from 1 foot below the surface to 19 feet; 120 feet of 8-inch pipe from surface to 120 feet; 242 feet of 6-inch pipe from 1 foot below surface to 243 feet. The altitude at the curb was 976 feet.

Driller's Log	Thickness in Feet	Depth in Feet
Pleistocene and Recent (21 feet thick; top 976 feet) —		
Black soil	4	4
Gravel to sand	14	18
Hardpan	3	21
Mississippian and Pennsylvanian:		
Clay and shale, blue-black	52	73
Limestone	13	86
Shale, black	34	120
Limestone	3	123
Shale, black	46	169
Limestone	7	176
Shale, red	41	217
Limestone	2	219
Shale, red and green	23	242
Limestone	10	252
Sandstone	12	264
Limestone	79	343
Shale, green	5	348
Limestone	74	422

Fort Dodge, Webster County, Well No. 11

In September 1931 a test hole was drilled for the City of Fort Dodge by Thorpe Bros. Well Co. of Des Moines. The well was drilled to a depth of 530 feet, and the diameters were from 10 to 6 inches. It was a flowing well with a yield of 600 gallons per minute. Water was first encountered at 25 feet in sandstone, with an approximate yield of 3 gallons per minute. Eighty percent of the flow was found between 335 and 525 feet. The well is cased as follows: 28 feet of 10-inch pipe from the surface to 28 feet; 122 feet of 8-inch pipe from the surface to 122 feet; 243 feet of 6-inch pipe from 1½ feet below the surface to 243 feet. The altitude of the curb is about 976 feet.

Driller's Log	Thickness in Feet	Depth in Feet
Pleistocene (60 feet thick; top 976 feet) —		
Clay, black and yellow	12	12
Gravel and sand	12	24
Clay, blue and yellow	16	40
Hardpan	2	42
Clay, blue	18	60
Mississippian:		
Shale, black	16	76
Limestone	3	79
Sandstone, calcareous	11	90
Shale, black to gray	27	117
Limestone, argillaceous	9	126
Shale, calcareous, black and gray	51	177
Limestone	8	185
Shale, gray	4	189
Shale, red	26	215
Limestone	11	226
Shale, red and green	16	242
Limestone	8	250
Sandstone, soft	3	253
Limestone	32	285
Shale, blue	3	288
Limestone	22	310
Limestone, water bearing	35	345
Limestone (samples washed away)	183	528
Limestone, brown	2	530

Fort Dodge, Webster County, Well No. 12

This well was drilled for the city of Fort Dodge by Thorpe Bros. Well Co. of Des Moines in 1931. This well, which is No. 12, is a drilled well and has a depth of 541 feet. It was begun in October and completed in December, 1931. It was started with a 20-inch hole and finished with a 12-inch hole. The flow of the completed well was 800 gallons per minute. The water flows above the curb. Flow was first encountered at 253 feet in sandy limestone, and the approximate amount was 371 gallons per minute. Eighty percent of the flow came from 335 to 534 feet below curb. A 16-inch pipe extends 246 feet, and a 10-inch pipe extends 64 feet to a depth of 310 feet below the curb. In the 64 feet of pipe there is 19 feet of perforated pipe and a 2.8-foot nipple. The altitude at the curb is 1,011 feet.

Driller's Log	Thickness in Feet	Depth in Feet
Pleistocene and Recent:		
Soil, black and yellow	12	12
Gravel and sand	12	24
Clay, blue and yellow	16	40
Hardpan	2	42
Clay, blue; shale, black	34	76
Mississippian and Devonian:		
Limestone	3	79
Sandstone, calcareous	11	90
Shale, black and gray	12	102
Limestone, blue	24	126

Shale, black	7	133
Limestone	57	190
Shale, red	25	215
Limestone	11	226
Shale, green	16	242
Limestone	11	253
Limestone, arenaceous	37	290
Shale, green	3	293
Limestone, arenaceous	42	335
Sandstone	7	342
Limestone	16	358
Sandstone	4	362
Limestone	78	440
Limestone, arenaceous	25	465
Limestone	8	473
Limestone (samples washed away)	29	502
Limestone (samples washed way)	7	509
Limestone (samples washed away)	25	534
Limestone, brown	7	541

Fraser, Boone County, Well No. 2

In October 1933 a well was drilled for Fort Dodge, Des Moines & Southern Railway by Thorpe Bros. Well Co. of Des Moines. The well was drilled to a depth of 314 feet, and its diameters were from 10 to 6 inches. The well had a natural flow of 1.5 gallons per minute. Water was first encountered at 17 feet in gravel. This supply was shut off. The first 173 feet of the well was cased with 6-inch standard black pipe.

Driller's Log	Depth in Feet
Pleistocene and Recent:	
Cinder fill	0–2
Yellow clay	2–9
Sandy clay	9–17
Gravel	17–23
Pennsylvanian:	
Gray shale	23–29½
Dark gray shale	29½–33½
Coal	33½–36
Fire clay	36–38½
Light gray shale	38½–44½
Dark gray shale	44½–46½
Coal	46½–47½
Fire clay	47½–51
Light gray shale	51–61
Sandstone	61–66
Gray shale	66–74½
Dark gray shale	74½–76½
Coal	76½–79½
Fire clay	79½–81
Gray shale	81–116
Shale and lime streaks	116–127
Dark gray shale	127–155
Light gray shale	155–166
Soft lime and sandstone	166–171½
Solid limestone	171½–195½
Green shale	195½–199

Mississippian:	
Solid limestone	199–287
Gray shale	287–289
Porous limestone	289–314

Garfield, Appanoose County

In July 1933 a deep well was completed for Mr. Baumeister of Garfield by Thorpe Bros. Well Co. The depth was 351 feet, and the diameters are from 6 to 4 inches. The static head stands at 165 feet, and there is a draw-down of 20 feet. Water was first encountered at 330 feet in white sandstone, the approximate yield being about 3 gallons per minute. The well was cased as follows: 6-inch standard pipe from the surface to 112 feet, 4⅝-inch inserted joint pipe from 112 feet to 240 feet, and 4-inch inserted joint pipe from 240 feet to 351 feet. The elevation at the curb was approximately 1,011 feet.

Driller's Log	Depth in Feet
Pleistocene and Recent:	
Black soil	0–4
Yellow sandy clay	4–20
Sand, yellow and fine	20–41
Gray drift, sandy	41–43
Sand, fine and yellow	43–50
Gray drift, sandy	50–56
Pennsylvanian:	
Sand; red color, fine, dry	56–60
Blue clay	60–100
Mixed shale	100–195
Coal	195–198
Dark gray shale	198–236
Sandstone, band	236–237
Mixed shale	237–330
Sandstone, soft	330–350
Brown limestone	350–351

Garner, Hancock County

In January 1932 a well was drilled for the town of Garner by E. A. Ford of Marshalltown. The well was drilled to a depth of 225 feet. The approximate elevation is about 1,216 feet above sea level. Samples were submitted by J. J. Becker of Fort Dodge.

Record of Strata	Depth in Feet
Mississippian:	
Limestone and sand, in about equal parts, gray	79–82
Similar, but in fine grains of about equal size	82–85
Limestone, medium dark gray, briskly effervescent	95
Limestone, shaly, drab, fine-textured	100
Limestone, finely granular, gray	108
Limestone, dark gray, granular, evidently dolomitic	116
Shale, fine-textured, light gray, slightly limy	125
Limestone, gray, granular, dolomitic	131–140

Limestone, similar	145
Limestone, tan, sample in very fine grains	145
Limestone, gray, sugary texture, in coarse grains and chips	150
Limestone, of two types, one granular and sugary, like that above, with considerable insoluble sandy residue, the other pale blue, fine-grained, with much clay residue	150–155
Limestone, light gray, granular, dolomitic, considerable siliceous residue	155–160
Limestone, similar to above	163–165
Limestone, similar to above	175–180
Limestone, similar to above but fine in texture	180–185
Limestone, similar to sample above and in smaller grains	185–190
Limestone, tan colored, finely granular, sample in chips and grains	195
Limestone, tan, finely granular, sample in small grains, much sandy residue after treatment with HCl	200
Limestone, medium dark gray, sugary, in small grains	205
Limestone, mingled light and dark gray, finely sugary, sample in coarse chips	210
Limestone, similar to above	215
Limestone, light gray, rather finely granular, probably somewhat dolomitic, with a good deal of white flinty residue after heating in acid	220
Limestone, gray, granular, with much calcite, residue similar to that of sample above. Probably most if not all of these granular limestones are dolomitic and contain silica	225

Lisbon, Linn County

In September 1932 a well was drilled for the city of Lisbon by Thorpe Bros. Well Co. of Des Moines. Its depth was 350 feet, and its diameters from 16 to 10 inches. The well yielded 238 gallons per minute with a draw-down of 145 feet. The static head stood at 24 feet. Water was first encountered at 298 feet in limestone. Sixty feet of 10-inch cast-iron pipe was used in casing the well.

Driller's Log	Depth in Feet
Pleistocene and Recent:	
Clay	0–7
Silurian:	
Broken limestone, very hard	7–50
Solid limestone	50–145
White limestone	145–270
Hard blue limestone	270–297
Very hard limestone, some water channels	297–300
Limestone	300–336
Hard limestone, water at 338 to 348	336–350

Mason City, Cerro Gordo County, Well No. 10

In December 1932 a city well was completed for Mason City by Thorpe Bros. Well Co. of Des Moines. This well was drilled to a depth of 1,243 feet with diameters from 26 to 12 inches. The static head stands at 150 feet below the surface. A 26-inch hole was drilled to 99 feet; a 19-inch hole from 99 to 250 feet. The hole tapered from 19 inches in diameter at 250 feet to 17 inches at 420 feet. A 15-inch hole was drilled from 420 to 743 feet, and a 12-inch hole from 743 feet to

the bottom. The well was cased as follows: 101 feet of 20-inch pipe from the surface to 99 feet; 109 feet of 12-inch pipe to 143 feet. Water stood at the 35 to 40 foot level until a depth of 990 feet was reached. Then the water level lowered gradually to 150 feet at the 1,075-foot level and remained there.

In spite of the large number of wells that have been drilled at Mason City, comparatively few samples have been saved and hence interpretation of the geologic section must still be made largely from the drillers' logs.

Driller's Log	Thickness in Feet	Depth in Feet
Pleistocene and Recent (17 feet thick; top 1077 feet above sea level) —		
Fill	17	17
Devonian and Silurian (188 feet thick; top 1060 feet above sea level) —		
Limestone with shale streaks	73	90
Shale	4	94
Limestone, hard	111	205
Ordovician:		
Maquoketa and Galena (455 feet thick; 872 feet above sea level) —		
Limestone	455	660
Platteville (69 feet thick; 417 feet above sea level) —		
Shale	55	715
Rock	14	729
Glenwood (11 feet thick; top 348 feet above sea level) —		
Shale	6	735
Limestone with shale streaks	5	740
Saint Peter (60 feet thick; top 337 feet above sea level) —		
Sandstone	60	800
Prairie du Chien (350 feet thick; top 277 feet above sea level) —		
Limestone and dolomite, crevices from 990 feet	350	1150
Cambrian:		
Trempealeau: Jordan (70 feet thick; top 73 feet below sea level) —		
Sandstone	70	1220
Trempealeau: Lodi (23 feet thick; top 143 feet below sea level) —		
Limestone, sandy, and dolomite; crevices	23	1243

Mason City, Cerro Gordo County, Decker Well No. 3

In May 1933 a well was completed for Jacob Decker & Sons of Mason City by Thorpe Bros. Well Co. This was a rock well. The depth of the well is 1,260 feet, and the diameters are from 28 to 12 inches. The well is cased with 28-inch pipe from the surface of the well to 12 feet; 20-inch pipe from 12 feet to 50 feet; 12-inch pipe from 50 feet to 726 feet. The curb of the well is approximately 1,125 feet above sea level.

Driller's Log	Thickness in Feet	Depth in Feet
Devonian; Silurian; Ordovician (Maquoketa, Galena, and Decorah):		
Limestone and dolomite	648	648
Ordovician:		
Platteville (70 feet thick; top 477 feet above sea level) —		
Shale	60	708
Limestone	10	718
Glenwood (9 feet thick) —		
Shale	9	727
Saint Peter (73 feet thick; top 398 feet above sea level) —		
Sandstone	73	800
Prairie du Chien (330 feet thick; top 325 feet above sea level) —		
Limestone and dolomite, crevices from 990 to 1130	330	1130
Cambrian:		
Trempealeau: Jordan (70 feet thick; top 5 feet below sea level) —		
Sandstone, 1130 to 1190 coarse sand	70	1200
Trempealeau: Lodi and St. Lawrence (penetrated 60 feet; top 75 feet below sea level) —		
Limestone and dolomite	60	1260

Mitchellville, Polk County

The deep well for the Training School for Girls at Mitchellville was completed in June 1932 by Thorpe Bros. Well Co. The well was drilled to a depth of 2,410 feet, and the diameters are from 23 to 10 inches. On completion the well yielded 1,000 gallons per minute with a drawdown of 151 feet. The static head stood at 191 feet. Water was first encountered at 610 feet in limestone with an approximate yield of 10 gallons per minute. Water was found in the Saint Peter sandstone and in crevices of the New Richmond, but the largest supply was found in the Jordan sandstone. The well was cased as follows: 16-inch pipe to 412 feet, 12-inch pipe to 816 feet, and 10-inch pipe to 1,475 feet.

Driller's Log	Depth in Feet
Pleistocene and Recent:	
Fill	0–10
Blue clay	10–67
Yellow clay	67–88
Blue clay	88–101
Sand	101–104
Pennsylvanian:	
Gray shale	104–112
Red shale	112–120
Gray shale	120–147
Gray shale with rock streaks	147–210
Black shale	210–330
Gray shale with streaks of hard rock	330–395
Limestone with streaks of shale	395–515
Mississippian:	
Limestone	515–610
Shale, greenish gray	610–710

Devonian:	
Limestone with shale streaks	710–768
Limestone, hard	768–815
Silurian:	
Limestone	815–1355
Ordovician:	
Red shale	1355–1380
Blue shale	1380–1465
Limestone	1465–1820
Green shale	1820–1822
Limestone	1822–1835
Green shale	1835–1838
Limestone	1838–1878
Shale	1878–1883
Saint Peter sandstone	1883–1918
Limestone	1918–2131
Sandy limestone	2131–2151
Sand	2151–2181
Limestone	2181–2261
Open lime	2261–2281
Limestone	2281–2381
Sand	2381–2410

Mineral Analysis

Silica	.327	Grains	per	U. S.	Gallon
Oxides of Iron and Aluminum	.046	"	"	"	"
Carbonate of Lime	8.295	"	"	"	"
Sulphate of Lime	9.685	"	"	"	"
Carbonate of Magnesia	7.325	"	"	"	"
Sodium & Potassium Sulphates	35.062	"	"	"	"
Sodium & Potassium Chlorides	5.600	"	"	"	"
Sodium & Potassium Nitrates	Trace				
Loss, etc.	.104	"	"	"	"
Total Sol. Mineral Solids	66.444	"	"	"	"
Organic Matter	Trace				
Total Sol. Incrusting Solids	25.678	"	"	"	"
Total Sol. Non-incrusting Solids	40.766	"	"	"	"
Pounds Sol. Incrusting Solids per 1,000 U. S. Gallons					3.66
Pounds Sol. Non-incrusting Solids per 1,000 U. S. Gallons					5.82

Remarks: Appearance of water — colorless, slight suspension.

Moravia, Appanoose County, School Well

This well is 559 feet deep. It is cased with 6-inch casing to 138 feet and with 5-inch casing from 116 to 354 feet. The static head is 265 feet below surface, and the well yields 12 gallons per minute. It was drilled by F. S. McCutcheon of Des Moines. The elevation is about 1,000 feet above sea level.

Driller's Log	Thickness in Feet	Depth in Feet
Pleistocene and Recent:		
Drift, yellow	40	40
Drift, grade	90	130
Mud, sea	6	136
Pennsylvanian:		
Shale, gray	14	150
Shale, light	80	230
Shale, dark	17	247

Shale, gray	5	252
Sandstone	5	257
Shale, light	23	280
Shale, dark	4	284
Rock, hard, black	1	285
Shale, light	5	290
Shale, dark	5	295
Shale, gray, trace of coal	8	303
Shale, light	10	313
Shale, gray	40	353
Sandstone	6	359
Limestone	12	371
Shale, sandy, gray	49	420
Shale, dark	8	428
Mississippian:		
Sandstone, gray	32	460
Sandstone, water bearing	60	520
Limestone, white	10	530
Shale	2	532
Limestone	8	540
Limestone, soft	9	549
Limestone	10	559

Muscatine, Muscatine County

Well No. 1 was an oil prospect dug under the direction of A. L. Madden of Muscatine. The prospect was started April 4, 1931, and was completed June 5, 1931.

Driller's Log	Thickness in Feet	Depth in Feet
Pleistocene and Recent:		
Surface gravel, sand	90	90
Gravel	50	140
Silurian:		
Limestone, gray	30	170
Limestone, white	37	207
(Dry gas 15 feet; wet gas and oil 25 feet)		
Limestone, brown	40	247
Limestone, gray	23	270
Limestone, blue water	55	325
Limestone, white	15	340
Ordovician:		
Maquoketa —		
Shale, gray	7	347
Limestone, blue water	30	377
Limestone, white and gray	12	389
Limestone, brown	26	415
Limestone, brown	19	434
Shale, gray	32	466
Limestone and shale	20	486
Shale, gray	99	585
Shale, brown, very hard	44	629
Shale, black	22	651
Galena-Platteville —		
Limestone (Trenton), gray, hard	1	652
Limestone, brown; oil showing	4	656
Limestone, light brown; water, some salt	26	682

Persia, Harrison County

In November 1933 a well was drilled for the water supply of Persia

by Thorpe Bros. Well Co. of Des Moines. The depth was 250 feet, with a diameter of 6 inches. It yielded five gallons per minute, with a draw-down to the bottom of the well. The static head stood at 65 feet. Water was first encountered at 54 feet in a dirty sand with an approximate yield of 15 gallons per minute.

Driller's Log	Depth in Feet
Pleistocene and Recent:	
Soil	0–2
Clay, yellow	2–35
Clay, blue	35–54
Sand, dirty	54–69
Clay	69–118
Pennsylvanian:	
Sandstone	118–124
Clay	124–134
Limestone	134–146
Shale	146–154
Limestone	154–166
Shale	166–174
Limestone	174–178
Shale	178–187
Limestone	187–191
Shale	191–250

Stratford, Hamilton County

This well, which was started in December 1930 and completed in March 1931, was drilled by Thorpe Bros. Well Co. of Des Moines for Chicago North Western Railway Co. Its depth is 634 feet, and its diameters from 12 to 6 inches. The static level was 150 feet below curb. The well yielded 36 gallons per minute with a draw-down of 130 feet. Approximately 5 gallons per minute was encountered from 50 to 69 feet in fine sand. The water was unsatisfactory and so this well was abandoned.

Driller's Log	Thickness in Feet	Depth in Feet
Pleistocene and Recent:		
Soil	5	5
Clay, yellow	11	16
Clay, arenaceous, bluish gray	42	58
Sand, fine, gray	11	69
Clay, gray, some rock	206	275
Sand, very fine	3	278
Pennsylvanian:		
Shale and thin streaks of rock	162	440
Mississippian:		
Limestone, light color	60	500
Limestone, light gray	131	631
Shale, light blue	3	634

Stratford, Hamilton County, Town Well

In 1930 a town well was completed for Stratford, Iowa. It is located about 600 feet from the railroad station, with an elevation of approx-

imately 5 feet above the railroad. The well was started with a 15-inch diameter and finished with a 10-inch diameter. The depth is 495 feet. The well was cased with 319 feet of 12-inch casing and 170 feet of 10-inch casing. The static head stands at 180 feet, and there is practically no draw-down. The yield is 215 gallons per minute. The elevation of the well is approximately that of the railway station, which is 1,113 feet.

Driller's Log	Thickness in Feet	Depth in Feet
Clay, sand, fine	275	275
Sand, fine	37	312
Shale, and thin streaks of rock	38	350
Rock, and thin streaks of shale	50	400
Shale and rock, alternating	20	420
Shale	40	460
Rock and thin streaks of shale	35	495

Williams, Hamilton County

This well was drilled for the town of Williams by J. J. Becker of Fort Dodge. The static head stands 50 feet from the curb. The well yield is 125 gallons per minute with a draw-down of two feet. An 8-inch pipe was set to 300 feet; 6¼-inch casing to 750 feet; 5-inch pipe to 1,000 feet; 40 feet of 4½-inch casing at 1,500 feet; 80 feet of 4-inch casing at about 1,600 feet.

Record of Strata	Depth in Feet
Ordovician:	
Glenwood shale (20 feet thick; top 289 feet below sea level) —	
Shale, bright blue-green, fissile, abundant pyrite, slight effervescence	1500–1515
Saint Peter sandstone (50 feet thick; top 309 feet below sea level) —	
Sandstone, white quartz sand with less than 1 percent of iron oxide grains, quartz grains well rounded, and average diameter between ¼ and ½ millimeters in diameter	1520–1570
Prairie du Chien: Shakopee dolomite (118 feet thick; top 359 feet below sea level) —	
Dolomite, calcareous, gray to drab, granular and in cuttings contains no fragments of rock, effervesces freely, contains grains of quartz and iron oxide in the dolomite	1572–1595
Dolomite, effervesces slowly, samples contain small chips of light gray to drab dolomite which is firmly coherent, contains many rounded quartz grains	1600–1610
Dolomite, light gray and more compact than that of the bed immediately above	1620
Dolomite, coarsely granular, gray-buff, contains chips of rock in the cuttings	1630–1640
Dolomite, light gray, fine grains, no chips from the cuttings, effervesces slowly	1650–1660
Dolomite, light buff, coarsely granular and crystalline, cuttings contain some chips, effervesces slowly	1670–1680
Dolomite, gray-buff-colored, some chips of hard compact rock, effervesces slowly	1688
Prairie du Chien: New Richmond sandstone (40 feet thick; 477 feet below sea level) —	

Sandstone, white to light buff due to some iron oxide grains; most of the grains are well-rounded quartz although some show their original angularity. The slight effervescence appears to be from dolomite carried down from above ---------- 1700–1728

Prairie du Chien: Oneota dolomite (30 feet to the bottom of the well; 517 feet below sea level) —

Dolomite, light buff, the buff color due to a small percentage of iron oxide on some of the grains; effervesces slowly; no chips of the rock in the fine sandy cuttings ---------- 1740–1758

Berry Well, Ringgold County

This well was drilled by G. H. Rose & Son, contractors and drillers of Clarinda, Iowa. It is located one mile west and one-half mile north of Redding, Ringgold County. The diameters were from 10 to 12 inches and the well was drilled to a depth of 715 feet. A 10-inch casing was set at 200 feet, and 8-inch was set at 700 feet. The first water was encountered at a depth of 40 feet.

Driller's Log	Thickness in Feet	Depth in Feet
Soil	5	5
Clay, yellow	10	15
Clay, blue	8	23
Quicksand, water	15	38
Shale, light	14	52
Limestone, white	5	57
Shale, light	13	70
Limestone, gray	5	75
Shale, light	20	95
Shale, white	10	105
Limestone, white	10	115
Shale, dark	1	116
Limestone, gray	5	121
Shale, dark	4	125
Limestone, gray	15	140
Shale, black	6	146
Limestone, white	4	150
Shale, dark	8	158
Shale, red	10	168
Limestone, white; shale	17	185
Limestone, white	13	198
Shale, blue	10	208
Shale, light	5	213
Limestone, gray	25	238
Shale, light	7	245
Limestone, white	5	250
Shale, dark	2	252
Limestone, gray	8	260
Shale, black	3	263
Limestone, white	27	290
Shale, dark	4	294
Limestone, white	21	315
Shale, light	3	318
Limestone, gray	5	323
Shale, light	12	335
Limestone, gray	17	352
Limestone and shale	15	367
Limestone	4	371
Shale, light	5	376

Shale, dark	27	403
Limestone, gray	5	408
Shale, black	4	412
Shale, light	23	435
Shale, red	7	442
Limestone	3	445
Shale, light	12	457
Shale, black	15	472
Limestone, gray	5	477
Shale, dark	8	485
Limestone and shale	35	520
Shale, light	20	540
Red rock	2	542
Shale, light	53	595
Shale, brown	8	603
Limestone	1	604
Shale, dark	6	610
Limestone	1	611
Limestone and shale	4	615
Shale, light	20	635
Limestone	2	637
Limestone and shale	38	675
Shale, dark	40	715

Well of Louis Charon, Webster County

This well was drilled in Fort Dodge for Louis Charon, one mile north of Central Ave. and 5th Street, 20 rods from the Des Moines River. The depth of the well is 94 feet and the water stands 3 feet from the curb. The samples were received from J. J. Becker of Fort Dodge, 1930.

Driller's Log	Depth in Feet
Pleistocene and Recent:	
Glacial drift, yellowish brown, pebbly, highly calcareous, evidently Wisconsin till	10–30
Mississippian:	
Limestone, gray, rather fine-grained, in small chips, some yellow calcite; sand grains, clear, rounded, nearly colorless; some clay, probably from above, which cements the other materials. Limestone and sand probably belong to the St. Louis	35
Sand grains, similar to those above, some small masses of sand concreted with calcareous cement; much calcite in grains and powder; all light gray	50
Sand, similar to above but dark gray, some iron pyrite, much calcite	60
Limestone, gray, in small chips and grains of calcite, with some clear quartz sand and some pyrite	70
Limestone, dark gray, granular, some in white crystals of calcite	80
Limestone, dark gray, in fine sand, some white calcite	90–94

Moline Oil and Gas Co. Well, Rock Island County, Illinois

This oil prospect was drilled on the Christensen Bros. farm in the southwest corner of $SE\frac{1}{4}$ $SE\frac{1}{4}$ section 8, Twp. 17 N., R. 1 E., Hampton Township, Rock Island County, Illinois. The samples were studied by M. Blair and D. M. Delo of Illinois Geological Survey in January 1933. The record was given to the Iowa Geological Survey by Merlyn

Buhle (student in the Department of Geology, State University of Iowa).

Record of Strata	Thickness in Feet	Depth in Feet
Pennsylvanian:		
Shale, carbonaceous, micaceous, sandy, pyritic, dark blue-gray, weak	30	30
Siltstone, micaceous, brown-gray; sandstone, calcareous, gray, fine, fragment of coal; interbedded shale, sandy, dark gray and weak	33	63
Sandstone, very shaly, calcareous, micaceous, gray, fine, coherent; 75-foot hole fills with water	24	87
Shale, slightly sandy, micaceous, carbonaceous, dark gray and weak	18	105
Shale, noncalcareous, carbonaceous, laminated, dark blue-gray and firm	15	120
Siltstone, calcareous, gray, very fine, compact, grading to shale, micaceous, dark gray, weak, and sandstone, calcareous and fine	32	152
No sample	3	155
Devonian:		
Dolomite, light buff, fine to very finely crystalline, compact to partly porous	35	190
No sample	5	195
Silurian:		
Niagaran—		
Dolomite, light gray, very finely crystalline, partly porous	60	255
Dolomite, white, very finely crystalline, partly porous (gas at 326 feet)	101	356
Dolomite, white, very finely crystalline, partly porous with much vug quartz; dolomite, argillaceous, light gray-brown, very fine, partly porous	13	369
Dolomite, cherty, light gray-brown, finely crystalline, partly porous, bluish, secondary silica	66	435
Dolomite, cherty, light gray-brown, finely crystalline, partly porous; shale, silty, very dolomitic, gray, small black spots, very firm	29	464
Ordovician:		
Maquoketa—		
Dolomite, argillaceous, dark mottled gray, finely granular, fossiliferous, compact; shale, dolomitic, greenish gray, weak	29	493
Shale, dolomitic, greenish gray, weak	25	518
Dolomite, mottled brown and dark gray, finely granular, fossiliferous, compact with interbedded shale, greenish gray, weak	48	566
Dolomite, argillaceous, brown to dark brownish gray, fine, compact, fossiliferous; little shale, greenish gray	58	624
Dolomite, argillaceous, brown to very dark, fine, compact, grading to shale, very dolomitic, very dark, very firm	29	653
Galena—		
Dolomite, light brown, finely crystalline, partly porous, calcite inclusions, disseminated pyrite	47	700
Dolomite, light buff, little chert, white and buff, 819-900	200	900
Platteville—		
Dolomite, light brown, few gray spots, finely crystalline chert, brown to buff, finely pyritic near top (Decorah 900-926; L. E. Workman.)	87	987
Glenwood—		
Sandstone, light buff-gray, medium to fine, incoherent	15	1002
Shale, greenish-gray, firm, pyritic; sandstone, fine, incoherent with interbedded shale, sandy at base	14	1016

Saint Peter —		
Sandstone, white, fine to coarse, incoherent	64	1080
Shale, light green and gray, sandy, weak	5	1085
Prairie du Chien (447 feet thick; top 470 feet below sea level) —		
Shakopee (185 feet thick) —		
Dolomite, white to light buff, finely crystalline, partly oölitic; little chert, light buff, partly oölitic	15	1100
Sandstone, white, fine to medium, incoherent	5	1105
Dolomite, light buff-gray, finely crystalline, partly oölitic	16	1121
Sandstone, fine to medium, white, incoherent	4	1125
Sandstone, same, and dolomite, light buff, slightly sandy interbedded	50	1175
Sandstone, as above, but with white chert	14	1189
Dolomite, light gray; shale, dolomitic, pinkish brown, firm	6	1195
Dolomite, light buff-gray, (light brown at base) very finely crystalline	18	1213
Dolomite, white, finely crystalline, silty; chert, white, oölitic	14	1227
Shale, dolomitic, pinkish brown, firm; dolomite as above but pinkish	21	1248
Dolomite, light buff-gray, very finely crystalline	22	1270
New Richmond (45 feet thick) —		
Sandstone, fine to medium, transparent, incoherent	22	1292
Sandstone, same as above; dolomite as above	23	1315
Oneota (217 feet thick) —		
Dolomite, white, very finely crystalline, few pink and green spots	18	1333
Chert, buff and white; little dolomite as above	5	1338
Dolomite, white, very fine; chert, white	14	1352
Dolomite, same; little chert, white; (few pink and buff spots)	71	1423
Chert, buff and white as above, little dolomite	7	1430
Dolomite, very finely crystalline; little chert, white, some good geode quartz	70	1500
Dolomite, light gray to buff, very finely crystalline, little chert, buff to white	32	1532
Cambrian (1450 feet plus; top 917 feet below sea level) —		
Trempealeau (287 feet thick) —		
Jordan (29 feet thick; from 917 to 946 feet) —		
Sandstone, white, fine to medium, incoherent	19	1551
Sandstone, same but cherty, white chert	10	1561
Lodi and St. Lawrence (258 feet thick; from 946 to 1204) —		
Dolomite, white, finely crystalline, cherty, white chert	23	1584
No sample	9	1593
Sandstone, very fine to fine, incoherent	5	1598
Dolomite, light buff, finely crystalline	58	1656
Dolomite, same, little pyrite	42	1698
Dolomite, same, white chert, porous	32	1730
Dolomite, same, slightly glauconitic, few pink spots	66	1796
Dolomite, same, no chert, partly light gray	23	1819
Franconia (120 feet thick; from 1204 to 1324) —		
Dolomite, argillaceous, glauconitic, sandy, red and gray	6	1825
Sandstone, argillaceous, dolomitic, light gray, partly pink and green, glauconitic, fine	13	1838
Shale, dolomitic, very fine sand, glauconitic, gray, weak	16	1854
Sandstone, argillaceous, light gray, fine, dolomitic, glauconitic, buff-gray, sandy, pyritic, slightly glauconitic	25	1879
Sandstone as above, no dolomite	28	1907
Dolomite, sandy (fine sand), light buff-gray, finely crystalline, slightly glauconitic	10	1917
Shale, weak, gray, dolomitic, sandy, very fine sand	17	1934

Dolomite, very sandy, fine sand, gray, pink and green spots, glauconitic	5	1939
Dresbach:		
Galesville (136 feet thick; from 1324 to 1460) —		
Sandstone, slightly dolomitic, light gray, fine to very coarse, incoherent	14	1953
Sandstone, nearly white, fine to very coarse, incoherent	57	2010
Sandstone, nearly white, fine to very coarse, incoherent; dolomite, light gray, sandy and crystalline	10	2020
Sandstone, nearly white, fine to very coarse, incoherent; dolomite, light gray, sandy and crystalline	45	2065
Sandstone, brownish, very fine and fine, incoherent, few flakes of white chert	10	2075
Eau Claire (225 feet thick; from 1460 to 1685) —		
Sandstone, white to brown, slightly glauconitic, partly coherent	15	2090
Sandstone, white and brown, medium, slightly glauconitic, incoherent	10	2100
Sandstone, slightly dolomitic, and glauconitic, light pinkish gray, very fine to medium, incoherent	5	2105
Sandstone, slightly glauconitic, white to yellow, fine to very fine, incoherent	19	2124
Sandstone, same, but very fine to coarse, partly coherent, little shale, greenish gray, firm	5	2129
Sandstone, pink to red, slightly glauconitic, very fine to coarse, incoherent	8	2137
Sandstone, silty, white, very fine, coherent, glauconitic	8	2145
Shale, silty, red and a little green, flaky, weak	5	2150
Shale, silty, white to pink, very fine, coherent, grading into siltstone	43	2193
Sandstone; shale, gray, partly reddish and green, firm, micaceous	25	2218
Sandstone, dolomitic, light gray, very fine, coherent, glauconitic	17	2235
Sandstone, dolomitic, light gray, few pink spots, fine, coherent, thin flakes of brown material imbedded	10	2245
Sandstone, dolomitic, light gray, fine, mostly incoherent	28	2273
Sandstone, light gray to yellowish, very fine to coarse, incoherent	10	2283
Sandstone, white, medium, incoherent, fragments of dolomitic, sandy, brownish gray, pyritic	17	2300
Mount Simon (682 feet thick; from 1685 to 2367 plus) —		
Sandstone, white to yellow-brown, incoherent	17	2317
Sandstone, white to yellow, fine, and coarse, incoherent	153	2470
Sandstone, pink and yellow, fine and coarse, incoherent	87	2557
Sandstone, white and yellow, coarse and very coarse, incoherent	20	2577
Sandstone, pink and yellow, coarse and very coarse, incoherent	13	2590
Sandstone, yellow and white, fine to coarse, incoherent	55	2645
Sandstone, pink and white, fine to very coarse, incoherent	5	2650
Sandstone, red, fine, incoherent	18	2668
Sandstone, pink, white, yellow, fine to coarse, incoherent, with a few flakes of white chert	14	2682
Sandstone, red, fine to coarse, incoherent	13	2695
Sandstone, white to yellow, very fine to medium, incoherent	10	2705
Sandstone, gray to brown	277	2982

Des Moines County Asylum Well, Burlington

Driller's Log	Thickness in Feet	Depth in Feet
Drift	43	43
Shale, gray, with strips of limestone	47	90
Limestone, Burlington, white	100	190
Shale	4	194
Limestone, gray	21	215
Shale, Kinderhook	303	518
Limestone, Devonian	144	662
Shale	2	664
Limestone	11	675
Shale, Maquoketa	61	736
Limestone, Trenton	182	918

Des Moines Dairy Farm, Polk County

In July 1933 a deep well was completed for the Des Moines Dairy Farm by Thorpe Bros. Well Co. The depth of the well is 770 feet, and its diameters are from 10 to 6 inches. Water was first encountered at 380 feet in limestone with an approximate yield of two gallons per minute. On completion the well yielded 20 gallons per minute with a draw-down of 250 feet. The static head stood at 105 feet. The well is cased with 6-inch steel pipe to 443 feet, and with 4-inch pipe from 443 feet to 770 feet.

Driller's Log	Depth in Feet
Pleistocene:	
Black subsoil	0–5
Yellow clay	5–15
Sand and gravel	15–20
Sea mud	20–45
Pennsylvanian:	
Gray shale	45–100
Red shale	100–125
Light shale	125–150
Brown shale	150–240
Black shale	240–315
Light shale mixed with rock	315–335
Lime (little water, 2.5 gallons per minute)	335–420
Green shale	420–443
Mississippian:	
Shelly limestone	443–460
Shale	460–465
Gray limestone	465–565
Green shale	565–567
Shelly limestone	567–582
Gray shale	582–607
Dark limestone	607–710
Green shale	710–740
Limestone	740–770

Well at Fitch Farm, Polk County

Record of well at Fitch Farm in NE¼ NW¼ section 26, Crocker Township, Polk County. One mile south of Ankeny.

Driller's Log	Depth in Feet
Pleistocene and Recent:	
Drift	92
Pennsylvanian:	
Shale with thin sandstone bands	92–375
Mississippian:	
Meramec: Saint Louis —	
Limestone, brown, sandy	375–510
Limestone, gray, very little shale	510–592
Kinderhook —	
Shale, light gray, with hard bands	592–598

Record of Strata	Depth in Feet
Limestone, dark gray, fine-grained, much opaque light gray flint, some transparent colorless calcite showing good cleavage	512
Limestone, dark gray, some flint, brisk response to acid	525
Limestone, dark gray, in fine chips and grains, some dark gray limy shale	547
Limestone, similar to above, a little lighter gray; flint in small chips, not noticeable	552
Limestone, light gray, fine grains, much flint in small chips	560
Limestone, light gray, and much flint in light gray to white chips	565
Limestone, light gray, some flint and a little dark gray shale	570
Limestone, similar to above but a little darker; flint and quartz chips	575
Limestone, like sample above	580
Limestone, similar to sample at 575	585
Limestone, gray, angular grains, some white flint, some shale	590

Henkel Well, Wapello County

Senator Roy E. Stevens of Ottumwa furnished the following log of a well that was drilled on the Henkel farm, in the west half of section 30, Highland Township, Wapello County. This well is on the upland four miles north of Ottumwa and adjoins the Stevens farm on the east. The elevation of the Des Moines valley at Ottumwa is 645 feet; that of Rutledge, on the Chicago, Milwaukee, St. Paul and Pacific Railroad, is 832 feet on the upland near the Stevens and Henkel farms. The depth of the well is 278 feet. The well furnishes 23 gallons per minute under the pump.

Driller's Log	Thickness in Feet	Depth in Feet
Pleistocene and Recent (72 feet thick; top about 832 feet above sea level) —		
Clay, joint	44	44
Clay, blue	28	72
Pennsylvanian, Des Moines series (124 feet thick; top 760 feet above sea level) —		
Shale, red	4	76
Shale, blue	50	126
Shale, red	6	132
Shale, blue	25	157
Shale, red	28	185
Shale, blue	11	196
Mississippian, Ste. Genevieve and St. Louis (?) formations (penetrated 82 feet; top 636 feet above sea level) —		
Limestone	23	219
Sandstone	4	223

Limestone	15	238
Sandstone	40	278

In the earlier reports of this Survey the "St. Louis" formation included all the Mississippian limestone and sandstones that lie just below the Pennsylvanian strata, or, where these are absent, below the drift. This classification was followed by Leonard in his report on Wapello County in volume XII, the report for 1901. In more recent reports, however, the uppermost Mississippian strata are separated from the St. Louis beds and are classified as Ste. Genevieve or Pella. These beds, in southeastern Iowa, include typically a basal sandstone about 5 or 6 feet thick and fairly thick beds of limestone interbedded with thin shales. These beds are 25 or 30 feet thick. It does not seem reasonable to attempt any subdivision of the Mississippian beds as they were penetrated in the Henkel well. Perhaps the lower beds belong in the St. Louis formation, as the thickness penetrated, 82 feet, seems to be too great for the Ste. Genevieve alone. The uppermost layers of the Ste. Genevieve are, or were, exposed in the floor of the valley of a stream in the north edge of Ottumwa known as Harrows Branch. The exposure was just above the mouth of the valley and was at the same level as the Des Moines valley.

Larson Well, Webster County

This farm well was drilled for Sam Larson by J. J. Becker of Fort Dodge. It is located in the NE¼ section 25, Badger Township, Webster County, two miles north of Industry. It is 459 feet deep, and the static head stands between 40 and 50 feet.

Record of Strata	Depth in Feet
Shale, pink to red and light blue, limy, gritty	116
Limestone, gray, crystalline, responds readily to cold acid; a little shale, darker gray	140
Limestone, gray, sample in fine grains and powder, with much sand in fine rounded grains many of which are frosted	145
Limestone, a little darker gray and very fine-textured, sample in somewhat coarser grains than that at 145 but still with much sand	160
Limestone, light gray, finely granular, sample in fine grains, much fine sand, 2 samples	170–180
Limestone, dark gray, finely granular sample in coarse grains and chips; some sand, 190 and 200; fine grains and powder at 210 and 220; 4 samples	190–220
Shale, blue-gray, fine-textured; and limestone, gray, both in chips and powder; 230; more shale at 240 and 250; more limestone at 260 and 270; 5 samples	230–270
Limestone, gray, finely oölitic (round, egg-like nodules) with almost colorless cement. Much shale, like that above, may be fallen from above	290

Limestone, light gray, oölitic texture not prominent; much shale. Limestone in fine grains at 340, no chips; a little coarser, sugary at 350 to 380; sugary and somewhat oölitic at 390; fine grained at 400 and 410; buff colored, sample in very fine grains and powder at 420; grains tan colored and sugary at 430, some white flakes; darker gray and finely granular at 440 and 450; lighter gray but otherwise similar at 459; 17 samples ---------- 300–459

East of Mitchellville, Well No. 1

In October 1932 a well was completed for WHO Radio Station near Mitchellville by Thorpe Bros. Well Co. It is located in the NE¼ sec. 13, township 79 N., R. 22 W., Jasper County. The well was drilled to a depth of 1,150 feet, with diameters from 10 to 5 inches. The static head stood at 150 feet below surface. The well yielded 27 gallons per minute with a draw-down of 330 feet. Water was first encountered at 6 feet in clay, with an approximate yield of 3 gallons per minute. The casing is as follows: 130 feet of 10-inch heavy pipe from the surface to 130 feet; 255 feet of 8-inch steel pipe from 110 to 365 feet, perforated at water zones; 396 feet of 6-inch pipe from 344 to 740 feet perforated at water zones; 197 feet of 5-inch pipe from 718 to 915 feet, perforated at water zones. The elevation at the curb is approximately 970 feet.

Driller's Log	Thickness in Feet	Depth in Feet
Pleistocene and Recent (85 feet thick):		
Soil	3	3
Clay	67	70
Sand	3	73
Clay, hard	5	78
Clay, sandy	7	85
Pennsylvanian (215 feet thick):		
Shale	215	300
Mississippian (370 feet thick):		
Limestone	45	345
Shale	5	350
Limestone	40	390
Shale and lime streaks	115	505
Limestone, hard	65	570
Limestone, and shale streaks	35	605
Shale	65	670
Devonian (115 feet thick):		
Limestone	90	760
Shale	25	785
Silurian (365 feet thick):		
Limestone	80	865
Limestone, soft, sandy	10	875
Limestone	275	1150

Reilly Well, Webster County

This well is located three-fourths mile northwest of the County Farm, Fort Dodge, in section 4, Elkhorn Township. The well was dug

for Miss Anna Reilly and is 246 feet deep. The diameter of the well is 5 inches, and it is cased with 5-inch S & S casing to 198 feet. The first water was found at a depth of 230 feet. The static level is at 118 feet below curb. The altitude of the well is 1,140 feet, about 120 feet above the river. Samples of the drillings were received from J. J. Becker, 1930.

Record of Strata	Depth in Feet
Pleistocene (90 feet thick; top 1140 feet above sea level) —	
Glacial drift clay and sand, gray	40
Glacial drift clay, yellow, pebbly	60
Glacial drift clay, very sandy, yellow, not much lime	75
Glacial drift clay, similar to that above; and shale, black	90
Pennsylvanian (100 feet thick; top 1,050 feet) —	
Shale, black and gray, fine textured, limy	100
Shale, similar to above	105
Shale, black, smooth	110
Shale, gray, finely gritty, some iron pyrite	120
Shale, gray, reddish, yellow, slightly limy	130
Shale, red, limy	140
Shale, similar to above	150
Shale, like above, limy, some light blue-gray	160
Shale, mostly blue-gray, some red, limy	170
Shale, mixed red and light blue, finely sandy	180
Shale, chiefly greenish blue and red, finely sandy, limy	190
The strata from 90 to 190 feet belong to the Coal Measures.	
Mississippian (56 feet; top 950 feet) —	
Limestone, light gray, in powder and sand, some iron pyrite and some silica in form of chert	198
Limestone, light gray, in chips and powder, fine-grained	205
Limestone, light gray, in fine powder, with much clear colorless sand in fine rounded smooth grains	210
Sandstone, in fine clear grains; with a little limestone, light gray	220
Limestone, gray in chips and powder, with some white clay and fine clear sand grains	230
Water came in here	
Sandstone, fine clear grains, some limestone	240
Sandstone, very fine clear grains, little limestone	246
The limestones and sandstones belong to the St. Louis stage.	

Well of John Scripps, Webster County

This well was drilled for John Scripps by J. J. Becker of Fort Dodge in May 1931. The location is NE¼ section 35, Douglas Township, Webster County, 1,650 feet from the north line and 1,250 feet from the east line of section 35. The depth is 486 feet, and the static head stands at about 60 feet. The well is five inches in diameter and yields about 7½ gallons per minute with no draw-down. No record was kept of the first 148 feet.

Driller's Log	Thickness in Feet	Depth in Feet
Permian:		
Gypsum	10 or 12	148
Mississippian:		
Clay, red	52	200
Rock	50	250

Rock, loose	37	287
Limestone	113	400
Limestone, light gray, finely crystalline, effervesces freely in acid	10	410
Limestone, light buff, very finely granular	10	420
Limestone, very similar to that at 410	10	430
Limestone, like that at 430	10	440
Limestone, like sample above	10	450
Limestone, light buff, very fine-grained, effervesces slowly in cold acid	10	460
Limestone, like sample above	10	470
Limestone, as above	16	486

Winterset, Madison County

A prospect hole for coal was dug seven miles north of Winterset on Highway 169. The depth is 195 feet. It was dug by F. S. McCutcheon of Des Moines.

Driller's Log	Thickness in Feet	Depth in Feet
Pleistocene and Recent:		
Drift, yellow	11	11
Gravel	5	16
Drift, gray	72	88
Wood and boulders in layers	4	92
Pennsylvanian:		
Rock, hard	2	94
Limestone, "Missouri"	29	123
Shale, light gray	9	132
Limestone	3	135
Shale, dark	4	139
Shale, gray	11	150
Shale, dark	2	152
Coal	½	152½
Shale, gray	5	157½
Sandstone, hard	4	161½
Shale, light gray	10	171½
Rock, hard	1	172½
Shale, gray	18½	191
Sandstone	1½	192½
Shale, dark, and coal	1½	194
Shale, light	1	195

Clear Lake State Park, Cerro Gordo County

This well was drilled by McCutcheon Well Co. of Des Moines and was completed April 29, 1933. The depth of the well is 160 feet, and it is cased with 125 feet of 6-inch Standard casing, which is driven one foot into solid limestone. Sandy broken limestone was found from 135 to 152 feet, and shale from 152 to 160 feet. The head of water in the completed well was 26 feet below curb. When pumping 15 gallons per minute the draw-down was 6 feet, and when pumping 25 gallons per minute the draw-down was 8 feet. The elevation is approximately the same as that of the railway station, which is 1,236 feet. The elevation at Mason City is 1,130 feet. At Mason City the bedrock is prac-

tically at the surface, while at Clear Lake the drift extends to a depth of 107 feet. This seems to indicate that the surface of the bedrock is practically horizontal between the two towns, while the surface rises one hundred feet at Clear Lake.

Driller's Log	Thickness in Feet	Depth in Feet
Pleistocene and Recent:		
Drift, yellow	6	6
Sand, coarse	4	10
Sand, sugary	22	32
Drift, gray	75	107
Devonian:		
Shale, yellow	4	111
Limestone, broken, drilled easily, pushed up into pipe, water	6	117
Shale, yellow, very finely sandy	4	121
Shale, gray, hard bands	3	124
Limestone	28	152
Shale, light	8	160

Record of Strata	Depth in Feet
Sand, grains irregular in size, ranging from fine to one-half inch, mostly light gray, some dark green, red, almost black; rounded; vigorous response to acid, indicating lime. Evidently lake sand	10
Sand, fine, uniform in texture, except for a few pebbles, tan-colored; much lime	20
Sand, very fine, or finely gritty clay, tan-colored, texture uniform; brisk response to acid but much finely sandy residue	30
Clay, gray, gritty, pebbly, strongly limy; typical unleached Wisconsin glacial till	40, 50, 60
Clay, very similar to sample above	70, 80
Clay, similar to samples above	90
Clay, slightly more yellowish than samples above, texture similar; only slight response to acid, indicating less lime	100
Clay, yellowish or greenish gray, very fine-textured, a few black pebbles, some yellow iron concretions; practically no reaction with acid. Evidently mostly preglacial shale	110
Sand, mostly dark gray angular limestone pebbles, mostly less than one-sixteenth inch in upper part, as large as one-eighth inch in lower part. Driller says this rock drilled very readily but was evidently vesicular, porous limestone, not gravel; water rose rapidly within 40 feet of curb. Casing would not sink faster than the drill	111–117
Shale, yellowish green, fine- and uniform-grained, not pebbly like glacial drift; not limy, no reaction with acid. Evidently this shale and the limestone above it are the upper Devonian beds that outcrop at Mason City	117–119
Limestone, dolomitic, gray, sugary texture, in coarse chips up to one-fourth inch in diameter; effervescence slow in cold acid, brisk in hot acid. Some clear glassy quartz chips, some black, not glassy, hard	125
Limestone, similar to above, chips up to one-half inch in diameter	135
Limestone, similar to samples above, in coarse powder and small chips	145
Limestone, grading into shale, much clay residue, medium gray; the harder chips are sugary	150
Shale, light gray, very fine texture, much lime	155

Dolliver State Park Well, Webster County

This well yields 32 gallons per minute with a pressure of 19 pounds. The curb of the well is 40 feet above the Des Moines River. Most of the

supply of water comes from the bottom. This well was drilled by F. S. McCutcheon of Des Moines in April, 1931.

Record of Strata	Depth in Feet
Mississippian:	
Limestone, light tan, in coarse chips, brisk effervescence in acid	112
Sandstone, light gray, very fine and even in grain, glassy or white; a little reaction with acid showing presence of some lime	120
Limestone, dolomitic, gray, rather fine-grained, almost entirely soluble in hot acid	130
Limestone, darker gray, finely granular, much residue after treatment in hot acid	200
Limestone, gray, in fine grains and powder, nearly all soluble in acid	220
Limestone, in somewhat coarser chips, otherwise similar	250
Limestone, similar to above; a large fragment consists of red and bluish white chert, similar to some seen in Dallas Center well at 650 feet	275
Limestone, light gray, brisk response to acid, a fragment of crinoid stem, in small chips	300
Limestone, in fine white and light gray grains, nearly all soluble in acid	340
Limestone, dark gray, finely granular, mostly soluble in acid; some chips of fine-grained sandstone	360–370
Limestone, light gray, in chips and granules which respond briskly to acid	375

Lacey-Keosauqua State Park, Van Buren County, Well No. 2

This well was located about six feet south of Drilled Well No. 1 and about 100 feet south of the southeast corner of the State Park Lodge. It was finished about June 1, 1932. The elevation of the drilling curb is 720 feet, and the curb of the finished well is 714 feet. A 10-inch casing extends from the top of the well to 104 feet below drilling curb with a driving shoe at the bottom. There is a lead packer at the top of the 8-inch casing and a burlap packing at 187 feet below curb. The 8-inch casing is perforated between depth of 188 and 207 feet. There is no casing in the well below the bottom of the 8-inch casing. The depth of the well is 455 feet and the yield is 13 gallons per minute. It was drilled by Thorpe Bros. Well Co. of Des Moines.

Driller's Log	Depth in Feet
Pleistocene:	
Clay, yellow; sandy between 30 and 40 feet	0–100
Pennsylvanian:	
Shale, black, with some coal	100–120
Mississippian:	
Ste. Genevieve —	
Limestone, white	120–139
Shale, light	139–148
Sandstone	148–150
Limestone	150–155
Shale, light	155–157
St. Louis —	
Limestone, white and gray	157–170
Limestone, magnesian (dolomite), containing water	170–202

Warsaw —	
Shale, gray, with some gray limestone, containing water in lower interval	202–259
Keokuk (Geode beds) —	
Limestone, gray; shale with chalcedonic silica	259–270
Limestone, gray	270–280
Shale, gray	280–283
Keokuk —	
Limestone and shale, gray	283–301
Shale, light gray, containing water	301–305
Limestone, with chert	301–365
Limestone, buff, porous, containing water	365–373
Burlington —	
Limestone, light, carrying water in lower interval	365–425
Kinderhook —	
Limestone, gray	425–443
Shale, gray	443–455

Pammel State Park, Madison County

This well was drilled to a depth of 696 feet, and the altitude at the curb is 955 feet. A 6-inch casing was put in to a depth of 398 feet; 178 feet of 5-inch casing extends from 377 to 555 feet; 174 feet of 5-inch casing extends from 514 to 688 feet. The static water level is 70 feet from the surface. Pumping 10 gallons per minute resulted in a drawdown 140 feet from the surface; pumping 15 gallons per minute lowered the water 177 feet from the surface; pumping 18 gallons per minute lowered the water to 207 feet from the surface.

Driller's Log	Thickness in Feet	Depth in Feet
Drift	17	17
Limestone	7	24
Shale, red	66	90
Rock, hard brown	2	92
Gray and black shale	32	124
Limestone	8	132
Shale, gray, with hard bands	68	200
Sandy lime rock	3	203
Gray shale	58	261
Gray sand shale	8	269
Gray shale	24	293
Hard bands	2	295
Gray shale	20	315
Sand rock	5	320
Red shale	4	324
Gray shale	9	333
Sand shale	5	338
Sand rock	2	340
Gray shale hard bands	12	352
Red shale	48	400
Gray and black shale	10	410
Coal	1	411
Mixed shale	52	463
Sandstone	20	483
Gray and dark shale	31	514
Coal	2	516
Light shale	4	520
Dark shale	29	549

Dark sand shale with sand rock bands	71	620
Shale and hard bands	40	660
White sand rock	32	692
Light gray shale	4	696

Record of Strata	Depth in Feet
Pennsylvanian:	
Limestone, light gray, coarse chips, finely granular	124–132
Limestone, similar to sample above	201–205
Limestone, darker gray than sample above, response to cold acid slight, stronger in hot acid, suggesting dolomite	317–322
Sandstone, light gray, fine-grained, tiny specks of white mica	340–342
Sandstone, similar to above, except that sample is all in powder	465–473
Sandstone, like sample above, also a little shale	473–480
Sandstone, dark gray, very fine and uniform; a little mica; a good deal of dark gray shale; no lime in shale, some in sandstone	665–675
Sandstone, like sample above	675–685
Mississippian:	
Sandstone, gray, fine, in chips; and limestone, gray, granular, quick response to acid (This seems to be the top of the St. Louis limestone)	685–692

Rush Lake State Park, Palo Alto County

The Rush Lake State Park well, in Booth Township, was drilled by McCutcheon Well Co. of Des Moines. It was drilled to a depth of 345 feet and finished in white sand. The well was cased with 4½-inch wrought steel standard weight pipe from the surface to 340 feet. A 4½-inch by 5 foot No. 14 slot Johnson Well Screen was fitted with a 17-foot length of 3-inch well casing threaded into shoe at bottom of screen, and collar was welded at top of screen, the pipe being perforated in side of screen. The 3-inch casing part of screen assembly is fitted at top with a 3½-inch standard pipe coupling turned to fit snugly inside of the 4½-inch well casing.

The water headed 126 feet below the surface, and it tested 30 gallons plus per minute.

Driller's Log	Thickness in Feet	Depth in Feet
Pleistocene and Recent:		
Soil and clay	20	20
Drift, gray	60	80
Sand, in streaks	30	110
Drift, gray	105	215
Drift, hard, yellow	25	240
Drift, bluish gray	90	330
Cretaceous:		
Sand, white		
Sandstone, Dakota?	15	345

Clarinda, Page County

On November 5, 1928, Iowa's First Oil Developing Company of Clarinda began the drilling of Wilson No. 1 oil prospect hole. It is on

the bottom lands of Nodaway River four miles south of Clarinda, on the Wilson farm, in the southeast quarter, southeast quarter, section 24, T. 68 N., R. 37 W., in Page County. The drillers were G. H. Rose and Son of Maryville, Missouri. The well was begun with a diameter of 15½ inches and was lined with 15½-inch casing to 25 feet. Thence the hole is 12½ inches in diameter to 506 feet and is cased with 12½-inch pipe to that depth. Below this point the diameter is 10 inches to 912 feet with 10-inch casing. At 912 feet the well was reduced to 8 inches with casing of the same size, and at a greater depth was reduced to 6⅝ inches.

A set of samples was furnished the Iowa Geological Survey by the driller. The samples were studied also by several geologists of Kansas and Oklahoma, among them Mr. Anthony Folger and Mrs. Fanny C. Edson. Many of their findings are incorporated in this record.

Record of strata of Wilson No. 1 oil prospect of Iowa's First Oil Developing Co., Clarinda.

	Depth in Feet
Pleistocene and Recent (25 feet thick; top about 988 feet above sea level):	
Glacial clay, yellow, sandy, noncalcareous	0–10
Pennsylvanian: Missouri series (690 feet thick; top 963 feet above sea level) —	
Limestone, gray, fine-textured, in light gray powder and chips, responds readily to acid; 25 to 31 and	33–36
Shale, blue, gray, drab, sandy	36–40
Shale, dark gray, calcareous, some small clear specks may be selenite (gypsum)	51–60
Limestone, light gray, finely crystalline	70–80
Limestone, dark gray, finely granular, some Fusulina	80–83
Limestone, or limy shale, in fine strongly calcareous concreted powder, light gray, some sand grains which may be from above	83–94
Limestone, light gray, fine-grained	94–102
Shale, bluish gray, very fine-grained, very slightly calcareous	102–140
Limestone, dark gray, very finely granular	140–144
Limestone, light gray, finely sugary, many small specks of pyrite	144–150
Shale, very smooth feel, rather light gray, noncalcareous	150–160
Limestone, light gray, finely sugary	160–165
Shale, dark gray, very finely gritty, limy; 2 samples	340–349
Limestone, dark gray, very fine-grained	353
Shale, bluish, purplish, fine-grained, limy; 4 samples	355–372
Limestone, gray, in fine powder and grains. Label says "salt water." Sample of water is decidedly salty	385–392
Shale, gray, limy, chips of limestone at 435; some bluish and whitish at 450; 6 samples	418–450
Limestone, light gray, finely sugary, some darker flakes are hard shale like that at 440; "top of lime below No. 27"	450
Shale, light and dark gray, finely gritty, limy; 3 samples	452–460
Limestone, dark gray, soft, very fine-grained, much very fine dark clay residue	462–465
Shale, dark gray, fine-textured, very little lime	465–467
Limestone, light gray, finely sugary	467–470
Limestone, white and light gray, in fine powder which is almost entirely soluble in cold acid	470–473
Limestone, gray, sugary texture; 2 samples	473–477
Limestone, blue-gray, fine texture	477–480

Limestone, gray, finely sugary texture ---------- 480–484
Limestone, dark gray, almost black when wet, finely sugary texture, some shale; 2 samples ---------- 484–493
Shale, finely gritty, dark gray, limy; sand grains 495–499; 3 samples-- 493–499
Shale, light gray, very finely gritty, limy; 2 samples ---------- 499–504
Limestone, light gray, in coarse powder, effervesces very freely in cold acid, some residue probably siliceous ---------- 504–505
Shale, limy, dark gray, soft, very smooth feel, also dark green, very finely granular, hard ---------- 505–510
Shale, light gray, finely gritty, limy ---------- 510–515
Limestone, light gray, in chips and powder, briskly effervescent, a very little light colored residue ---------- 515–519
Limestone, light gray, in grains and chips, packed with Fusulina and spines ---------- 519–523
Shale, dark gray, gritty with very fine sand; grains of limestone mingled in shale ---------- 523–530
Limestone, dark gray, somewhat shaly, granular, several specimens of fusulinids ---------- 530–535
Shale, dark gray, very finely gritty, quite limy ---------- 535–540
Limestone, dark gray, crystalline-granular ---------- 540–545
Limestone, dark gray, fragments oölitic, strongly effervescent, some dark residue ---------- 545–550
Limestone, light gray, crystalline-granular, in grains and chips, some of which contain Fusulina and other light colored masses, numerous black specks, 565-571; 4 samples ---------- 550–571
Shale, dark gray, finely gritty, limy ---------- 571–577
Limestone, dark gray, in small chips; some black fragments which do not respond to acid probably are black shale ---------- 577–581
Limestone, light gray, granular, readily effervescent; darker gray, 594–604; 4 samples ---------- 581–604
Shale, black, hard, laminated, numerous specks, probably mica, on parting planes ---------- 604–610
Shale, very limy, or limestone, shaly, dark gray, ready response to acid, but much dark very finely divided residue ---------- 610–615
Limestone, light gray, fine-grained ---------- 615–621
Limestone, light gray, sugary texture ---------- 621–627
Limestone, similar to above; and shale, black, hard, very fine-textured, mica specks ---------- 627–634
Shale, black, similar to above, noncalcareous, some reaction from mingled limy matter ---------- 634–640
Shale, light gray, noncalcareous, finely gritty, hard ---------- 640–645
Limestone, light gray, crystalline; 2 samples ---------- 645–652
Shale, gray, hard, finely gritty, nonlaminated ---------- 652–655
Limestone, light gray, similar to that at 645–652 ---------- 655–660
Shale, gray, noncalcareous, hard, some effervescence from powder in sample ---------- 660–665
Limestone, brown, crystalline, briskly effervescent; a little dark residue perhaps silica ---------- 665–670
Limestone, brown, with large clay content; and shale, greenish, fine-textured, limy, hard; much of sample is in powder concreted to hard masses; 2 samples ---------- 670–680
Limestone and shale, greenish gray, limestone subcrystalline, shale finely gritty, rather hard ---------- 680–685
Shale, gray, fairly hard, very fine-textured, very small lime content; some gray powder is briskly effervescent ---------- 685–691
Limestone, dark gray, fine-grained, with large clay content ---------- 691–695
Limestone, gray; and shale, dark gray and brown, slightly calcareous-- 695–702
Limestone, in white and gray crystalline granules very freely responsive to cold HCl; shale, blue-gray, chocolate-colored, hard, not limy; pyrite; 2 samples ---------- 702–712
Limestone, some clayey, some granular, readily soluble in cold HCl, light to dark gray; much shale, soft, greenish, reddish, gray, limy 712–715

Pennsylvanian: Des Moines series (895 feet thick; top 273 feet above sea level) —

Shale, gray and chocolate-colored, finely gritty, somewhat calcareous; samples contain some fragments of bright shiny brittle coal at 735–741 (bag says "Hit coal at 738–743, no cap rock") and at 741–745; 4 samples ---------- 715–745
Limestone, gray, clayey, fine-grained, in angular chips and flakes, brisk effervescence; shale, gray, finely gritty, perhaps one-fourth of sample 745–748, one-half of samples 748–750 and 750–755, some dark gray and brown in second sample; 3 samples ---------- 745–755
Shale, black and dark gray, laminated, strongly calcareous above, less below; 5 samples ---------- 755–785
Shale, dark brown, hard, slightly limy; some fragments of hard gray finely granular limestone ---------- 785–791
Limestone, light gray, fine-grained, very brisk effervescence, slight residue; shale, dark gray, limy, carbon streaks, mica specks; 4 samples ---------- 791–804
Shale, light gray, soft, calcareous, some flakes of dark gray limestone 804–808
Limestone, dark gray, hard; shale, dark gray, hard, limy; darker 822–827; probably some differences were detected by the driller, as noted in his log, but the samples are very similar; 7 samples -- 808–841
Shale, light and dark gray, some calcareous, some not, very fine-textured; 5 samples ---------- 841–876
Shale, similar to above, noncalcareous; sandstone, fine, light gray, noncalcareous; 2 samples ---------- 876–885
Shale, black, finely laminated, noncalcareous, some in large flakes; limestone, light gray, fine-textured ---------- 885–894
Shale, gray, very fine-textured, mostly noncalcareous; calcareous with some dark brown noncalcareous 904–906, mostly dark brown, noncalcareous 906–915, some gray limestone 915–920, somewhat calcareous 924–928, almost black 928–955, a few fragments limestone and sandstone 955–964; 18 samples ---------- 894–990
Sandstone, medium gray, composed of fine subangular clear grains of quartz, numerous white mica specks; shale, very dark gray, fine-grained, a few large chips 990-1000, abundant small chips 1000–1005, 1010–1018; 5 samples ---------- 990–1021
Sandstone, like that of sample above; shale, a few dark gray flakes, noncalcareous, but mostly in concreted masses of light gray, limy, fine-textured material ----------1021–1025
Shale, light and dark as above but noncalcareous; a few grains of quartz sand, perhaps from above ----------1025–1034
Shale, light tan to light blue, gritty, calcareous; limestone, some small light gray chips ----------1034–1044
Limestone, light gray, fine-grained, briskly effervescent in cold HCl; shale, light and dark gray, very fine-textured, noncalcareous; residue fine, hard, whitish grains probably chert ----------1044–1050
Shale, black, very fine-textured; a few fragments of bright coal (log says "Coal, very inferior, 1044–1057"); powder of sample gives some reaction with acid, residue includes chert ----------1050–1057
Shale, as above; sandstone, gray, fine-grained, in grains and small pebbles; a few grains of limestone ----------1057–1065
Shale, light to dark gray, finely gritty, calcareous 1065–1075, mostly noncalcareous below; some sandstone 1113–1119; thin films and lenses of limestone 1119–1125; concreted calcareous masses 1130–1140, quartz sand 1145–1170, 1193–1206; nearly black 1206–1245; 25 samples ----------1065–1245
Sandstone, medium gray, composed of fine subangular clear quartz grains; some bluish black shale, nearly gritless ----------1245–1251
Shale and sandstone as above, in approximately equal amounts ------1251–1265
Shale, dark gray, similar to above, no sandstone; calcareous 1287–1292; some samples concreted into hard masses, some in small chips; powder slightly calcareous 1320–1330, strongly so 1340–1350, but chips noncalcareous; black 1345–1350, dark tan 1350–1357, mixed black and tan 1364–1371, tan 1371–1377; 20 samples ----------1265–1384
Shale, gray and black, former finely gritty, latter almost gritless, all noncalcareous; sandstone, similar to those above, nearly equal

to shale in amount; powder contains some effervescent particles; 4 samples ---------- 1384–1410
Shale, very dark gray, finely gritty, noncalcareous, pyrite, a few small chips of coal 1417–1422; in small chips and grains, with some sand in fine rounded to subangular grains 1422–1427; more sandstone, in small gray pebbles 1427–1433; 4 samples ---------- 1410–1433
Sandstone, gray, grains fine to very fine, subangular to rounded, clear to translucent, a few white; a very little black shale 1433–1435; tan, grains more even in size 1435–1461; somewhat calcareous 1468–1474; some black shale and pyrite 1490–1495; 8 samples ---- 1433–1495
Shale, black and dark gray, in small chips, almost noncalcareous, some pyrite; sandstone, grains similar to those in sandstones above, small amounts 1495–1503, equal to shale 1503–1512; mostly black shale, with much pyrite 1512–1530; 4 samples ---------- 1495–1530
Shale, very dark gray, fine-textured, smooth feel, no lime; sand in fine frosted grains of irregular sizes; some concreted fragments of whitish powder which effervesces freely in acid but leaves a large residue of very fine material, probably "gypsum" of driller. Mostly shale at 1540 and 1563–1568; mostly sand at 1540–1545 and 1568–1575; about equal, 1545–1563; some fragments of shale show small pockets of fine sand and lime. Six samples ---------- 1540–1575
Shale and limestone, dark gray, shale finely gritty, some fragments black ---------- 1575–1580

Mississippian (406 feet thick; top 622 feet below sea level):
Meramec and Osage (315 feet thick) —
Limestone, light gray, finely crystalline; some dark gray shale in small fragments; some sand like that above (Driller's log shows that limestone begins at 1,610 feet) ---------- 1610–1614
Limestone, gray, very finely crystalline, in powder to small chips, response to acid prompt and long continued, 1614–1624; in powder and fine grains, with much sand in fine rounded frosted grains, 1624–1642; somewhat coarser granular chips below 1642 feet; darker gray, some chert, not much sand, 1647–1657; 9 samples ---- 1614–1657
Limestone, dark gray, very finely granular, some pyrite, ready response to acid; 2 samples ---------- 1657–1667
Limestone, bluish gray, in rounded chips and granules, a good deal of powder of gray shale ---------- 1667–1674
Limestone, similar to above except for absence of shale, in small angular subcrystalline fragments ---------- 1674–1680
Limestone, pepper and salt gray, in fine angular crystalline fragments, effervescence fairly rapid, fine white siliceous residue, 1680–1689; finer, rather slow reaction in acid, 1689–1697; somewhat darker gray, some clayey material, 1697–1702; prompt reaction, 1702–1712; brownish cast, 1702–1725; a large amount of white chert, 1721–1734; somewhat lighter gray and coarser, 1725–1729; some clay, less flint, 1729–1740; pepper and salt gray, clean, with much flint, sand grains and crystalline silica, 1740–1749; finer and more uniform, sample nearly all silica, 1749–1754; 16 samples ---------- 1680–1754
Limestone, similar to above, rather dark gray, with much light gray chert and some darker insoluble fragments; a little pyrite; limestone finely sugary texture; a little finer, lighter and more uniform of grain, 1765–1769, 1778–1792; larger chips of light chert, 1773–1778, 1792–1796; some chips of greenish shale, 1773–1787; chert same dark gray color as limestone, 1805–1810; nearly all chert and crystalline silica, 1810–1827; 15 samples ---------- 1754–1827
Shale and limestone; shale dark greenish, gritty, noncalcareous, in chips and powder; limestone gray, in powder and small chips, briskly effervescent; 3 samples ---------- 1827–1842
Limestone and shale, similar to above, except that limestone is predominant; chert abundant ---------- 1842–1845
Limestone, rather light gray, briskly effervescent, very finely granular; much chert, a few small chips of green shale, in fine grains, 1845–1853; somewhat more irregular sizes, pepper and salt gray with light chert and darker gray limestone, 1853–1862; finer, more

uniform grains, 1862–1875; somewhat clayey, 1871–1879; chert in irregular chips, 1879–1885, 1890–1896; all fine and uniform, 1885–1890; brownish cast, much insoluble residue, partly silica, partly clay, 1896–1904; 13 samples ---- 1845–1904

Shale, in green chips; limestone, in gray powder that effervesces rapidly; probably about equal parts ---- 1904–1908

Limestone, light gray chips and dark gray grains and powder; shale, in green chips, subordinate in quantity ---- 1908–1912

Limestone, light gray, in small grains, brisk effervescence, some siliceous residue; a few chips of green shale, possibly from above 1912–1916

Limestone, dark gray chips and powder, some flint; shale in gray chips and powder; 2 samples ---- 1916–1925

Mississippian-Kinderhook (91 feet thick; top 937 feet below sea level) —

Shale, light bluish gray, very fine-textured, strongly calcareous; less calcareous below 1943; dark gray, 1950–1955; same as at 1925 but not so highly calcareous, 1959–1968; 10 samples ---- 1925–1968

Shale, mostly light brick red, very fine-textured, strongly calcareous; dark brick red, 1976–1979; powder of all shale samples is more calcareous than lumps; 3 samples ---- 1968–1979

Shale, gray to blue-gray, fine-textured, noncalcareous; limestone, light gray, briskly effervescent, crystalline; apparently about equal, 1979–1988; mostly shale, 1988–1996; practically all shale, light blue, calcareous, 1996–2000; blue-gray, hard, fine-textured, chips show no reaction in dilute HCl, but when powdered they respond fairly briskly, as does the powder of all samples, 2000–2004; at 2004–2010 chips show no reaction, even when powdered and heated; somewhat calcareous, 2010–2016; 9 samples ---- 1979–2016

Devonian (85 feet thick; top 1,028 feet below sea level):

Limestone, with some shale, 2016–2021; light gray, crystalline, in chips and powder, with some blue flint, 2021–2030; 3 samples ---- 2016–2030

Limestone, rather dark greenish gray, finely sugary texture, ready effervescence in cold HCl; much dark greenish shale; all in chips and powder; a greater proportion of shale at 2047–2054; not many shale chips at 2068–2173 but much insoluble residue after treatment with acid; sample nearly all in grains, 2073–2076; many flakes of gray shale, 2076–2086, 2094–2097; numerous fragments of calcite may represent "gypsum" of driller's log; sample darker gray, 2081–2090; some light gray limy concreted masses, 2090–2094 (Mrs. Edson's slide 2090–2094 shows crinoid stems, some fragments of pitted surface, and other fossil); 15 samples ---- 2034–2097

Limestone, very light gray, in fine crystalline granules which react vigorously in cold acid, more so in hot acid, and all of which are soluble, leaving only a little very fine dark residue; much iron pyrite ---- 2097–2101

Silurian: Niagaran series (454 feet thick; top 1113 feet below sea level) —

Limestone, dolomitic, dark gray, finely crystalline, slowly responsive to cold acid but briskly so on heating; some white calcite; some dark fine residue; some chips of greenish shale may be from above; 3 samples ---- 2101–2116

Limestone, lighter gray, with much residue in chips, perhaps of chert; 3 samples ---- 2116–2130

Dolomite, dark brownish, finely crystalline, in small grains to fine sand which responds but slowly to cold acid but very briskly to hot acid; a few fragments of white calcite; in fine brown sand with fine white residual grains, 2144–2151; somewhat lighter sand with more fine silica, 2151–2161; residue much fine brownish silica, 2161–2175; only a little white siliceous residue, 2180–2186; lighter buff (finer, very little residue, 2198–2205; at 2212–2215 numerous flakes of bright black material, brown on exposed surfaces, does not melt or burn in flame but grows red and then returns to original color; light gray, much residue, 2215–2221; dark brown, little residue, 2221–2223; light gray, little residue, 2223–2225; dark gray, little residue, 2225–2232; lighter gray, little residue, some rounded sand grains, 2232–2251. No gypsum observed in any sam-

ples; 24 samples ---------- 2130–2251

Dolomite, dark gray and finely granular, light gray and more finely granular, all responding slowly to cold acid, briskly to hot acid; some white calcite which is strongly effervescent; a good deal of dark green shale as in many of the samples above. All in fragments one-eighth inch in diameter to fine powder. Residue is mostly shale with a little fine white powder which probably is siliceous, 2251–2258; more uniformly fine powder, some rounded sand grains, 2258–2263; a little coarser again, 2263–2269; more of the light gray dolomite, giving pepper and salt aspect, 2269–2275; more than half shale, remainder chiefly light gray dolomite, 2280–2290; 7 samples ---------- 2251–2290

Shale, dark green, as above, with perhaps one-fourth light gray dolomite, 2290–2295; about half shale, most of remainder red-brown dolomite and smaller part light gray dolomite, in fragments one sixteenth inch or less in diameter, 2295–2300; similar composition but in uniformly fine grains, 2300–2307; 3 samples ---- 2290–2307

Dolomite, rather light gray, in very fine subangular crystalline granules; a little greenish shale; considerable residue of fine white silica. Bag says "Unable to catch cuttings for 15 feet, 2307–2323." Lighter gray, almost no shale, nearly all soluble in acid, 2321–2340; still lighter and flourlike, almost entirely soluble, 2340–2374; sample at 2374–2380 is similar except that it yields much dark residue, which is very light and flocculent and in this condition occupies twice the bulk of the original sample; a little coarser, 2390–2420; sample mostly silica in small clear angular grains, 2395–2400; finer and more flourlike, a little cherty residue, 2420–2430. Evidently the rock from 2307–2430 is a unit, as all samples are similar except for minor details as noted; 24 samples ---------- 2307–2430

Dolomite, light gray, in very fine granules, slow reaction in cold acid, very similar to samples above, a little siliceous residue; finer and more flourlike, small residue, 2445–2449; large fine white residue, 2451–2455; concreted masses of light gray flourlike material and slightly coarser, darker gray, nonconcreted dolomitic sand, "could not catch cuttings at 2460," 2455–2465; much cherty residue, 2479–2484; slightly darker and coarser, 2500 to 2505; grains sugary, 2520–2528; mixture of light and dark gray fragments, much light gray chert, 2547–2551; dark gray, much chert, all in small grains, 2551 to 2555. All the above samples are similar to each other as well as to those from 2307–2430; 27 samples ---------- 2430–2555

Ordovician:

Maquoketa formation (40 feet thick; top 1,567 feet below sea level) —

Shale, light bluish gray powder, very fine textured; with limestone in fine grains which give the mass a finely gritty feel (Mrs. Edson's slide 2555–2581 shows bryozoa, round plates with boss in center.) 2555–2560

Shale, dark green, in large chips which are decidedly gritty between the teeth. In hot acid the chips show some reaction and disintegrate into small insoluble fragments. This sample is more argillaceous and siliceous than the one above ---------- 2560–2565

Shale, medium green, finely gritty, some reaction in hot acid, numerous grains of pyrite. In dry powder and small chips, some concreted masses, 2565–2568; grayish, otherwise similar, 2568–2571, bag says "Taken off end of bit;" 2 samples ---------- 2565–2571

Shale and limestone mingled, shale in small green chips and flakes which react somewhat in hot acid; limestone in subangular sugary granules which effervesce strongly in hot acid but only slightly in cold acid, showing that they are dolomitic. The two elements are present in about equal parts, 2571–2575; similar, but more dolomite, 2575–2578; 2 samples ---------- 2571–2578

Dolomite, light gray, in fine powder and concreted flakes, brisk reaction in hot acid but large residue, 2578–2581; similar but in somewhat coarser granules, 2581–2585; darker gray, a few fragments of white hard brittle substance probably chert, 2585–2590; similar, some translucent chert, a little pyrite, 2590–2595 (Mrs.

Edson's slide at 2585–2590 shows fragments that may be bryozoa. She calls them Galena); 4 samples ---------- 2578–2595

Galena, including Maysville-Eden? (328 feet thick; top 1,607 feet below sea level) —

Quartz, white and gray, mostly granular, some clear crystalline fragments; a little limestone or dolomite; pyrite, samples similar to that from 2578–2581, 2595–2615; similar but in smaller fragments and more quartz, 2620–2628; coarser again, 2628–2633; concreted lumps and rather fine powder of quartz and dolomite. Effervescence in hot acid brisk but of short duration, much residue of quartz chips, 2633–2636; range of sizes somewhat less, chips to coarse powder, 2636–2640; more than half of sample is quartz, not much dolomite, 2640–2656; some flint, a little pyrite and dolomite, 2656–2669; mostly quartz in small angular fragments, some dolomite, 2669–2681. (Some chips of shale intermingled in these samples are thought to be fallen from above.) 10 samples ------ 2595–2681

Quartz, gray, finely granular, chips and powder, chips show a little effervescence as if they contained some dolomite; some pyrite, 2681–2690; quartz, in more uniform fine granules, 2690–2716; some calcite, silica in crystalline granules, 2716–2723; a fragment one-fourth inch diameter shows that the rock is composed of subcrystalline granules, is minutely cavernous and contains a little dolomite; mostly of quartz, in small white granules, 2723–2727; some white calcite, a little finely granular quartz; some pyrite, 2727–2736; more calcite and silica, 2736–2745; some chert in white angular fragments, no calcite fragments evident, a little dolomite, 2745–2751; mostly white chert, 2751–2754; chert, a little crystalline quartz, 2754–2764; mostly chert, 2764–2769; some chert, a little granular quartz, 2769–2774; a little calcite and granular quartz, no chert observed, 2774–2784; mostly chert, a little quartz, a little reaction with acid, 2784–2793; quartz, 2793–2802; quartz and chert in small fragments, 2802–2806; 26 samples ---------- 2681–2806

(The driller states that cavings from shale about 2,575 feet have been falling and mingling with the lower cuttings. Perhaps most or all of the shale noted in samples has fallen from that layer. Hole at 2,900 feet was open from 2,010. Rock drilled very slowly through the cherty beds.)

Chert, milky white, in sharply angular fragments, apparently same as that in previous samples; a few rounded grains of clear quartz, a few fragments of finely crystalline quartz; a little pyrite; slight reaction in hot HCl, indicating a very little dolomite; a little shale in small chips, may be cave, as suggested above; 3 samples ------ 2806–2822

Chert, mingled white and brownish gray, with a little gray and brownish gray dolomite, 2822–2828; slightly more reaction, only a little white chert, 2828–2837; 3 samples ---------- 2822–2837

Chert, white, similar to that above 2822, a little more dolomite, 2837–2841; a large amount of gray to white calcite and dolomite in subcrystalline granules, some crystalline quartz, 2841–2845; 2 samples ---------- 2837–2845

Dolomite, light gray, finely granular, fragments small, some rounded, some subangular; a little white chert. This sample is gradational from those above. Half of the sample dissolves in hot acid, 2845–2849; similar but with more calcite and dolomite, 2849–2852; almost all dolomite and calcite, very little chert, not much residue, 2852–2857; similar but darker, brownish, much shale, which is of same character as in all samples above, 2857–2862; similar brown, 2862–2873; much shale in sample, 2866–2873; driller says this is cavings; 6 samples ---------- 2845–2873

Dolomite, similar to samples above, brownish gray, crystalline-granular, strong reaction in hot acid; some white calcite; some shale and a few crystals of pyrite, 2870–2875; very similar but with some white chert in angular fragments, 2875–2883; similar but lighter gray, 2883–2891; dolomite in smaller granules, silica in white hard chalklike rounded fragments, also a little angular chert,

2891–2894; similar but darker gray, 2894–2923; dolomite, about same color as at 2875, in fine crystalline gray powder, nearly all of which dissolves in hot acid, except the fine shale, increasingly finer in the lower samples, 2923–2945; coarser, brownish, similar to samples above 2923; samples show much shale and pyrite, some response in cold acid, brisk in hot acid, 2945–2950 (Mrs. Edson's slide at 2910–2915 shows more of the round embossed plates, also other rounded fragments like cephalopods or gastropods); 17 samples ----------2873–2923

Decorah formation, Ion, Guttenberg and Spechts Ferry members (36 feet thick; top 1,935 feet below sea level) —

Dolomite, as above, in fine gray and brown crystalline granules, and shale, brown, fine-textured, on heating in test tube gives off heavy gray fumes and brown oily droplets, with petroleum odor ------2923–2959

Platteville (33 feet thick; top 1971 feet below sea level) —

Dolomite, similar but with very little of brown shale, 2959–2964; similar, no brown shale evident, 2964–2979; some white chert, rounded frosted colorless quartz grains, milky white quartz fragments, along with much shale from above, 2979–2992. All of these samples in unwashed condition are brownish, aside from the green shale, which has fallen from above and which is present in nearly all samples. However, washed fragments of dolomite are gray and brown (Mrs. Edson's slide at 2950–2995 shows fragments of fossils, a possible ostracod, bryozoa, gastropods, and other forms); 8 samples ----------2959–2992

Saint Peter sandstone (30 feet thick; top 2,004 feet below sea level) —

Sand and dolomite, in about equal parts; sand in fine rounded frosted colorless grains; dolomite appears to be very similar, also in powder (Bag says "hit at 2999"), 2995–3006; very little reaction, almost all sand grains, 3017; some white granular calcite and a little colorless dolomite, 3018–3022; 4 samples ----------2995–3022

Prairie du Chien formation:

Shakopee dolomite (103 feet thick; top 2,034 feet below sea level) —

Dolomite, essentially similar to that above 2,995, brownish gray, granular; a little white calcite; a little chert; some sand grains like those above; much green shale fallen from above, 3022–3033; dolomite in fine gray concreted granular powder which responds somewhat to cold acid, briskly to hot acid, with a very fine suspended residue; sample similar to those from 2923–2945, 3033–3038; somewhat coarser loose dark gray powder, some granular insoluble residue, 3038–3041; fine powder, like that at 3033–3038; light gray, 3042–3050; slightly coarser, mostly nonconcreted, a little siliceous residue, 3050–3060; 5 samples ----------3022–3060

Sample consists chiefly of sand, etc., from concrete with which hole had been filled; numerous chips of green shale from above; some small whitish masses of rather fine powder, evidently from dolomite. These dissolve slowly in cold acid with very little residue; 4 samples ----------3060–3079

Still includes abundant chips of green shale and some concrete but most of sample is small fragments of white calcite, or perhaps dolomite, as they dissolve rather slowly in cold acid; 2 samples--3079–3085

Almost all dolomite in fine clear or whitish granules, very little residue (very few shale chips below 3,100); a fragment of oölitic chert at 3120–3125 ----------3085–3125

New Richmond (38 feet thick) —

Some glassy frosted rounded grains of sand, 3125–3129; these constitute nearly half the sample at 3139–3143; sample at 3157–3163 whitish because of presence of much white powder, but mostly soluble in hot acid; some sand in clear rounded grains, some concrete ----------3125–3163

Oneota dolomite (182 feet thick) —

Dolomite, small chips, 3163–3168; sample shows rock to be nearly white, translucent, very finely granular dolomite; dolomite, as above, no sand seen, 3168–3172; a little darker and coarser at

3172–3187; same, in sparkling crystal fragments, 3187–3192; very fine again at 3197–3203; darker gray, chips of green shale from above, 3203–3213; light gray, fine-grained, 3217–3238; a little darker, 3238–3243; very fine-grained, entirely soluble, 3243–3259__3163–3259

No samples; driller says cuttings too fine to catch _____3259–3270

Dolomite, light to dark gray, in very fine grains, similar to samples above, 3270–3303; a little white residue, probably siliceous, 3303–3321; no sand grains, silica in white brittle masses; 10 samples __3270–3321

Dolomite, similar to above, light gray, in very fine fragments, showing that rock is crystalline, a little very fine siliceous residue____3321–3345

Cambrian:

Trempealeau formation —

Jordan sandstone (30 feet thick; top 2,357 feet below sea level) —

Sandstone, more or less rounded grains, fine residue of dolomite somewhat abundant, 3345–3349; brownish gray and with a fair amount of fine clear sand in rounded grains, 3349–3353; no sand grains, very little residue, in samples below; 12 samples _____3345–3375

Lodi member (25 feet thick) —

Dolomite, brownish gray, still in very fine fragments, very small residue. Mr. Bednar says cuttings for 65 feet were so fine they floated away; reddish tinge at 3394, due to film of iron oxide on grains; sample at 3400 mainly chips of white granular dolomite with sparkling faces _____3375–3400

St. Lawrence member (68 feet thick) —

Chips at 3405 similar to those at 3400 but darker gray; fragments from 3412 "Bailing with sand pump, no cuttings;" sample at 3423 brownish gray, similar to that at 3390, almost no residue; light gray, very fine and flourlike, coheres in cakes, 3431; darker again but still very fine at 3438 and 3442, light gray at 3449–3451, no residue; a little more brownish but otherwise similar at 3457–3463, a few gray chips at 3468, most of sample fine grains, no sand or shale _____3400–3468

Franconia formation (108 feet thick; top 2,480 feet below sea level):

Dolomite, similar to that above but with much dark green noncalcareous shale in small chips, a little residue of white silica but no sand grains, 3473–3478; similar, only in coarser fragments and darker gray with pinkish tinge, some fragments "off the bit" show clear crystal faces, 3482; shale forms perhaps one-fourth of these samples; 3 samples _____3473–3482

Shale and dolomite; several large fragments show the two intermingled in the natural state. Small rhombohedral crystals are embedded in the green shale. Sample is one half dolomite _____3482–3484

Shale and dolomite; shale dark green, gritty, noncalcareous; dolomite light gray, angular, as in samples above, forms three quarters or more of sample, 3486; more shale, perhaps one-third at 3491, giving darker gray aspect to sample; similar but finer, 3494; more shale, some chips one-fourth inch in diameter, 3498; "No cuttings 3498–3502; shale and rhombic dolomite crystals intermingled, some flakes of impure iron ore(?) 3507; less dark shale, dolomite pinkish, 3520–3537; finer, less shale, 3543–3552; coarser, still pinkish, more shale, a little pyrite, as in most samples of this shale, 3556–3576 _____3486–3576

Dresbach formation (435 feet thick; top 2,588 feet below sea level):

Galesville member (54 feet thick) —

Probably one-half sand, in fine grains, mostly rounded and clear, a few angular, a few frosted, 3582; sandstone, fine clear grains, not many frosted, many angular; very little shale or dolomite, 3587; more shale and dolomite at 3593. Mr. Bednar says "We got (the sand) at 3582 and had 8 feet of it and then went into another lime shell. The last sample, marked 3593, is another sand"_____3576–3593

Sandstone, many grains colorless, rounded and frosted, some broken and subangular, many coated with red film of iron oxide, fragments of the rock are seen to be composed of many of these grains; a little dolomite in white rhombic crystals, from above;

some green shale, fallen from above; the entire set of samples has a distinct red-brown color; a little finer, with concreted masses of almost flourlike grains of clear quartz and brick-red dust, at 3581–3598 ---------- 3600–3630

Eau Claire member (255 feet thick) —

Sandstone, as above, a little dolomite in rhombic crystals, and a little shale as above, an occasional flake of muscovite mica; more red dust at 3625, 3632, 3655, and becoming gradually but distinctly lighter in shade below 3655 so that below 3700 the samples have a buff or pinkish tinge, also fewer grains are coated with iron oxide; grains finer at 3718. The entire deposit so far seems to be uniform; there are no divisions below 3570. The grains are not so even in size as are those of the typical Saint Peter, and the broken condition of many of them suggests rather firm cementation; 29 samples ---------- 3635–3794

Sandstone, grains rather small but irregular in size, many rounded, some frosted, but more clear and glassy, some broken and subangular, some pinkish like rose quartz, very few grains showing coating of iron oxide, sample has light pink tinge, essentially like samples described above; a few fragments of white dolomite and a few flakes of green shale; an occasional flake of muscovite mica; a little finer and more uniform at 3808, 3814, 3885 ---------- 3801–3885

Mount Simon member (126 feet thick) —

Sandstone, with fragments of white dolomite and a little green shale; occasional flake of muscovite mica; original fragments of rock crush easily under a knife blade or even with the fingers ---------- 3885–3914

Sandstone, grains mostly clear or nearly so, mostly rounded, some subangular as if broken from larger pieces, a few white, grains generally more uniform in size than in some samples above, otherwise similar to material within the overlying three hundred feet or so; a few pink to dark red fragments are seen to be composed of an aggregate of fine grains with red shaly cement and a few mica flakes; the whole sample has pinkish tinge; a few small cleavage pieces of white dolomite and a few fragments of green shale, 3920; a little more material that is coarser, making sample less uniform, 3926, 3933, 3939, 3948, 3962, 3967, coarser still at 3957, somewhat finer at 3972. A duplicate sample from 3926 is a concreted mass of quartz grains and red shale. This and the fragments mentioned above probably represent fairly well the character of the original rock. The cleaner sands are washed samples; 10 samples ---------- 3920–3972

Shale, sandy, or shaly sandstone, consists of sand grains as above with red shale matrix, in concreted blocks, sand grains irregular in size, shale very finely gritty. This material probably is similar to that above except that the shale has not been washed out of these lower samples; 2 samples ---------- 3979–3991

Sandstone, many grains very fine, some a little coarser, in general finer than samples above 3979 but otherwise similar in color and content; numerous flakes of muscovite mica; 4 samples, 3997, 4002, 4006 ---------- 3997–4011

Red Clastic series, probably Middle Cambrian or earlier (penetrated 1,275 feet; top 3,023 feet below sea level):

Sandstone, grains mostly clear, some stained reddish or pinkish, some frosted, irregular in size, from powder to grains one-eighth inch in diameter; a few crystals of dolomite, a few fragments of green shale; a few flakes of mica; some samples a little finer and more uniform; a few small hard brittle whitish to pinkish fragments are perhaps feldspar, as they show smooth cleavage faces and no response to acid; more red clay at 4110 and much more at 4116, a little less at 4126–4134. These samples are very similar to those described previously and evidently belong to the same formation. Mr. Bednar writes: "This shale is running in streaks, I think, and thicker in places." The presence of mica and feldspar with the quartz sand and shale suggests that this rock was

formed from the erosion and partial decay of granitic rock at no great distance from here, perhaps in southern Minnesota, or on Nemaha Island, part of the now buried ridge in eastern Nebraska; 18 samples ---------- 4011–4134

Shale, dark pinkish red, finely sandy, gritty but noncalcareous, some sand grains over one-sixteenth inch in diameter, 4143; many coarser grains at 4149; fine-grained and brick-red at 4154, 4159, 4166 (this sample mostly shale); dark pinkish red, about equal parts sand and shale, 4184; dark red sandy shale, 4216; pinkish red finely sandy shale, 4271. Samples mostly sand, grains irregular in size, very fine to one-sixteenth inch and over, some clear, some frosted, many rounded, some broken, a few fragments probably feldspar, a few flakes of mica, very little clay, samples pinkish, 4164 (Bag says "1½ feet, sand, rest shale"), 4200, 4209, 4255 (much green laminated shale caved "from about 1000 feet up"), 4234, 4244, 4254 (more pinkish shale), 4262 (some shale), 4280; 17 samples ---------- 4143–4280

(These samples evidently represent a part of the same formation as do the 18 samples previously described. There is no definite change in character, though shale is more in evidence than in higher layers. The red color of this shale and the character of the sand grains suggest rocks broken down under somewhat arid conditions.)

Shale, finely sandy, dark pinkish red, similar to material above, 4287; similar but lighter pink, 4295; still light red, sandy material coarser, some grains over one-eighth inch in diameter and angular, a rounded black diorite pebble one-fourth inch in diameter, 4305; sand a little finer, 4314; very fine-textured, 4334, 4351, 4361; slightly coarser, similar in color, 4372; more coarse sand, up to one-sixteenth inch or over, 4381. Sample all sand, grains small, none over one-sixteenth inch in diameter, nearly all clear, some pinkish, mostly rounded, some more or less angular, a few angular fragments of white quartz, a few flakes of mica, 4324; similar but somewhat coarser in grain, sample pinkish from clay, 4341; quartz fragments up to one-eighth inch in diameter, otherwise similar, 4390; few grains exceeding one-sixteenth inch, enough red clay to give pinkish color to sample, 4397. Most of the samples contain a few flakes of green shale, some of them fine-grained and all clay, perhaps from the Maquoketa. Other fragments are filled with the small crystals of dolomite that are characteristic of the Franconia in this prospect. 13 samples ---------- 4287–4397

(These samples are alternatingly more or less sandy red shales, which have been quite similar all the way below 3560 feet.)

Shale, sandy, or shaly sandstone, light red, clay matter ranges from more than half to almost nothing; sand grains mostly colorless, glassy, some rounded and frosted, some irregular; fine powder to one-sixteenth inch in diameter; 4408, 4426, 4434, 4450.

Samples mostly sand, grains similar to those just described, a few flat pieces of laminated micaceous fine-grained sandstone, which doubtless supplied the flakes of clear colorless mica seen in the loose sand; most of these samples have a pinkish tinge, due largely to clay powder, 4415, 4441 (Bag says "sandy shale," shale evidently washed out), 4456; samples mostly sand, some clay, 4468, 4477; more clay at 4485, 4505.

Sand, fairly clear, as in samples above, except that some grains are stained red, some fine brown powder imparts its color to the samples, some white fragments of dolomite react with hot acid, 4488; sample again light pinkish like those above the previous one, very slight reaction to hot acid, 4496; all sand, 4513, 4531, 4559, (a grain of pyrite), 4574.

Samples mostly sand at 4522, 4538, 4546 (some white dolomite grains); a little more clay at 4568, 4581; 22 samples ---------- 4408–4578

(These samples are still similar to those above. Fragments of

shale with tiny dolomite crystals are found in most of the samples and so reaction to acid may be expected in any of them. The response to acid at 4461, however, seems to be from some dolomite in place. No lime was found at 4559.)

Sand, gray, grains irregular in size, one-eighth inch to flourlike particles, clear and glassy, very slight reaction with acid from white specks of dolomite which may be from shaly material from above, as masses of shale with included dolomite crystals are present, some fragments of pink feldspar and muscovite mica, 4585, 4591; grains finer and more uniform, brownish from iron rust apparently, numerous flakes of mica, some chips of fine-grained greenish gray micaceous sandstone, 4594; similar, most grains clear, some white, some pinkish, many perfect rhombohedrons of dolomite from shale above, 4599; grains fine and uniform at 4605; reddish tinge, some concreted masses of sand and pink clay, 4616.

Shale, pink, very finely gritty, no lime, 4621, 4624, 4628.

Sand, brownish red, grains small, mostly clear, some white, a little mica, some reddish clay, 4631; similar, except that clay makes about one half of bulk, 4635; similar at 4638, a little lime present, several pieces of greenish gray dolomite with some perfect rhombohedral crystals, also some darker greenish fragments, more laminated and with some shale, 4638; all reddish fine sand, some lime reaction, 4662.

Shale, dark red, finely sandy, contains some lime, 4668, 4674.

Sand, dark red, very fine, mica flakes, some lime, 4671, 4677; light pink, somewhat coarser, very little lime or clay, 4683; dark red again, much clay, a little lime, 4686; gray, very fine, some brown rust, either from iron in matrix of sandstone or from some introduced iron, a little lime, 4688; dark red, very fine, numerous flakes of mica, strong reaction for lime, 4690; gray, fine to rather coarse, one-sixteenth inch, some lime present, 4699, 4704; dark red with brown rust, very fine, strong lime reaction, 4708; 25 samples ----4585–4708

Samples received July 13, 1932.

	Depth in Feet
Clay, dark red, very finely sandy, no lime, corrected depth ----------	4710
Clay, more sandy than above, red-brown ---------- (Both of these samples give off a faint odor of sulphur on being heated and become lighter in color, perhaps due to oxidation of some organic matter.)	4716
Sand, light brown, with small rounded grains of quartz, some clear, some white; a few grains are angular; some fine tan-colored powder may be feldspar; a few grains of muscovite mica; much magnetic iron, which may be from the drill or may be native to the rock; largest grains are not over one-sixteenth inch in diameter ----------	4723
Sand, dark brown, in fine grains, many of which are angular; some flat fragments of iron oxide; some fine brown powder, iron as above ----------	4730
Clay, dark red-brown, sandy, similar in all respects to first two samples, sticky, stains fingers ----------	4735
Sand, very dark brown, fine grains, some angular, some rounded, some fine powder, of which the black portion is magnetic; some grains are clear quartz, some opaque as if of other minerals, many are iron oxide. Gives off sulphur odor ----------	4737
Sand, similar to above, much magnetic iron in powder ----------	4740
Sandstone, red, in angular grains and fragments, some clear quartz, some white, but most grains are really fragments composed of many fine grains; some small muscovite mica flakes ----------	4745
Sandstone, red, rather soft, fine uniform grains ----------	4749
Sandstone, similar to above, but sample is mostly pulverized (June 23, 1932) ----------	4755
Sandstone, red, similar to above, mostly very fine red grains but some	

clear glassy angular quartz ---------- 4773
Sand, clayey, or sandy shale, red, similar to above, but in finely gritty powder and concreted lumps; a few chips show this rock to be similar to that above; 3 samples ----------4797, 4800, 4803
Sandstone, bright red, fine-grained, much material that is a little coarser, irregular in size, subangular to rounded, clear quartz, white fragments perhaps chalcedony, muscovite flakes, pellets of smooth red clay like pipestone, but practically no clay in matrix-- 4810
Sandstone, red, similar to above, but more red clay pellets and white granular quartz ---------- 4814
Sandstone, similar to above, except that more quartz is in clear subangular grains ---------- 4822
Sandstone, light red, fine-grained, grains subangular; none of the red clay pellets; might be quartzite (July 4, 1932) ---------- 4829
Sandstone, similar to above but brown in color ---------- 4832
Sandstone, or quartzite? red, like sample at 4829 ----------4834–4840
Sandstone, red, like two above; with chips of light blue-gray sandstone, rather soft. Probably this is what driller calls "green shale" at this depth ---------- 4850
Sandstone, brick red, very fine-grained, numerous mica flakes; 3 samples ----------4860, 4865, 4869
Sandstone, red, similar to above, but grains irregular in size, very few clear quartz grains; some greenish sandy shale flakes; some concreted masses of very fine light red sand or shale ---------- 4874
Sandstone, brick red, very fine like that at 4860–4869; 2 samples ----4880–4885
Sandstone, light red or brown, rather fine grains ranging from powder to one-sixteenth inch in diameter, angular to subangular, clear quartz, also some opaque fragments; muscovite mica ---------- 4890
(This sample looks much like those above 4670 that were called quartzite. Very little clay is present in the samples from 4880 and 4885. Nearly all of the sample is sand, a good deal of it in very fine grains.)

Samples received October 6, 1932. DEPTH IN FEET

Sand, or sandstone, brown, grains small, subangular, mostly clear and glassy, some reddish; brown color of sample is due to some dark clay matter. Some muscovite mica in flakes up to one-eighth inch in diameter. One small fragment of rock is a brownish red sandstone ---------- 4890
(This sample is from the same depth as the last one in the previous shipment, which is much brighter reddish. Possibly this was a washed sample, as the one just received is more reddish after being washed.)
Sandstone, similar to that above, with addition of several thin flakes of magnetic iron, which seem too brittle to be metallic, from tools, 4895 and 4900; lighter pinkish brown at 4904; more reddish at 4908; darker red at 4912 and 4916 and with many flakes of iron, some of them more than half an inch long; six samples -------4895–4916
Sandstone, light reddish or brownish, very similar to the first samples at 4890; numerous flakes of muscovite mica; a few pieces of iron as in samples above; perhaps washed ---------- 4923
Sandstone, in very fine grains, dark brown, similar to that about 4900, some flakes of iron; a small fragment is composed of fine grains of sand and is finely laminated. The dark color of the sample is due to red-brown clay. White limy shale in fine powder ------- 4930
Sandstone, or quartzite, light reddish, many angular fragments of glassy quartz, appear as if broken from the mass, some grains are subrounded; some mica flakes. This sample appears more like typical quartzite than do most of those immediately above. It resembles that from 4923, and like that one it may have been washed ---------- 4936
Shale, brownish, very finely gritty, with numerous small white masses which are limy, soft and even more fine-grained than the brown-

ish part. The driller describes this as "chalk white shale, did not test for lime." The brownish material is not limy. Some mica ---4936–4941

Shale, white, exceedingly fine-grained, responds readily to acid, showing a large percentage of lime, but with much residue. Described by the driller as "white shale, or chalk, white, shaly" ----------4936–4941

Shale, dark red-brown, fine-textured, concreted into lumps. After being washed the sample shows some fine grains of sand, some clear, some red, also small fragments of red sandstone, not hard enough to be quartzite; a small green fragment that looks like shale with specks of pyrite; white limy shale at 4941; 2 samples--4941–4947

Sandstone, dark red-brown, without enough clay to bind the sand together. Grains very small and uniform, stained red. Several large fragments show the rock to be a fine- and uniform-grained dark red sandstone with fine mica flakes on the bedding planes and some greenish shaly patches; 2 samples ----------4953–4959

Shale, dark brown with shade of reddish, in concreted lumps, much very fine sand; some fragments of gray rather soft sandstone and one of dark red shale with smooth feel. A few flakes of magnetic iron similar to that from 4895–4930 ---------- 4964

Sandstone, red-brown, composed of very fine red sand grains with enough clay to form some lumps. Several flakes of red shale with green patches ---------- 4969

Sandstone, dark red, mostly fine red sand grains with some clear ones; many small fragments of dark red sandstone, also some large chips of dark red, very fine-grained sandy shale ---------- 4975

Shale, dark red-brown, similar to that at 4964 ---------- 4978

Sandstone, dark red, grains fine, but irregular in size, mostly rounded, mostly red, some clear; a number of fragments of dark red fine sandstone, some shaly. White limy shale ---------- 4982

Sandstone, dark reddish brown, very fine-grained and uniform, some clay ---------- 4985

Shale, similar to sample above but with more clay, samples have a gritty feel from fine sand; washing this material reduces it greatly but leaves a residue of very fine red sand; 4 samples ----------4991–5004

(Very few of these samples from 4890–5004 have the characteristic quality of quartzite — the breaking through the grains rather than around them. Most of the sands seem to be from sandstone of average hardness; some samples are clay shales — all strongly stained red by iron. No trace of lime was found except in the concreted masses of white shaly powder in the samples from 4930, 4941 and 4982 and in the sample of white shale from 4936–4941.)

Shale, dark reddish brown, very fine-grained, a few small specks of mica; similar to samples above; 4 samples ----------5009–5023

Sandstone, dark red-brown, grains fine but irregular, some rounded, many subangular, mostly dark red, some clear. Some fragments of dark red fine-grained sandstone; some small specks of mica. Sample marked "washed" ---------- 5029

Shale, black, very finely gritty, concreted into lumps; gives off distinct sulphur odor when heated slightly and turns brown on further heating, while light colored fumes are driven off. On digestion with ether a yellowish greasy scum remains on the dish. This will burn in the flame. After being washed the residue is fine red sand, like that above. The samples appear to be similar to those above except that they may have been stained by oil from the drilling machinery or some such means; 2 samples ----------5034–5039

Sandstone or shale, dark brown, very fine-grained, similar to sample above except that it has a larger percentage of sand and is not black. Gives off a slight sulphur odor when heated. Residue after washing is very fine red-brown sand. Lower sample contains more clay; 3 samples ----------5044–5055

Samples taken from 5055 to 5150 feet deep, sent November 24, 1932.

	Depth in Feet
Grains of quartz mica, probably metallic iron, and some brownish shale. Most of the sample is attracted by the magnet. Sample bag says "cavings off walls after standing a month"	5055
Shale, dark brown with reddish tint. Some flakes of mica, some metallic iron and some iron oxide, also a little very fine quartz	5060–5065
Shale, reddish brown, a little metallic iron and iron oxide, flakes of mica	5070–5093
Shale, light reddish brown, similar to samples above	5098–5113
Shale, light reddish brown, similar to samples above	5117–5122
Shale, light reddish brown, some metallic iron and iron oxide similar to above	5125–5129
Shale, light reddish brown, like that between 5117 and 5122 feet. Minerals similar to those in other samples	5134
Shale, light reddish brown like that between 5070 and 5093 feet. Similar to samples above	5140
Shale, light reddish brown, like that of several beds above. Minerals like those above	5145–5150

Samples from Clarinda Prospect. Received May 19, 1933.
Depth of samples, 5150 to 5250 feet.

	Depth in Feet
Shale, very fine texture, reddish brown, ocher-like, very little metallic iron, a few mica flakes, mostly fine quartz grains; three samples	5156–5164
Shale, similar to samples above but a little more coarsely sandy	5173
Shale, similar to sample above but finer, like those from 5156–5164; 3 samples	5175–5184
Shale, similar to three samples above, but very slightly coarser	5186
Shale, similar to above, but slightly finer	5189
Shale, a little finer than sample above, a number of white mica specks	5194
Quartz sand, mostly clear fragmental quartz, with enough iron rust to give reddish color to the sample, some black magnetic iron, some whitish soft fragments, may be kaolin, some mica flakes	5201
Sand, similar to sample above, except for smaller amount of black iron and absence of white kaolin?	5206
Sand, grayish, otherwise like sample above; a few fragments of shale, red, mostly very fine, with thin films of mica flakes, at 5212; 2 samples	5212–5217
Sand, reddish, mostly quartz, some rusted, much mica in small flakes	5220
Sand, similar to above sample, some flakes of shaly material, grayish green, fine texture	5222
Sand, reddish gray, similar to samples above	5226
Sand, similar to sample above but more grayish; two samples	5234–5236
Sand, dark brownish gray, very fine and uniform grains, much mica, as in all the samples from 5201 down	5240
Sand, dark reddish brown, with gray tinge, somewhat coarser than sample above. Several slabs of greenish gray rock, micaceous, schistose, very fine texture, as if it were an altered shale	5244
Sand, brownish gray, fine and uniform texture, otherwise similar to samples above	5248
Sand, brownish gray with red tinge, grains rather coarse and irregular, minerals about same as in all samples below 5201 — quartz, mica, iron rust, some black material that is not magnetic	5250

All the samples from 5201 feet are quite similar and evidently belong to the same kind of rock. They have the appearance of a decayed granite, although no feldspar was noted.)

Driller's Log, Wilson No. 1 Oil Prospect.

	Thickness in Feet	Depth in Feet
Soil	10	0–10
Sand and gravel, lots of water	15	10–25

Limestone	6	25–31
Shale, dark	2	31–33
Limestone	3	33–36
Shale, dark	4	36–40
Shale, light	3	40–43
Shale, blue	3	43–46
Limestone	5	46–51
Shale, gray	19	51–70
Limestone	10	70–80
Coal and shale (inferior coal)	3	80–83
Shale, light	11	83–94
Limestone	8	94–102
Shale, black	38	102–140
Shale, calcareous	4	140–144
Limestone	6	144–150
Shale, dark	10	150–160
Limestone	5	160–165
Shale	1	165–166
Limestone	6	166–172
Shale, gray and black	8	172–180
Limestone	28	180–208
Shale, dark	16	208–224
Limestone, white	4	224–228
Shale, light	8	228–236
Rock, red	14	236–250
Shale, light	70	250–320
Shale, brown	20	320–340
Shale, dark, sandy	9	340–349
Limestone and shale, broken	7	349–356
Shale, brown	19	356–375
Limestone	10	375–385
Sand, water salty	12	385–397
Shale, black	8	397–405
Shale, blue	4	405–409
Shale, brown	4	409–413
Shale, blue	31	413–444
Shale, white	1	444–445
Limestone, white, broken	2	445–447
Limestone, white, hard	4	447–451
Shale, dark	11	451–462
Limestone, black	7	462–469
Shale, white	4	469–473
Limestone, hard (white to gray to black to brown)	15	473–488
Shale, light and sticky	11	488–499
Shale, light and sticky	5	499–504
Limestone, white	6	504–510
Shale, light	4	510–514
Limestone, white	10	514–524
Shale, dark	14	524–538
Limestone	36	538–574
Shale, dark	4	574–578
Limestone, white	30	578–608
Shale, dark	8	608–616
Limestone, white	18	616–634
Shale, white	12	634–646
Limestone	14	646–660
Shale, dark	10	660–670
Shale, light	10	670–680
Limestone, white	10	680–690
Shale, light	12	690–702
Shale, brown and red	23	702–725
Shale, light blue	10	725–735
Shale, blue	3	735–738
Coal	5	738–743

Limestone	2	743–745
Shale	2	745–747
Limestone, hard	8	747–755
Shale, black	25	755–780
Shale, blue	5	780–785
Limestone, white	17	785–802
Shale, light gray	20	802–822
Shale, calcareous and also dark	8	822–830
Limestone (water enough to drill with)	22	830–852
Shale, light	53	852–905
Shale, dark	7	905–912
Limestone, white	6	912–918
Shale, light to dark	77	918–995
Sand, water salty	25	995–1020
Shale, white	14	1020–1034
Shale, dark	4	1034–1038
Limestone, arenaceous, soft	4	1038–1042
Shale, light	2	1042–1044
Coal (very inferior)	13	1044–1057
Shale, dark	188	1057–1245
Sand, water (break in the middle)	15	1245–1260
Shale, dark	65	1260–1325
Lime shell	2	1325–1327
Shale, black	64	1327–1391
Lime shell	1	1391–1392
Shale, dark	18	1392–1410
Shale, arenaceous, light	10	1410–1420
Coal	2	1420–1422
Shale, dark	13	1422–1435
Sand, water (show of oil in top of sand)	42	1435–1477
Shale, black	2	1477–1479
Sand, water	3	1479–1482
Shale, brown	2	1482–1484
Sand, water	46	1484–1530
Sand, water	5	1530–1535
Limestone, gypsum, sand and dark shale	30	1535–1565
Shale and pyrites	10	1565–1575
Shale, black	15	1575–1590
Pyrites of iron	5	1590–1595
Shale, dark	15	1595–1610
Limestone, arenaceous	64	1610–1674
Shale, light	4	1674–1678
Limestone	2	1678–1680
Sandstone, fresh water	20	1680–1700
Brown lime flint (salt water)	32	1700–1732
Shale, sandstone, broken limestone	1	1732–1733
Limestone	2	1733–1735
Limestone, streaked with sandy shale	3	1735–1738
Limestone, brown	12	1738–1750
Limestone, gray, very fine, drills like sand	40	1750–1790
Limestone, coarse	11	1790–1801
Limestone, hard	4	1801–1805
Limestone, coarse	26	1805–1831
Shale, hard, gray	4	1831–1835
Limestone, hard	2	1835–1837
Shale mixed with streaks of limestone	8	1837–1845
Limestone, fine and very hard	53	1845–1898
Shale, brown	2	1898–1900
Limestone, very fine	14	1900–1914
Limestone, coarse	5	1914–1919
Limestone, streaks of shale	2	1919–1921
Limestone, hard	13	1921–1934
Shale, black, mixed with lime shells	36	1934–1970
Shale, red	1	1970–1971

Limestone	2	1971–1973
Shale, a trifle more red than above	6	1973–1979
Limestone, gray, hard	17	1979–1996
Shale, hard, grayish blue	4	1996–2000
Shale, blue	3	2000–2003
Limestone, gray, hard, very fine	18	2003–2021
Limestone, blue, hard, coarse, mixed with gray and brown	9	2021–2030
Limestone, coarse, hard, blue	4	2030–2034
Limestone and gypsum	5	2034–2039
Limestone, very hard, gray	23	2039–2062
Limestone, fine, brown	6	2062–2068
Shale	9	2068–2077
Limestone, coarse, brown	8	2077–2085
Limestone, arenaceous, gray and brown	21	2085–2106
Limestone, fine, gray and brown	18	2106–2124
Sand and limestone, light gray	6	2124–2130
Limestone, arenaceous, dark brown	19	2130–2149
Limestone, dark brown, fine	26	2149–2175
Dolomite, brown, fine lime	58	2175–2233
Limestone, coarse, brown	18	2233–2251
Limestone, coarse, brown, streaked with blue shale	4	2251–2255
Limestone, brown, coarse to fine	25	2255–2280
Limestone, white; shale, green	5	2280–2285
Limestone, fine, brown	32	2285–2317
Limestone, medium dark gray, chalky, floats	83	2317–2400
Limestone, gray, sharp, fine	15	2400–2415
Limestone, white, chalky, hard to catch	10	2415–2425
Limestone, chalky, some gypsum cuttings hard to catch, strong smell of gas	19	2425–2444
Limestone, coarse, brown	16	2444–2460
Limestone, fine, dark gray	29	2460–2489
Limestone, fine, light gray	7	2489–2496
Limestone, coarse, hard, gray	4	2496–2500
Limestone, fine, light gray	50	2500–2550
Limestone, fine, medium light gray	5	2550–2555
Limestone, dark, coarse grain	5	2555–2560
Shale, bluish green, not compact, cavy	5	2560–2565
Shale and limestone, dark and light gray and white, some gypsum and pyrite, cavy	8	2565–2573
Limestone, dolomitic, fine-grained, gray	55	2573–2628
Limestone, dark gray, very coarse grain	12	2628–2640
Limestone, light gray, very fine	4	2640–2644
Limestone, arenaceous, medium coarse	4	2644–2648
Limestone, brown, dark	28	2648–2676
Limestone, dark gray, fine	44	2676–2720
Limestone, light gray, fine-grained	10	2720–2730
Gypsum, white, hard, sticky drilling	3	2730–2733
Limestone, coarse, hard, flinty	12	2733–2745
Limestone, with gypsum, white	1	2745–2746
Crevice	1	2746–2747
Limestone with asphalt	4	2747–2751
Limestone, coarse, white	19	2751–2770
Limestone, coarse, light gray	25	2770–2795
Limestone, dark gray, fine	30	2795–2825
Limestone, coarse, brown	15	2825–2840
Shale, brown	10	2840–2850
Chert and silica	10	2850–2860
Dolomite	2	2860–2862
Limestone, brown	28	2862–2890
Limestone, gray	20	2890–2910
Limestone, brown	8	2910–2918
Limestone, dark gray turning to blue, very fine grain	27	2918–2945
Limestone, brown, medium-grained	35	2945–2980
Shale, blue	2	2980–2982

Limestone, white, coarse, water	8	2982–2990
Limestone, brown, coarse	9	2990–2999
Sandstone, fine, gray, much water	26	2999–3025
Shale, gray	2	3025–3027
Limestone, brown, and gypsum, fine	9	3027–3036
Sandstone, fine, gray, salty	5	3036–3041
Dolomite and gypsum, water	9	3041–3050
Sandstone, very fine, water	5	3050–3055
Dolomite, gray, fine	3	3055–3058
Dolomite, gray	42	3058–3100
Limestone, brown; dolomite, fine	24	3100–3124
Dolomite, solid, brown, medium	6	3124–3130
Dolomite, light gray and fine	10	3130–3140
Sand, white, medium to fine	25	3140–3165
Dolomite, dark and fine	15	3165–3180
Dolomite, light and fine	39	3180–3219
Dolomite, light, coarse	56	3219–3275
Dolomite, red-brown, fine	1	3275–3276
Shale, black, oil showing	4	3276–3280
Sand, brown, oil showing	30	3280–3310
Dolomite, white and gypsum	7	3310–3317
Sand, brown, broken, and lime	5	3317–3322
Limestone, brown	38	3322–3360
Limestone, gray, some gypsum, fine as flour (no cuttings), hard	50	3360–3410
Dolomite, gray, fine and hard	37	3410–3447
Limestone, gray, coarse	1	3447–3448
Limestone, gray	4	3448–3452
Dolomite, gray	13	3452–3465
Limestone and shale, green-gray, fine to medium	3	3465–3468
Shale, and granite, brown	2	3468–3470
Limestone and shale	13	3470–3483
Limestone and shale, green	12	3483–3495
Limestone and shale, white and green	20	3495–3515
Limestone, brown; shale, green	8	3515–3523
Limestone, gray; shale, green	12	3523–3535
Limestone, gray; shale, green; some dolomite and gypsum, medium	10	3535–3545
Limestone, gray; shale, green; some dolomite	15	3545–3560
Sandstone	8	3560–3568
Limestone, gray; gas showing	2	3568–3570
Sandstone, white, coarse	3	3570–3573
Sandstone, coarse, brown	4	3573–3577
Sandstone, red, coarse	3	3577–3580
Shale, red	3	3580–3583
Sandstone, glassy, reddish brown	10	3583–3593
Shale, arenaceous, red, fine	7	3593–3600
Sandstone, red, some silica, fine streaks of red shale and gypsum	116	3600–3716
Limestone, gray	4	3716–3720
Sandstone, red, coarse, and lime shells	35	3720–3755
Limestone, arenaceous, white and brown, fine to coarse to fine, siliceous	30	3755–3785
Same as above with strips of red shale	100	3785–3885
Shale, arenaceous, red; sand, reddish brown, thin layers of shale. Silica in quartzites at times, medium and coarse, changeable, thin lime shells between	123	3885–4008
Sand, reddish, thin layers of red shale, silica in quartzite, cuttings fine at times, medium, then coarse, lime shells now and then	106	4008–4114
Shale, reddish brown, hard	48	4114–4162
Sandstone, red; shale	58	4162–4220
Shale, red	40	4220–4260
Sandstone, red, strips of red shale, sand predominates	5	4260–4265

Shale, red, some pretty sandy, broken sand both fine and coarse	35	4265–4300
Sandstone, red, medium	6	4300–4306
Shale, red; sandstone, broken	114	4306–4420
Sandstone, red, fine	40	4420–4460
Limestone, arenaceous, brown, very hard	3	4460–4463
Shale, red; sandstone	63	4463–4526
Limestone and dolomite, sharp	2	4526–4528
Shale, red; sand	35	4528–4563
Shale, arenaceous, red	2	4563–4565
Sand and red shale, dries to reddish brown, silica predominating	35	4565–4600
Shale, red and muddy; limestone, arenaceous, brown, very fine, cuttings heavy and settle fast	28	4600–4628
Shale, red	2	4628–4630
Limestone, arenaceous, but light, drills awfully hard	4	4630–4634
Shale and limestone, red, cuts very fine; shale consists of a green-blue and bright red, and is dolomitic	6	4634–4640
Sandstone, white	28	4640–4668
Limestone, brown and gray, responds to cold acid, and drills very fine	2	4668–4670
Limestone, sandy and black	38	4670–4708
Set 4,708 feet of 5 3/16 casing and shut out all water at this point. Bailed the hole dry and now carrying an absolutely dry hole. Dumping water to drill with.		
Sand, brown, oil showing black and heavy appearances of dead oil	8	4708–4716
Sandstone, gray	7	4716–4723
Sand, brown, fine-grained	15	4723–4738
Shale, sandy with hard drilling shells every few feet, brown to an almost red color	91	4738–4829
Sandstone, light brown	11	4829–4840
Shale and sandstone, reddish brown	4	4840–4844
Shale, arenaceous, red, variegated with green shale	6	4844–4850
Shale, arenaceous, light reddish brown	35	4850–4885
Sandstone, thin strips of shale, brown	5	4885–4890
Shale, brown	5	4890–4895
Shale, arenaceous, brown	28	4895–4923
Shale, arenaceous, light brown	13	4923–4936
Chalk, white shaly	5	4936–4941
Shale, arenaceous, brown	35	4941–4976
Chalk, limestone, white	4	4976–4980
Shale, and sandstone, brown	30	4980–5010
Shale, arenaceous, dark brown to dark gray	40	5010–5050
Shale, brown and blackish gray	5	5050–5055
Some of the brown shales carry a conglomerate or different colors of shales, namely white, brown, green to blue, and red.		

Notes. — The Mississippian shows normal facies in this well — chiefly limestone with some shale in the Osage and Meramec series; it is mostly shale with some limestone in the Kinderhook series. The same is true of the Devonian system, which is mostly limestone with some shale. The Silurian seems to be a unit and to belong to the Niagaran series. It is nearly all dolomite, with some shale. Some microfossils seem to be characteristic of the formations in which they occur. In this prospect the Maquoketa shale is rather thinner than typical. The

Galena is typical in thickness and character. The Decorah is very distinctive; petroleum is very easily distinguishable. Evidently the Platteville is absent at this location. The Saint Peter is persistent, though not thick. It is followed by the three members of the Prairie du Chien in order, with about the usual thickness. The persistence of thin members across the state is remarkable. The Maquoketa is a good example; it is thinner than at Fort Dodge, where it is 300 feet thick, or at Sac City, where it is 70 feet thick. The dip of the beds is well shown between Sac City, where the Saint Peter is 246 feet below sea level, and Clarinda, where it is 2,004 feet below sea level — a drop of 1,760 feet in 120 miles to the south. At Fort Dodge, 40 miles farther east, the strata are at the lowest level for this latitude — 400 feet below sea level.

The recent classification of the Cambrian makes the Trempealeau a formation and makes the Jordan, Lodi, and St. Lawrence members. The Jordan is rather thin at Clarinda and not so typical as at some places; it consists of sandstone with some dolomite. The Lodi is usually shaly, but here it is mainly dolomite.

The drill entered the Upper Cambrian at a depth of 3,345 feet. So far as these studies determine, the base of the Upper Cambrian lies 4,011 feet below the surface — 3,023 feet below sea level. All drilling below this point to the bottom of the hole at 5,286 feet was in the Red Clastics, probably of Middle Cambrian age — of course far below any possibility of oil or gas and getting farther with every added foot.

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