

ART. XXVII.—*Notes on the Cambrian in Missouri and the Classification of the Ozark Series*; by ARTHUR WINSLOW.

Introductory Remarks.—The Magnesian or Ozark series of rocks in Missouri covers nearly the entire southeastern quarter of the State. The members consist chiefly of dolomitic limestones and sandstones. They were assigned by the first Geological Survey of the State to the Lower Silurian and Calciferous age and were classified as follows, from the top downwards:*

First Magnesian Limestone.
Saccharoidal Sandstone.
Second Magnesian Limestone.
Second Sandstone.
Third Magnesian Limestone.
Third Sandstone.
Fourth Magnesian Limestone.
Fourth Sandstone.

This assignment and classification were followed, with slight modifications, by Shumard, Meek, Broadhead and others in later works, though, in the first report cited,† the discovery of a trilobite is noted in the Third Magnesian limestone which was considered identical with one in the *Potsdam* sandstone of New York, and in later reports and papers Broadhead refers to the lower members of the series as of probable Potsdam age.‡

Walcott, in recent writings, reasoning largely from the published results above referred to, has included the lower members of the Ozark series in the Cambrian§ and expresses this conclusion in the following words: || “The Cambrian rocks in Missouri occur in the southwestern¶ portion of the State, about the Ozark Uplift. As far as known they are of Upper Cambrian age and consist of a sandstone that occurs beneath the third magnesian limestone, or Calciferous, and the fourth magnesian limestone of the Missouri survey, beneath which, according to Prof. G. C. Broadhead, there are other arenaceous and calcareous beds.” According to this the last three numbers of the table given above would belong to the Cambrian.

Recent work of the present Geological Survey of Missouri has shown that a re-classification of the members of the Mag-

* Swallow. 2nd Annual Report 1854, Part I, pp. 115 to 130.

† Ibid., p. 124.

‡ Report Missouri Geological Survey 1873-74, pp. 352, 257, 358.

§ The North American Continent in Cambrian Time, and Bulletin No. 81, U. S. Geological Survey, Correlation Papers—Cambrian.

|| Bulletin 81, p. 339.

¶ Southeastern probably meant.

nesian series is necessary,* and it is further tending to the conclusion that rocks placed higher in the series than the Third sandstone are of Cambrian age. As bearing upon these questions the results of studies recently made by the writer in Madison, St. Francois and Ste. Genevieve counties are here presented.

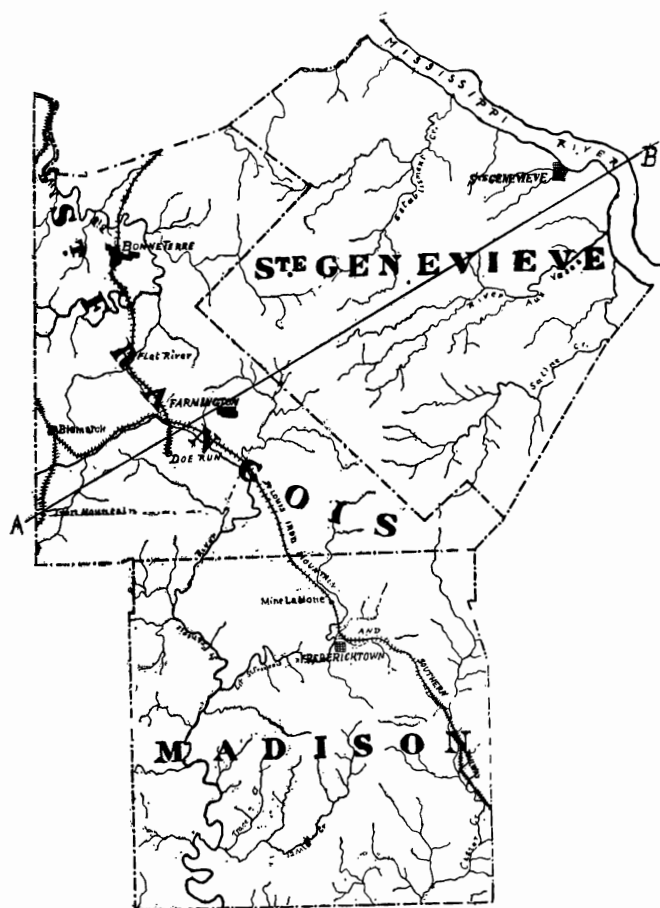


Fig. 1.—Outline map of St. Genevieve, St. Francois and Madison Counties.

Previous Results in St. Genevieve County.—St. Genevieve county is in the eastern portion of the State, about 40 miles south of St. Louis. As is shown in the adjoining sketch it is bordered by the Mississippi river on the east, by St. Francois

* Vol. ii, Report Missouri Geological Survey, 1892; Iron Ores, chap. v.

county on the west and corners with Madison county on the southwest. A description of the geology of this county by B. F. Shumard was published in 1871,* from results of work done during earlier years. According to this report the country lies on the eastern flank of the Ozark uplift and, proceeding from the river westwards, the upturned edges of the eastward dipping strata of Carboniferous, Devonian, Upper and Lower Silurian ages are successively encountered. It is with the last of these alone that we are concerned here. The report describes among the rocks of this period,† the First magnesian limestone, the Saccharoidal sandstone, the Second magnesian limestone, the Second magnesian sandstone and the Third magnesian limestone, as they are found in this county, one under the other, dipping gently to the east.

The Second magnesian limestone, in which we are specially interested, is stated to occupy a large area chiefly in the central and northwestern portions of the county, and to extend across the eastern half of the county in a belt from one to three miles wide. The Second sandstones, in which we are also interested, is described as constituting the surface rock over a larger portion of the country than any other formation and is present in greater vertical development. It is particularly well shown over the high central portion of the county. It is described as varying in lithological character, but usually appears in thin beds of white, yellow, or reddish colors and made up of moderately fine siliceous grains; sometimes, however, it is coarse-grained to the extent of being a grit-stone or conglomerate, containing large pebbles of milky translucent quartz. The thickness is stated to be 150 ft.

The Third magnesian limestone is described as occurring in the western and southern portions of the county, with the "usual lithological characteristics."

Previous Results in Madison County.—The geology of Madison county was described by Broadhead in 1873.‡ According to this report the sedimentary strata fill the valleys between mountains and hills of Archæan rocks. The general section of these strata given is as follows, from the top downwards.

6. Sandstone.
5. Chert beds and magnesian limestone.
4. Magnesian limestone.
3. Grit-stone with some magnesian limestone.
2. Marble beds.
1. Sandstone.

* Report Missouri Geological Survey, 1871, pp. 289 to 303.

† Opus cit., pp. 298 and 299.

‡ Report Mo. Geological Survey, 1873 to '74, pp. 342 to 379.

The members of this section numbered 1, 2, and 3 and part of 4 are placed in the Potsdam; the upper one hundred feet or more of 4 are described as belonging to the Third magnesian limestone; numbers 5 and 6 are placed in the Calcareous and 6 is thought to be probably the "Third sandstone."

The lowest sandstone (1) is described as occurring in the northern part of the county, in between the granite hills; it is generally fine grained and of white or buff color, or may be a coarse, brown or red conglomerate. Thicknesses of from 40 to 90 feet are exposed in places. The sandstone found about Mine La Motte is included in this description.

The marble beds (2) are found only at a few localities in the central and southwestern portions of the county. The grit-stones are similarly exposed only at a few points. The magnesian limestones (4) are stated to be of wide distribution; the lower beds are placed in the Potsdam and are separated from the upper beds, of 160 feet or more, which are grouped under the head of the Third magnesian limestone, though the reasons for this separation are not very clear. The chert and sandstones (5 and 6) occupy the hill tops in scattered patches.

No explanation is given of the stratigraphic structure of county and the reasons for differentiating the marble and grit-stone beds (2 and 3) and for placing them at the places designated in the section are not plain.

Previous Results in St. Francois County.—No report especially describing St. Francois county has been published; but the sedimentary rocks there are in direct continuation of those of Madison county and the prevalent limestone has generally been considered to belong, in great part at least, to the Third magnesian. According to our understanding, then, the interpretation of the stratigraphy and structure of this region to be drawn from these reports would be as is expressed in the following section, along the line A, B, drawn in the sketch map on p. 222.

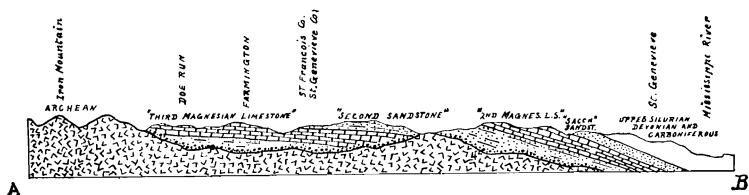


Fig. 2.—A generalized section across St. Francois and St. Genevieve counties, expressing the results of early work.

Results of the present Geological Survey.—During the past few years the present Geological Survey has prosecuted field work during part of each field season in this section of the

State. In this period the writer has carefully examined numerous outcrops and exposures and has, further, had the benefit of the results of a large amount of diamond drilling and shafting which have been done here, notably in the vicinity of Bonne Terre, Flat River, Farmington, Doe Run, Iron Mountain, Mine La Motte and Fredericktown. The results of this work all go to show that in St. Francois and in the northern part of Madison counties the sedimentary rocks between and beyond the granite and porphyry hills may be divided into the following three parts from the top downwards.

- | | Observed thicknesses.
Feet. |
|---|--------------------------------|
| 1. Limestone, magnesian, crystalline; immediately underlies most of the valleys and constitutes the bulk of the non-Archæan hills. In thin and massive beds; includes some shale, especially in the lower parts; arenaceous layers encountered at places, but are of subordinate importance and not persistent. This is the lead-bearing horizon of southeastern Missouri | 1 to 500 |
| 2. Sandstone, of white, gray and reddish colors; generally composed of pure quartz grains with secondary enlargements liberally developed; sometimes thinly bedded, even shaly, elsewhere massive, but generally friable and difficult to drill through | 1 to 100 |
| 3. Conglomerate, composed of granite or porphyry boulders with a limestone, grit or clayey matrix, 1 to 50
Granite or porphyry floor. | |

This section is, of course, not represented in full everywhere. The best succession is perhaps found in the center or the broader valleys, between the Archæan hills. As one approaches the sides of the valleys any or all of the beds may taper out. The detrital conglomerate would, naturally, not be found resting against a steep granite wall, but the boulders would have slid or rolled to lower levels; the limestone, being often at higher level than the sandstone, may extend beyond the latter up a concealed hill slope of granite or porphyry and, thus, be often directly in contact with either of these latter rocks, or with the conglomerate derived from them. On the other hand, a thickening of the sandstone towards its source, an inclination of the floor or a slight dip, aided by erosion, may bring the sandstone to view at a higher elevation than the geologically higher limestone. This is the case in the vicinity of Doe Run; about three miles southeast of that place the sandstone, which underlies the limestone con-

taining the lead ore at the Doe Run mine, rises to the surface and is exposed in the bluffs of the hills to a thickness of 70 ft. or more.

This bottom sandstone is encountered in the vicinity of Flat River at depths of about 400 ft. Eastward from that place, however, numerous drill holes put down in late years show that the sandstone rises higher and higher and, about two miles east of Farmington, it is exposed at the surface, on Wolf creek. Thence, in the same direction, towards St. Genevieve, this rock continues to occupy the surface to about the middle of the county. Limestone then comes in again with an eastward dip and is, in turn, succeeded by the overlying Saccharoidal sandstone described by Shumard. According to our views, then, the section along the line A-B, is as follows:

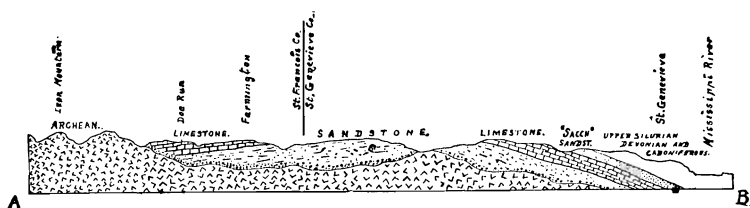


Fig. 3.—A generalized section across St. Francois and St. Genevieve counties, expressing the results of recent work.

On comparing this section with fig. 2, on p. 224, it will be seen that the principal difference is that the sandstone, termed "Second," overlies the limestone to the west in fig. 2, while, in fig. 3, it underlies it. The consequence is that this great body of limestone to the west, in St. Francois and Madison counties, instead of occupying the position of what have been called the Third or Fourth magnesian limestones is more properly in the position of the so-called Second magnesian limestone, and the underlying sandstone becomes correspondingly raised in the stratigraphic scale. Further, if the reasons cited for placing the limestones of Madison county in the Cambrian are good, we are of the opinion that all of the great body of limestone described above as occurring in Madison and St. Francois counties belongs to this age and the underlying sandstone and conglomerates also, as no stratigraphic break can be recognized throughout the section. This would bring the upper limits of the Cambrian to the base of what has been called the Saccharoidal sandstone in Missouri, at least as identified in St. Genevieve county.