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The Deep Well at Minneopa, Minnesota

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[*Paper AA*]

THE DEEP WELL AT MINNEOPA, MINNESOTA.—*C. W. Hall.*

[The following description is based chiefly on notes and borings secured by Mr. Bruno Bierbauer. The notes were taken on the spot from week to week and the borings were kindly furnished by Mr. Fox, who was in charge of the work. When the depth of 800 feet was reached, Mr. Bierbauer was obliged to leave Mankato. Subsequently Mr. W. D. Willard tried in vain to obtain further data. All borings which had been saved were so mixed and changed that even the workmen could not distinguish them. So he could learn positively no more than this:—the contract had been fulfilled and the depth of 1,000 feet had been reached. No gas but a good flow of water was secured.]

During the season of 1888 a deep well was bored at Minneopa, about one-half mile southwest of Minneopa Falls. The purpose of the well was an exploration for natural gas, by some Mankato gentlemen, possibly aided by men and capital from Ohio. The spot selected for the well lies about 100 feet above the level of the Minnesota river, which flows easterly only one mile away. The well is within the Minneopa creek valley and is bounded both east and west by hills 150 to 200 feet above the top of the well.

After penetrating soil and glacial debris to the depth of 88 feet, the Cambrian rocks were entered and were probably not bored through when work ceased at the depth of 1,000 feet. The first of these Cambrian rocks was a white sandstone; this soon gave place to a dolomitic rock which first appeared at 116 feet below the surface. Soon a white calcareous, flinty rock took the place of the dolomite, after which shales and sands alternated until the depth of 585 feet was reached, when a coarse conglomerate of quartzite pebbles appeared. Below this conglomerate, or below 800 feet, the record is uncertain and unsatisfactory.

In detail, the record of the well is as follows:

		THICKNESS.	DEPTH OF WELL.
1.	Soil and clay with evidences of vegetation	10 ft.	10 ft.
2.	Quicksands and gravels	40 ft.	50 ft.
3.	Blue clay with some pebbles	10 ft.	60 ft.
4.	Material chiefly sands of different degrees of coarseness to the bottom of the glacial drift	28 ft.	88 ft.
5.	White sandstone. This sandstone in a part of its thickness is quite indurated, it effervesces vigorously and breaks down into a loose sand when thrown into dilute hydrochloric acid. It is of medium coarseness	28 ft.	116 ft.

6.	Limestone of a light pink color and rather fine texture. This layer has the color and texture of the best stone in the Kasota quarries	10 ft.	126 ft.
7.	A rock of uneven hardness carrying many flinty chips, an arenaceous dolomite which breaks down in warm hydrochloric acid with effervesence, losing from 75 to 80 per cent. of its weight	14 ft.	140 ft.
8.	A green shaly sandstone whose lumps harden on exposure to quite a firm, distinctly stratified green sandstone	15 ft.	155 ft.
9.	A red sand easily crumbling (no sample)	30 ft.	185 ft.
10.	A green shale containing a considerable proportion of sand grains	20 ft.	205 ft.
11.	A clean white sandrock of medium texture and very friable (no sample)	30 ft.	235 ft
12.	A green shale again appears to be the predominant rock (no sample)	65 ft.	300 ft.
13.	Coarse, red, granular drillings which carry in numerous small grains a dark green mineral. This rock consists largely of a dolomitic material and appears to be quite impervious, thus affording a cover to the water-bearing strata which lie below	5 ft.	305 ft.
14.	A white water-bearing sandstone from which a small stream of water flowed	30 ft.	335 ft.
15.	A white and brown sand, very compact and apparently a cover to the layers below	40 ft.	375 ft.
16.	A white water-bearing sandstone	150 ft.	525 ft.
17.	A white water-bearing sandstone, differing but little from the preceding number	60 ft.	585 ft.

[When the drill entered No. 16, water rapidly rose in the well and long before the bottom of No. 17 was reached a heavy volume was flowing from the mouth of the casing. It completely filled a 5¾ inch pipe. In temperature this water is from 53 degrees to 55 degrees Fahr. and is comparatively soft.]

18. Sandstone and conglomerate. The workmen were still boring in this bed when Mr. Bierbauer closed his notes; they had penetrated it 215 feet. In places the rock was apparently a compact red sandstone; in others it was a conglomerate made up of pebbles of a bright red, vitreous, non-granular quartzite. In size they vary from a fraction of an inch to several feet in diameter. The microscope shows that the silicious cement in which the original grains are imbedded is clear quartz interstitially deposited in axial continuity with the grains them-

selves. *In short, these pebbles are fragments not of quartz but of quartzite*.....	215 ft.	800 ft.
The records for the remaining distance are regarded as valueless, but the record of the Mankato well (this volume Bull. 1, p. 143) leads to the belief that the rocks penetrated must have been silicious sediments.....	200 ft.	1,000 ft.

However, authentic records have been preserved for the first 800 feet of this well; and that depth is sufficient to prove its importance to geologists, for one more fact is presented in evidence of the correctness of the position for which the Wisconsin geologists have contended, namely, that the great red quartzite formation of the northwest belongs to an earlier geologic age than the white and friable sandstones of the Upper Mississippi valley. Only 16 miles from this well the Courtland exposures of red quartzite can be seen and they show a rock identical in chemical and physical characters with the material out of which these pebbles were worn. These quartzite exposures with their southwesterly extension through Watonwan and Cottonwood counties into South Dakota are the only belt of this kind of rock known in Southern Minnesota. We conclude that the conglomerates penetrated in sinking this well must have been formed from the erosion of these quartzite beds.

But in the case of the sandstones the way to a conclusion is not so clear. For all the well record can show to the contrary, there may be a great unconformity between the quartzite conglomerates and the overlying sandstones and shales. Such unconformity, did it exexist, would afford a place here in Southern Minnesota for the Keweenawan formation between the Cambrain complex of sandstones, shales and dolomites and the quartzites and would offer strong, presumptive evidence that the quartzites are of Huronian age. An unconformity here, it must be admitted, is far from proven.

Whether we here call them Huronian quartzites or not, we know that the time necessary for their formation, their thorough vitrification and their subsequent erosion must have been enormous. Therefore the Sioux quartzite, as the formation of this lithologic character stretching from Courtland to the southwest into South Dakota has been called by Dr. White, belongs to an earlier and entirely distinct horizon from that of the so-called Potsdam or Saint Croix formation of the Upper Mississippi valley, and the time-gap between the two is one of great extent.

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