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The Burlington Artesian Well

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been very heavy in crops and damage to soil. The loss of live stock drowned would probably have been almost as heavy had it occurred in daylight, owing to the very rapid rise of the streams. The estimate of $100,000 total loss is not far from correct.

There are many other interesting features which should be written up. The weather conditions can be obtained from the weather bureau. The map for the date shows a low reaching into Iowa, but would not warrant a forecast of general rain The energy liberated by so heavy a fall of rain would form an interesting study. I have collected some data concerning similar storms in previous years. The heaviest fall that has come to my notice was fifteen inches, at Wilmington, Del., on the 29th of July, 1839.

THE BURLINGTON ARTESIAN WELL.

BY FRANCIS M. FULTZ.

Work was commenced on the Burlington artesian well about midsummer of 1896; but, owing to cessation of operations for somewhat more than a year, it was not finished until midsummer of 1898. The well is located in Crapo park, and the expense of putting it down was borne out of the park funds.

It was expected that a flow would be reached in the St. Peter sandstone at a depth of about 900 feet. This belief was based on the flow obtained at the Ft. Madison and Keokuk wells, south of Burlington about twenty and forty miles respectively. As will be seen from the subjoined section the St. Peter was reached at a depth of 950 feet. No flow was obtained, but the water rose to within thirty-eight feet of the surface, and indicated a strong supply. There was no further change of the head of more than a foot or two, although the drilling was carried down to 2,430 feet and passed through at least two other water-bearing strata.

The diameter of the well is six inches for 1,700 feet and five inches for the balance. No casing is used excepting through the loess and drift. At 1,700 feet a test was made of the capacity. Over 100,000 gallons were pumped out daily for one week, with no appreciable lowering of the head. At 2,430 feet, where the work was stopped, the pump was again put in and over 100,000 gallons were thrown out daily, for ten days, without lowering the head.

No analyses of the waters have yet been made. The water pumped out after the drilling was stopped, and which was probably composed of a mixture from the different levels, was clear and sparkling and remarkably free from objectionable mineral tastes. It was slightly diuretic and laxative. No extended experiments have as yet been made in using the water for park irrigation, which was one of the main purposes in putting down the well. It is hoped that the supply will be great enough to feed an artificial lake and a fountain or two. The pumping will probably be done by electrical power.

Through the kindness of the Tweedy Brothers, who carried the drilling down to 1,700 feet, and the Wilson Brothers, who finished the work, a very complete series of samples of the drillings came into my possession. From these, glass tubes have been filled, one being placed in the public library and another in the high school at Burlington, each showing, approximately, a complete section of the well. At four different levels the drillings were washed away by the pressure of the water from below, the material doubtless finding its way into crevices through which the well passes at higher levels. There were four of these intervals when no samples were obtained, the first at 1,475 feet, and continuing for forty-four feet; the second at 1,630 feet, and continuing for forty feet; the third from 1,725 feet to 2,000 feet, making a long interval of 275 feet; and the fourth from 2,360 feet to 2,400 feet, equaling forty feet, making 400 feet in all from which no drillings were obtained.

The surface at the well is 685 feet above tide.

Number.	SECTION.	Thickness in feet.	Depth in feet.
66	Loess and drift	18	18
65	Limestone and chert, drillings coarse	23	41
64	Limestone, much less chert, drillings finer	37	78
63	Limestone, light buff, fine grained	19	97
62	Limestone, yellowish, sandy, cherty	13	110
61	Shale, sandy, with some lime	39	149

Number.	STATION.	Thickness in feet.	Depth in feet
60	Shale, light blue	126	275
59	Shale, dark blue	165	440
58	Limestone, compact, gray	140	580
57	Shale, gray	38	618
56	Shale, light blue	20	638
55	Shale, brown	50	688
54	Dolomite, brownish gray	49	737
53	Dolomite, dark gray, coarse grained	78	815
52	Dolomite, gray	10	825
51	Dolomite, pinkish gray, coarse grained	20	845
50	Dolomite, light brown, coarse grained	23	868
49	Shale, dark, slightly petroliferous	27	895
48	Shale, dark, dolomitic	15	910
47	Dolomite, with some little chert	16	926
46	Dolomite, gray	19	945
45	Dolomite, white	10	955
44	Sand, pinkish	45	1000
43	Sand, mixed with black shale	40	1040
42	Sand, clean, white, fine grained	10	1050
41	Sand, clean, white, coarse grained	15	1065
40	Sand, darker, coarse grained	35	1100
39	Dolomite, white, compact	180	1280
38	Dolomite, pink, compact	15	1295
37	Dolomite, pinkish gray, compact	40	1335
36	Dolomite, pinkish, compact	15	1350
35	Sand, rusty, with some lime and chert	10	1360
34	Sand, rusty	20	1380
33	Sand, very sharp grained	20	1400
32	Sand, fine grained	10	1410
31	Dolomite, white, compact	9	1419
30	Dolomite, with brownish shale	13	1432
29	Sand, mixed with limestone and chert	13	1445
28	Chert, white	15	1460
27	Sand, fine grained, with some shale and limestone	15	1475
	Drillings washed away	44	1519
26	Sand, brown, rusty	6	1525
25	Limestone and chert, whitish	20	1545
24	Sand, limestone and chert	25	1570
23	Dolomite, grayish-brown	15	1585

Number.	SECTION.	Thickness in feet.	Depth in feet
22	Dolomite, light gray	15	1600
21	Limestone, light gray, with some chert and sand	30	1630
	Drillings washed away	40	1670
20	Sand, clean, white	20	1690
19	Dolomite, yellowish, sandy	35	1725
	Drillings washed away	275	2000
18	Limestone, dark gray, dolomitic	5	2005
17	Limestone, dark gray, nearly pure	5	2010
16	Limestone, dark gray, arenaceous	20	2030
15	Dolomite, dark gray, arenaceous	20	2050
14	Dolomite, rusty gray, with sand and shale	45	2095
13	Dolomite, rusty gray, mixed with pure limestone	20	2115
12	Dolomite, rusty gray, with much pure limestone	15	2130
11	Limestone, dark gray, with some little sand	15	2145
10	Limestone, mixed with sand and shale	80	2225
9	Limestone, brownish gray, with much sand	10	2235
8	Sand, light gray, with some lime	15	2250
7	Sand, light gray, dolomitic	20	2270
6	Sand, white, fine grained	5	2275
5	Sand, rusty, coarser grained	85	2360
	Drillings washed away	40	2400
4	Sandstone, very hard (12 hours in drilling 5 feet), many pinkish grains resembling quartzite; mixed with much shale and dolomite from above	5	2405
3	Same as No. 4, but with some little slate	5	2410
2	Slate, very dark, compact	10	2420
1	Slate, same as No. 2, but harder	10	2430
	Drill stopped in pure slate, at 2,430 feet.		

SUMMARY.

Number.	FORMATION.	Thickness.	Depth.
66	Pleistocene	18	18
64-65	Augusta—Upper Burlington	60	78
62-63	Augusta—Lower Burlington	32	110
59-61	Kinderhook	330	440
55-58	Devonian	248	688
50-54	Silurian	180	868
48-49	Maquoketa	42	910
45-47	Trenton	45	955

Number.	FORMATION.	Thickness.	Depth.
40-44	St. Peter	145	1100
36-39	Upper Oneota	250	1350
32-35	New Richmond	60	1410
30-31	Lower Oneota	22	1432
5-29	St. Croix	968	2400
3-4	Sioux Quartzite (?)	10	2410
1-2	Primitive (?)	20	2430

In the discussion of this paper Mr. Leverett called attention to the need of careful examination of the suposed Sioux quartzite drillings, especially since a well at the neighboring town of Aledo, Ill , reached a depth of 3,100 feet without touching the quartzite.

THE LOWER RAPIDS OF THE MISSISSIPPI RIVER.*

BY FRANK LEVERETT.

INTRODUCTORY.

In the early days of navigation on the Mississippi, two important rapids were found to interrupt the passage of vessels at low water stages; one, about fifteen miles in length, being above the city of Rock Island, Ill., and the other, about eleven miles in length, above the city of Keokuk, Iowa. These became known, respectively, as the upper and lower rapids. The latter are also called the Des Moines rapids because of the situation above the mouth of the Des Moines river.

In both rapids the obstructions consist of rock ledges, yet the form of arrangement of the ledges is not the same. The upper rapids consist of a succession of rock barriers called "chains," each usually but a fraction of a mile in breadth, which pass across the river channel and are separated by pools or stretches of slack water. The lower rapids are more uniform, there being a nearly continuous descent across them. The rate of descent, however, varies, as shown below. In open-

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