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GEOLOGICAL NOTES FROM EARLY EXPLORERS IN THE MINNESOTA VALLEY.

BY N. H. WINCHELL.

(*Second Paper.*)

The error which Keating committed in reporting an out-crop of Limestone below the Sandstone at Fort Snelling was corrected by Featherstonhaugh. The supposed Limestone out-crop consisted of fallen masses from the top of the bluff. They probably lay nearly horizontal and concealed by the water of the river. The reported differences of lithology were due to the varying effects of exposure on the different layers, or to the action of water on the fallen pieces. In the further ascent of the valley Prof. Keating seems to regard the limestone seen (as that at Ottawa) as the same as that seen at Fort Snelling, an error which Mr. Featherstonhaugh perpetuates. In the same manner the underlying sandstone, as seen at the "Little Rapids," both observers parallelize with the sandstone seen in the bluff at the Fort. Nicollet did not detect this mistake. It was not till these outcrops were examined by Dr. B. F. Shumard that their difference of age was discovered. The Limestone at Shakopee he rightly refers to the Lower Magnesian (Formation 2), but he commits as great an error in referring the sandstone which underlies it to the horizon of the Potsdam, or Formation 1 of the report of Owen on the geology of Wisconsin, Iowa and Minnesota. The limestone at Shakopee has a thickness of about seventy feet, whereas the Lower Magnesian in the bluffs of the Mississippi has a thickness of over three hundred feet. By what means Dr. Shumard accounted for this great reduction in the

thickness of the Lower Magnesian, in order to justify the reference of the Sandstone at Jordan to the Potsdam, he does not state. The sandstone at Jordan, near Shakopee, was found in the summer of 1873, to be underlain by another great limestone member, which really is the *principal portion* of the Lower Magnesian, and that to which Prof. Hall and Dr. Owen generally refer in speaking of the Lower Magnesian of the northwest. That member of the Lower Magnesian seen at Shakopee is not generally seen in the immediate bluffs of the Mississippi, and has very generally escaped observation. As it is underlain by a soft and crumbling sandstone it is generally thrown, in outcrop, at some distance back from the river, and sometimes forms a series of bluffs or plateaux that constitute a bench or terrace. It is the uppermost member of the Lower Magnesian and lies immediately below the St. Peter sandstone. The limestone that succeeds the Jordan sandstone is seen at St. Lawrence and at Hudson, further up the Minnesota Valley, as well as at a great many places in the bluffs of Root river, in Fillmore and Houston counties. Prof. Hall, in 1865, followed Dr. Shumard in assigning the sandstone at Little Rapids, and generally between there and Mankato to the Potsdam. The details of the geology of this valley with the evidence of the existence of a great limestone member *below* the Jordan sandstone, are given in the Second Annual Report on the Geological and Natural History Survey of Minnesota.

In the American Journal of Science and Arts, for June, 1875, Prof. R. Irving of the University of Wisconsin, announces the discovery of a similar subdivision of the Lower Magnesian in that state, as exemplified near Madison. He has divided the Lower Magnesian into three parts, as follows in descending order:

1. Main Body of Limestone.....	85—120 feet.
2. Madison Sandstone.....	35 "
3. Mendota Limestone.....	30 "

Total thickness near Madison..... 150 feet.

The subdivisions as above given were made out in ascending order, whereas the subdivisions as worked out in the Minnesota Valley were ascertained in descending order. During the season

of 1875 this formation was carefully studied in Fillmore county, when the following order was fully established in descending order:

1. Shakopee Limestone.....	75 feet.
2. Jordan Sandstone.....	25—40 "
3. St. Lawrence Limestone.....	200 "
Total thickness.....	315 feet.

Fillmore county lies about midway between the Minnesota Valley, (where this alternation of strata was first observed in Minnesota) and Madison in Wisconsin, and the examination was made there with special reference to finding a solution to discrepancies which seemed to exist between those more remote localities. The only additional fact observed, beyond those given in the report on the Minnesota Valley in 1873, bearing on this question, was the actual thickness of the lower (St. Lawrence) Limestone, which was ascertained to be at least 200 feet thick with local variations of lithology.

Prof. Irving has suggested the possible horizontality of the different members of the Lower Magnesian as deciphered in Minnesota and Wisconsin, and has given a provisional table in which they stand thus:

SOUTH CENTRAL WISCONSIN.	MINNESOTA RIVER.
St. Peter Sandstone.	St. Peter Sandstone.
Main Body of Limestone 80—120 ft.	Shakopee Limestone.. 70 ft.
Madison Sandstone..... 35 ft.	Jordan Sandstone..... 50 ft.
Mendota Limestone..... 30 ft.	St. Lawrence Limes'ne. 200 ft.

There is some reason to believe, however, that the strata cannot be thus parallelized. The existence of the lowermost member, as discovered in Minnesota, in Fillmore county, and in the Bluffs of the Mississippi river at Winona and LaCrosse, with its full thickness (200 feet in Fillmore county and 250 feet at Winona) is presumptive evidence against its attenuation at Madison to 30 feet. It is more likely that the different members described by Prof. Irving are all included in the St. Lawrence Limestone, which, in Fillmore county, contains near its base a Trilobite bed, as described in the Mendota Limestone by Prof. Irving, and which amounts to more

than the total thickness of all the members at Madison. It is very possible also that the Shakopee Limestone, which was so hid as to escape observation in Minnesota for a great many years, has not been identified in Wisconsin. The Jordan may also be mistaken for the St. Peter. The following arrangement of these formations seems to the writer more likely to be correct. As the alternating Sandstones and Limestones in the Lower Silurian of the Northwest, which present so uniform a lithology, are comparable to the same phenomena in Missouri, and are, as there, probably one in history and origin they are all here grouped under a common term, that of Prof. Dana, *The Canadian*.

IN MINNESOTA.

St. Peter Sandstone . . . 125 ft.
 Shakopee Limestone . . . 70 ft.
 Jordan Sandstone 50 ft.

IN WISCONSIN.

St. Peter Sandstone . . . 100 ft.	
St. Lawrence Limestone 200 ft	{ Main body of Limestone .80-120 ft.
	{ Madison Sandstone 35 ft.
	{ Mendota Limestone 30 ft.
St. Croix Sandstone . . . 500 ft.	St. Croix Sandstone . . . 500 ft.

Further up the Minnesota Valley, Dr. Shumard notes what he regards as an outcrop of *Formation 1*, capped with about twenty-five feet of gray, concretionary Limestone. This point is about two miles below the mouth of the Cottonwood River. In this instance he seems to have mistaken the gray Limestone of the Lower Cretaceous, probably the Niobrara, for the Lower Magnesian.

This was the more natural as neither Dr. Shumard nor Dr. Owen anywhere mentions the Cretaceous as existing in Minnesota, and probably did not even suspect it; and as this Limestone is underlain by a white crumbling Sandstone that very much resembles the Jordan seen at Mankato and at the Little Rapids. This Limestone, however, on analysis, showed about ninety per cent. of carbonate of Lime, thus differing remarkably from the Lower Magnesian; and the Sandstone contains dicotyledonous leaves.