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Cryptozoon Minnesotense in the Shakopee Limestone at Northfield, Minnesota

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The iron ore found in the gabbro is unquestionably of igneous origin. It is a dull, massive magnetite with feebler magnetic attraction than the shiny granular ore of the Huronian quartzites. It also differs from the latter in containing titanic acid, ranging from 1 to 30 per cent. Although it is found in mountains which would be almost inexhaustible were they mined, the titanic acid renders the ore undesirable with the present methods of iron smelting. Where beds of the ferruginous Huronian quartzites are found involved in the gabbro overflow, as mentioned above, we seem to have non-titaniferous magnetite from the gabbro itself, but the appearance of the ore generally shows its true nature; and it may be stated as a general truth that the gabbro magnetite is titaniferous.

Ascending now through geologic time past all the rocks of the Silurian, Devonian and Carboniferous, we find our last iron ore formation to be the Cretaceous. At the bottom of this formation are found beds several feet thick of a low grade limonite ore. It occurs in Fillmore county, where the Cretaceous lies upon the Lower Magnesian, and is reported to be more than thirty feet thick in places. Some of this ore has been used at the furnace at Black River Falls, Wisconsin. It is probably of as good quality and as extensive in quantity as much of the ore formerly mined and smelted in Pennsylvania. But as long as we have mines in the northern part of our state of the best ore in the world, the poorer Cretaceous ore of the southern part of the state will not be used.

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[*Paper GG.*]

CRYPTOZOON MINNESOTENSE IN THE SHAKOPEE LIMESTONE AT NORTHFIELD, MINNESOTA.—*L. W. Chaney, Jr.*

Several years ago I noticed frequently what appeared to be curved strata in the Shakopee limestone at a point near Northfield. A carriage road passed along under the ledges near the river so that one traveling that way could scarcely fail to notice the peculiar arrangement. After puzzling somewhat over them, attention was called elsewhere and a railroad having usurped the place of the former carriage road, they were seen but little and forgotten.

Two years ago Mr. F. O. Higbee and Mr. W. S. Wingate of the junior class in Carleton College were prospecting for fossils

and came upon them again. As the class had been considering the smaller cryptozoa not long before, Messrs. Higbee and Wingate at once suspected that these might be such fossils on a gigantic scale. Upon their report I at once began examination, carefully measuring the formations and noting peculiarities of arrangement and taking photographs. The results of that examination are now presented.

At Northfield the Shakopee outcrops on both sides of the Cannon river, forming the immediate banks, while the bluffs at a greater distance are of the St. Peter sandstone. Wherever seen, the Shakopee limestone presents many peculiarities. It is full of flinty layers of unusual structure and its strata are exceeding irregular in composition and arrangement. A quarter of a mile below the town begins the ledge before spoken of, and it extends along the railway for half a mile or more. Along the face of the ledge at a height of from fifteen to twenty feet above the river is a very distinctly marked shelf which projects in some place two feet. Above this shelf are to be found the dome shaped masses which are now to be considered. As may be seen from Fig. 5, they present upon the face of the ledge the appearance of concentric layers, quite fine and close near the lower central part, becoming thicker and coarser as we proceed toward the outside. The inner layers curve somewhat sharply and seem to rest upon their edges on the shelf before mentioned. The outer layers change their direction and become apparently continuous with the adjacent horizontal layers. Occasionally two domes abut against each other. The line of division is then clearly marked, as a rule, and takes on two forms. One dome may be complete, its layers extending down to the general level upon which all seem to rest. The adjacent dome rests with the ends of its layers upon the sloping side of the

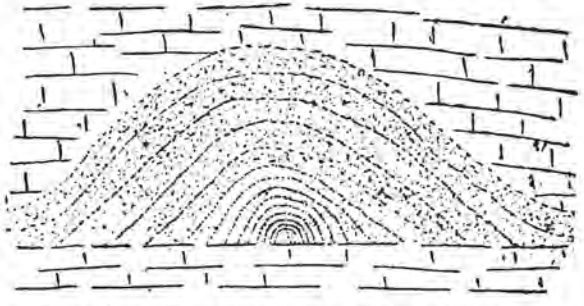
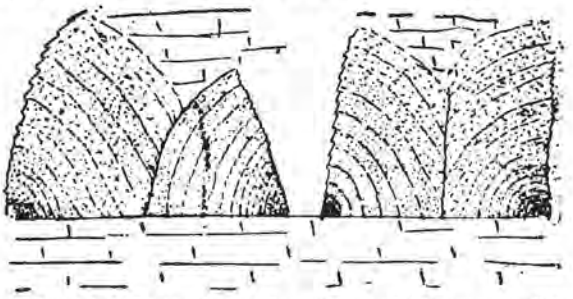


Fig. 5, showing structural features in the Shakopee limestone at Northfield.

first dome. In the second form the layers of each structure seem to terminate sharply at the line of junction. Fig's. 6 and 7.



Fig's 6 & 7, showing further structural features, possibly *Cryptozoon.*

So far as can be learned from study without microscopic examination the central portion of each dome is finely laminated with occasionally a lacuna between the laminae. Across these lacunae there extend frequent calcareous filaments. The outer layers as before stated are thicker and the cellular spaces larger. In a few instances it has been possible to view horizontal sections of these structures. At a point about a mile west of Dundas, Minn., I found such a case and was able to confirm the conclusions drawn from the vertical sections. The size of these domes varies considerably, the smaller ones being two feet along the base and eighteen inches high, the larger reach ten feet in horizontal dimensions and six feet in height.

With this statement of facts some discussion of the origin of these remarkable structures may be undertaken.

Three views are possible. 1st. They are entirely organic; 2nd. They are entirely concretionary, huge inorganic masses; 3rd. They are concretions formed about an organic core of relatively small dimensions.

In the fourteenth annual report of the Minnesota geological survey are described and figured specimens of cryptozoon found near Northfield and Cannon Falls. The figure is from a large specimen some sixteen inches across, which is in the general museum of the University of Minnesota. Similar specimens of even larger size were found in grading a street in Northfield and are now in the cabinet of Carleton College. Smaller specimens have been found in considerable numbers. The figure in the report just named shows the same general structure above described. The microscopic structure is shown to be finely laminated, the laminae being wavy. It is found that by patient digging there may be extracted from some of the domes a central mass having

all the characteristics of the smaller masses which are regarded as undoubted fossils. The difficulties in regarding the entire mass as fossil are: 1st. The size of the mass. If they are single fossils they are entirely unique as to size. It is true that corals have produced masses fully as large, but a colonial protozoon reaching anything like such dimensions is unknown so far as I can discover. 2nd. The change in structure which is observable as we pass from the center toward the outside. There appears to be no good reason why any such change should occur. If they are entirely organic there should, it would seem, be a substantial uniformity in structure from center to periphery.

The supposition that we are dealing with a simply concretionary structure seems untenable in view of the opinion of those who have made the most careful examinations.

The microscopic structure is regarded by Prof. N. H. Winchell as conclusive evidence of organic origin. Prof. Henry M. Seely writes me that he has discovered in the Calciferous of the Champlain valley two forms similar to those described and which he names provisionally Cryptozoon steeli and C. saxirodeum. C. steeli varies in size from two inches to two feet, while C. saxirodeum rarely exceeds nine inches. It will be noticed that the Northfield specimens are immensely larger than either of these. Professor Winchell in his report has given to the forms found at Northfield and Cannon Falls and varying from two inches up to twenty-five inches in diameter, the name Cryptozoon minnesotense. Should it seem that these larger forms are specifically distinct, C. *giganteum* would certainly not be an inappropriate name.

The third possible view suggested, namely that these structures are concretionary about an organic core, has several points in its favor. 1st. It accords with many other well known cases. Nothing is of more frequent occurrence than to find a concretion having a well preserved fossil in the centre and the dimensions of the concretion having no particular relation to the size of the fossil around which it has formed. 2nd. The marked difference between the inner and outer layer may thus be accounted for. The change in structure appears to be rather gradual, but in a few cases there is a somewhat clearly defined boundary between the central core and the surrounding layers. 3rd. The structure of the outer layers so far as can be judged from observation with a lens is suggestive of concretionary rather than of organic origin.

From whatever point we consider these structures, they are highly curious and interesting and at some time when more information is available, a more definite theory of their origin may be possible. At present they remain something of a mystery in spite of their close relation to things about which we think we have knowledge.

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[*Paper HH.*]

A RECENT VISIT TO LAKE ITASCA.—*By Warren Upham.*

Far in the northern forest of Minnesota, about a hundred and ninety miles north-northwest from Minneapolis and St. Paul, there lies a little lake which probably has become known, at least by name, to as many people throughout all civilized lands, as any lake of the whole world. Its pre-eminence comes from its being the head of the great river Mississippi, which first flows out from it fourteen miles northward, more nearly thirty miles by the meandering course of the river, and thence flows to the east through a succession of small and large lakes, and afterward to the south through the central part of this state and along its southeast boundary and onward thousands of miles to the Gulf. In size, Itasca belongs to the middle class of the ten thousand lakes and lakelets of Minnesota, its length from south to north being a little more than three miles, with a branch extending from its center about two miles to the east and southeast. It thus consists of three parts, which are called its Southwest, Southeast and North arms; and the width of each of these varies from about a quarter to a half of a mile. Its water is deep and clear, having a maximum depth, according to soundings by Mr. J. V. Brower, of about eighty feet in the Southeast arm, while the main lake, consisting of the Southwest and North arms, is found by him to be shallow at each end, thence gradually deepening to a maximum of about forty feet between Schoolcraft island and Bear point, which projects into the lake from the north at the junction of the Southeast arm. Its shores are mainly well wooded, and rise steeply from the water's edge, excepting small tracts of bog or tamarack swamps, through which most of the tributaries of Itasca enter the lake.

The first expedition seeking to reach the head of the Mississippi was that of General Cass in 1820, penetrating the northern