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THE CRETACEOUS IN MINNESOTA.

BY N. H. WINCHELL.

There are frequent exposures of the Cretaceous along the Minnesota river from Big Stone Lake to Mankato; and at several places lignitic coal occurs in beds varying from six inches to three or four feet in thickness. It is found on the Cottonwood river, a large tributary of the Minnesota from the south, and on the Blue Earth. There are evidences of it under the drift at points between Mankato and Mendota. It occurs in Steele county, also in Freeborn, Fillmore and Mower. There are indirect evidences of it in Dakota county, particularly at Empire City. It is scattered largely through the drift in the western part of Hennepin county. In the central and eastern parts of Wright county it has excited expectations of coal, and some shafting has been done. Pieces of lignite coal have been found along the Mississippi river as far north as Fort Ripley; and in Stearns county a considerable interest was excited a few years ago by exposures of lignite in the valley of the Sauk river, at several places, particularly at Richmond. It is met with in Faribault county in sinking deep wells, also in Kandiyohi. It is distributed abundantly through the drift in the valley of the Red river of the North, both in the form of "slate" and lignitic fragments. Pieces of lignite are said to have been found on the St. Louis river, near the mouth of Swan river. According to H. R. Schoolcraft, lignitic coal was discovered in the country south of the Lake of the Woods in 1858 or 1859. J. A. Wheelock refers to this in the "First Annual Report of the Commissioner of Statistics," Jan. 1st, 1860. In the summer of 1875, Cretaceous lignite was discovered in the country between Rainy Lake and Vermillion Lake, and a hundred pounds of what

was taken for coal were brought to Duluth from that point. During the last Summer (1878) further information has been obtained of lignite along the international boundary line on Nemakon Lake, east of Rainy Lake.

It thus appears that fragments of the Cretaceous, which cannot bear long transportation, are found throughout nearly the whole State, and that the beds *in situ* have been discovered in a sufficient number of places to enable us to conclude that they extend, or did prior to the spreading of the drift, from the Iowa state line to that of the British Possessions. The only portions of the State where these indications do not exist, are the triangle north of Lake Superior, and the so-called driftless area in the southeastern corner of the State. These are both many hundred feet lower than the central and western portions where the Cretaceous is known to exist, and must have been buried under the Cretaceous ocean unless by some great warping of the crust they were relatively much higher then than now. There is no evidence of such warping; hence it is more likely that unfavorable circumstances have prevented the preservation of the beds or concealed them, so as to delay their discovery.

A line drawn from the west end of Hunter's Island, on the Canadian boundary line, southward to Minneapolis, and thence southeastwardly through Rochester, to the Iowa state line would, in general, separate that part of the State in which the Cretaceous is not known to exist from that in which it does. It is not here intended to convey the idea that the whole State west of this line, is spread over with the Cretaceous, because there are many places where the drift lies directly on the Silurian or earlier rocks; but throughout this part of the State, the Cretaceous exists at least in patches, and perhaps once existed continuously.

The beds of this formation that occur in Minnesota, belong to the lower portion. The Dakota Group of Dr. F. V. Hayden, supposed to be the equivalent of the Nishnabotany sandstone of Iowa, is probably represented by the white sandstones at Austin and on the Blue Earth, and by the stone

quarried at Austin and at points below in the banks of the Cedar river, as well as by the sandstone seen at Fritz' quarry on the Minnesota, a few miles below New Ulm. There is a pebbly deposit in Fillmore county, associated with a white sandstone, that also probably belongs to the Dakota Group. The Fort Benton Group has been identified in the Sauk river valley by a few fossils found in explorations for coal a few years ago. This rests on the authority of F. B. Meek. There are also extensive clay and shale beds exposed along the Minnesota, and on the Cottonwood, embracing beds of lignite that doubtless belong to the Fort Benton. At New Ulm is a calcareous member, burned for quicklime, that probably represents the Niobrara

Wherever this formation has been explored for coal in Minnesota, the results have not been encouraging. The lignite varies from a cannel coal to charcoal, and is often injured by clayey impurities, and by the presence of what appears to be ashes. The difficulty and cost of mining are also increased by the non-indurated condition of the overlying layers, rendering it necessary to line by timbers, or otherwise support the upper part of every opening that is made. Some of the clays have been successfully employed in making pottery, and also in the manufacture of fire-brick.

To the drift the Cretaceous has contributed largely in the State of Minnesota. Its *debris* is distinguishable in nearly every county west of the above line. It is the source of much of the clayey material of the boulder clay, and its alkaline qualities are very perceptible in much of the surface water. Superficially the Cretaceous has produced a greater effect on Minnesota than any other geological formation; yet its beds *in situ* are less frequently seen than any others.