

DEEP WELLS IN MANITOBA.



Nos. 1-4.—These represent the coarse alluvial material deposited near the western shore of Lake Winnipeg, when its waters washed the foot of the Pembina escarpment during the period described by Mr. Warren Upham as that of the McCauleyville beaches. From No. 8 a considerable supply of good water was obtained.

Nos. 5-7.—Evidently till, consisting of harder clay with pebbles and striated boulders.

No. 8.—Was described to me as being precisely the same as the shale outcropping on the sides of the deep valley of Horse Creek, about a mile west of the town. This valley cuts down through the face of the Pembina escarpment and exposes a number of sections of the dark grey clay shales, with many crystals of selenite, typical of the Millwood subdivision of the Pierre shales. No fossils were collected from these exposures, but in the continuation of the same escarpment south of the international boundary line Mr. Warren Upham¹ collected *Baculites compressus* and other typical Pierre fossils.

Nos. 9-19.—In the absence of specimens it is impossible to correlate these beds precisely, either with the base of the Pierre, in which the "hard streaks" would represent layers of ironstone, or with the top of the Niobrara, where they would be bands of fragmental limestone similar to that seen outcropping on the Assiniboine river, below the mouth of Cypress Creek. It is not improbable that the line between the Pierre and Niobrara should be drawn somewhere through this series, as the lower "gritty" portions almost certainly belong to the latter formation. No great error, however, can be committed in grouping these as above.

No. 20.—Evidently to a large extent the mottled calcareous shale of the Niobrara formation. A specimen collected from 125 feet is a light grey, rather hard, mottled, calcareous clay, not splitting very readily along lines of bedding, but breaking into small polygonal masses of moderate size. Many rather large fragments of fish remains are scattered through it. Under the microscope it is seen to contain many small prisms of *Inoceramus* and a considerable number of foraminifera.

From 135 feet was collected a soft, very light-bluish-grey, non-calcareous clay containing fine acicular crystals of ankerite. From 180 feet the drillings consist of light-grey, non-calcareous clay like the last, mixed with some moderately dark-grey, mottled, calcareous clay, the latter containing a few fragments of fish remains, with many small foraminifera. From 215 feet was obtained a light grey, calcareous, mottled clay shale, breaking evenly, though not very readily, along the lines of bedding. It contains several both large and small species of foraminifera.

Nos. 21-23.—Would appear to represent the soft, unctuous, dark grey fissile, non-calcareous clay shale of the Benton formation. No specimens obtained.

Nos. 24-27.—This is in the main a beautiful white quartz sand, through which are mingled particles of clear white mica. The grains of sand are very irregular, some of them being moderately sharply angular, while others are more or less rounded.

In this sandstone are veins about 15 inches thick of incoherent running sand, one of them being struck at a depth of 360 feet and another at a depth of 377 feet.

At a depth of 324 feet water, strongly charged with chloride of sodium, was struck in a bed of fine white sand, and rose 250 feet in the well within a few minutes, after which it rose more slowly to within six feet of the surface. At one time, when the casing

¹ Upper Beaches and Deltas of the Glacial Lake Agassiz by Warren Upham. Bull. U. S., Geol. Survey No. 39. Washington 1887, p. 79.