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## The Stillwater Deep Well

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[Paper *EE.*]THE STILLWATER DEEP WELL.—*A. D. Meeds.*

The Stillwater deep well was bored by a stock company of Stillwater citizens organized for the purpose of investigating the nature of the underlying rocks with reference to the occurrence of natural gas. It was begun June 23, 1888, by Mr. Paige Guthrie, contractor of Pittsburgh, Pa., and continued until the summer of 1889, when it was abandoned after reaching a depth of 3,440 feet. The well is situated in the centre of town, two blocks west of the city hall, is about 75 feet above Lake St. Croix, and 740 feet above sea level. It is 5½ inches in diameter and cased to 740 feet, below which no water was found. Water was struck at various depths above that but nowhere in sufficient quantity to be of value.

The drift here is but 18 feet thick. The Palaeozoic rocks extend below the drift to a depth of 717 feet and consist of light colored sandstones, limestones and shales. The remaining rocks are of Keweenaw age, extending to the bottom of the well. They consist of dark red sandstones in the upper part, changing to fine grained and much altered diabases in the lower part. In thin slides these rocks agree well with descriptions of Keweenaw rocks from Lake Superior.

The following is the record of the well taken from samples preserved by the men in charge:

No.	THICKNESS.	DEPTH.
1.	Coarse yellow sand consisting of rounded grains of quartz, much rusted.....	18 ft.
2.	Gray limestone.....	85 ft. 103 ft.
3.	Fine grained quartz sand mixed with some limestone from No. 2.....	39 ft. 142 ft.
4.	Very fine grained and almost pure white sand.....	20 ft. 162 ft.
5.	Light green shale with some grains of sand and pieces of limestone.....	41 ft. 203 ft.
6.	Very fine white sand mixed with some green material from No. 5.....	12 ft. 215 ft.
7.	Light green shale with some grains of sand.....	56 ft. 271 ft.
8.	Fine grained white sand which has a grayish appearance, owing to coating of lime.....	31 ft. 302 ft.
9.	Coarse grained grayish sand with pieces of drab shale or limestone and some green material.....	10 ft. 312 ft.
10.	Coarse grained white sand, consisting of rounded grains of quartz, some of a grayish color, some pyrite and some pieces of shale from No. 9.....	10 ft. 322 ft.

No.	THICKNESS.	DEPTH.
11.	Grayish sand with some green grains. Effervesces slightly with hydrochloric acid.....27 ft.	349 ft.
12.	Gray shale or limestone with some rounded grains of quartz. Effervesces strongly. Resembles No. 2, but more shaly.....31 ft.	380 ft.
13.	Impure sandstone made up of rounded with some angular grains of quartz, with much broken up dark material, some red and yellow grains which effervesce with acid.....70 ft.	450 ft.
14.	Fine grained quartz sand with some impurities from No. 13.....10 ft.	460 ft.
15.	Pinkish shale with streaks of white and green, some quartz grains. Effervesces strongly with acid...80 ft.	540 ft.
16.	Coarse quartz sand, some grains of a yellowish color. Some grains very large and mostly rounded.....90 ft.	630 ft.
17.	Same as last but more yellowish.....58 ft.	688 ft.
18.	Dark red shale with grains of sand. Effervesces with acid.....13 ft.	701 ft.
19.	Coarse quartz sand, mostly rounded grains, with some red shale from No. 18.....5 ft.	706 ft.
20.	Fine dark red shale. Effervesces.....11 ft.	717 ft.
21.	Fine grained dark red sandstone. Effervesces...79 ft.	796 ft.
22.	Same as last.....96 ft.	892 ft.
23.	Same as last, very fine grained. In thin section* this is shown to be undoubtedly a clastic rock, made up of grains of quartz, feldspar and metallic grains probably magnetite, with a cement highly stained by ferric oxide and containing masses of calcite. Many of the clastic grains as well as the cementing material are heavily charged with ferric oxide.....31 ft.	923 ft.
24.	Same as last in general appearance. A small amount of salt water was struck at a depth of 1,950 ft. In thin section, however, this rock is shown to consist of an altered diabase porphyrite. The pyroxenic mineral is almost completely changed to chlorite and hornblende, and the feldspar is badly kaolinized. This latter mineral lies in long, lath-like individuals extinguishing very nearly to labradorite. With these non-metallic minerals there occurs quite a large quantity of some metallic mineral, probably magnetite, which is beginning to change slightly to hematite as can be seen on the borders of irregular and interstitial matters. The texture of this rock is medium.....1327 ft.	2250 ft.

\*In identification of minerals in thin sections the writer was assisted by Prof. C. W. Hall.

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|-----|---|---------|----------|
| 25. | This rock consists of material same as last but mixed with a large amount of calcite and pinkish grains of feldspar, giving it a mottled light appearance. At a depth of 2,450 ft. another salt pocket was struck and a small amount of brine continued to flow into the well to the close. A thin section of a piece of the light material proved to be a hornblende biotite granite in which the feldspar is quite badly altered to kaolin..... | 650 ft. | 2900 ft. |
| 26. | Darker than last; less of the light colored material. In this was found a piece of quite a large pebble, one surface worn smooth and rounded.....   | 46 ft.  | 2946 ft. |
| 27. | Dark red sandstone about same as 21. In thin section it appears to be almost identical in general characters with that occurring at 2,200 feet. It is badly altered and the more intimate structure of the grains is difficult to make out.....   | 4 ft.   | 2950 ft. |
| 28. | A very dark-brown diabasic rock with pieces of kaolinized feldspar and some green grains.....   | 225 ft. | 3175 ft. |
| 29. | Consists of the dark brown diabase similar to last, with some kaolin, calcite, and a notable amount of a green mineral found in long slender fibres, half an inch long, probably serpentine.....  | 100 ft. | 3275 ft. |
| 30. | Slate colored, fine grain diabase. In this rock pieces of native copper were found.....   | 25 ft.  | 3300 ft. |
| 31. | Same as last but mixed with considerable white material as in 29.....   | 5 ft.   | 3305 ft. |
| 32. | Same as 30.....   | 5 ft.   | 3310 ft. |
| 33. | Same as last.....   | 91 ft.  | 3401 ft. |
| 34. | A very fine grained drab colored rock which is reduced to dust, it is so finely broken up. It is a diabasic rock, with some white and some green material.....  | 39 ft.  | 3440 ft. |

Slides were made of the rock at 3,275 ft., and at other depths to the bottom. The rock appeared to be a diabase porphyrite, which at places is very fresh, as at 3,300 ft., and at other depths somewhat altered, as at 3,275. Where altered, it shows a darker color, the formation of hematite, the kaolinization of feldspar which is near labradorite, and the occurrence of quite numerous cavities filled with calcite. It does not appear from thin sections examined whether the calcite fills amygdaloidal cavities or cavities formed during the process of alteration which the rock has undergone. The feldspars for the most part have the peculiar lath-like shape noticed in layers above and the augite occupies interstitial places. There is comparatively little opaque mineral in

the freshest pieces but scattered through these are numerous grains of a partially decomposed mineral, which is doubtless olivine. Probably it is the decomposition of this mineral which forms the metallic portion of the more altered slides. One interesting feature of the fresher porphyrite is the fact that the interstitial augite which acts as the matrix for the feldspar individuals, extinguishes simultaneously over quite large areas, a fact which has been observed in both granites and gabbros as well as in the fresher portions in the so called mottled melaphyr of Pumpelly, here in the northwest.

April 2, 1889.

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[*Paper FF.*]

THE IRON BEARING ROCKS OF MINNESOTA.—*H. V. Winchell.*

[*ABSTRACT.*]

After speaking of the mining industries of northeastern Minnesota and pointing out on a chart some of the geographic and geologic features of our state Mr. Winchell continued :

The oldest formation in which we find iron bearing strata is the crystalline schist series, called the Vermilion series by the Minnesota geologists.

This formation consists of mica and hornblende schist strata, which spread over a large part of northeastern Minnesota. On the shores of Pelican lake, Rainy lake, Namekan lake, Vermilion lake and many others of our largest bodies of water, there are extensive out-crops of these rocks. Their dip is at all angles, from horizontal to vertical, but generally the latter. However, on Rainy lake several anticlinals are seen, where the dip changes from south to north, or vice versa. The general trend or strike of this formation is that of all the stratified rocks of the region, *i. e.*, about north, sixty degrees east.

It is only very recently that this formation has been proved to be iron-bearing. But during the past few months samples of good ore have been obtained from it in township 63 N., Range 12 W., north of the town of Ely. In sections 4 and 5 of this township the hornblende schist becomes charged with magnetite to such a degree that it is apparently a fair quality of magnetic ore. No analyses have yet been made of it. It may contain titanium.