

ART. XVIII.—*The Upper Silurian Beds of Western Tennessee; and Dr. F. Roemer's Monograph*; by Prof. J. M. SAFFORD, Lebanon, Tenn.

To no part of Tennessee has the attention of American palæontologists been more frequently directed than to the region of "the glades," in the western part of the State. Recently attention has again been called to this region by the publication of Dr. Roemer's valuable and elegant monograph.* For this work, which we welcome with great pleasure, we are much indebted to Dr. Roemer. It presents a unique local fauna of great interest. Setting aside a few forms, the species he enumerates and describes belong to a bed of calcareous shales and limestones equivalent to the Niagara group of New York. This bed I have denominated for some time past, in my unpublished notes, the 'sponge-bed,' or the sponge-bearing bed, the appropriateness of which name is at once seen by referring to Dr. Roemer's monograph.

* Die Silurische Fauna Des Westlichen Tennessee; Eine Palæontologische Monographie von Dr. Ferdinand Roemer; Breslau, 1860. See this Journal, xxxi, 127.

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The object of this article is to point out the fact that the fauna illustrated in the above work is not the only one occurring upon the glades. Heretofore not a little confusion has existed with reference to the different beds of this region. To this day, so far as the writer knows, no complete sections have been published. To present the number and order of the beds, and to prepare the way for a clear understanding of the formations and their condition, the following section, selected from the materials gathered for my Report upon the Geology of Tennessee, is given. It was made in the northern part of Wayne county. The successive beds crop out along a line, which commencing at the level of the Tennessee river (low water) at Clifton, and running back nearly four miles, terminates at the top, and on the end of one of the spurs, or fingers, that jut out from the high flat lands further east. The beds are arranged in descending order. The term Niagara is made to include both the Clinton and Niagara groups of New York.

CARBONIFEROUS.	{	9. Top of ridge overlooking the valley of Eagle Creek. Strata concealed; loose cherty masses scattered over the surface containing occasional fossils, 53 feet.
		8. Strata (when weathered) <i>bluish or greenish siliceous shale</i> . Eight feet at the base interstratified with thin, smooth, fine-grained sandstones which are charged with individuals of a small <i>Lingula</i> , 42 feet.
DEVONIAN, <i>Hamilton group?</i>	{	7. <i>Fine-grained sandstone</i> highly charged with the same <i>Lingula</i> as above, 8 feet.
		6. <i>Grey crinoidal Limestone</i> —Fossils obscure at this point, —the horizon, however, of well marked Lower Helderberg rocks at other points in Wayne county, 25 feet.
UPPER SILURIAN.	{	Lower Helderberg?
		Niagara, the Sponge-Bearing Bed.
		Niagara, the Variegated Bed.
LOWER SILURIAN. <i>Hudson River.</i>	{	5. <i>Glade forming Limestones and Calcareous Shales</i> .—The limestone grey often coarse crinoidal—sometimes argillaceous—All very fossiliferous—occasionally containing layers of chert, 90 feet.
		4. <i>Variegated Limestone</i> ; brownish-red and grey layers interstratified—many layers argillaceous— <i>orthocerata</i> abundant in lower part, 96 feet.
		3. <i>Greenish calcareous Shale</i> , containing <i>Leptæna sericea</i> , and <i>Strophomena alternata</i> , 15 feet.
		2. <i>Blue Limestone</i> in rough thick-bedded layers containing <i>Strophomena alternata</i> , <i>S. tenuistriata</i> , <i>Rhynchonella increbescens</i> , <i>R. dentata</i> , <i>Cyclonema bilix</i> , <i>Columnaria stellata</i> , &c., 21 feet.
	{	1. <i>Blue fine-grained Limestone</i> —in thin smooth layers separated by shaly leaves—has been used as "Hydraulic Limestone"—contains <i>Orthis testudinaria</i> , <i>Rhynchonella modesta</i> , <i>Lingula</i> , <i>Trilobites</i> , &c., 70 feet.

The beds numbered 4, 5, and 6, represent all the glade-forming limestones and shales, and it is to these that attention is especially invited. In this part of Wayne county, their entire thickness is seen to be 211 feet.

No. 4. *Variegated Limestone*.—This bed, the first I notice, rests directly upon the Hudson river rocks. The junction is well seen at Clifton and below that place, for several miles, along the eastern bank of the Tennessee river. This bed is seen in the glade region occupying generally a low position. Outside of Wayne and Hardin counties its base is rarely seen. The vicinity of Clifton is the most favorable place for studying the entire bed, that has come under my observation.

It is easily recognized by interstratified brownish-red layers, some of which, when crinoidal, furnish a pretty good marble. It is, however, often argillaceous and crumbling.

Its red color, due to sesquioxyl of iron, may indicate its Clinton affinities.

This bed is, in general, comparatively barren in fossils. Occasionally its layers are crinoidal. *Atrypa reticularis*, and several species of *orthoceras* are met with. At Clifton, the base of the bed, the entire mass, is exceedingly rich in individuals of several species of *orthoceras* and in large crinoidal stems and roots. The sponges especially are abundant.

No. 5. *Gray Limestones and Shales, or the Sponge-bearing Bed*.—This is the division to which Dr. Roemer's fauna belongs. It is a series of gray crinoidal limestones and calcareous shales, the latter often predominating. On the sloping marly glades the layers of limestone frequently crop out in two or three successive ledges separated by masses of shale. Thin layers of chert often occur interstratified with the limestone. Fossils abound, among them *Astraeospongia meniscus* is very characteristic, in fact the mass might well be called the *Meniscus bed*.

The general thickness of the bed is from 80 to 100 feet. In this respect, however, it is quite variable; at a few points the thickness is reduced to 30 and even to 20 feet. In the section above it is given at 90 feet; it is quite possible, however, that a portion of the overlying bed (as in it, at this point, no characteristic fossils were observed) ought to be included, thus making the thickness to a small extent greater.

The *Sponge-bearing Bed* is the prevalent rock of the glades in Hardin, Wayne, Decatur and Perry counties. It also occurs, to some extent, in Humphreys, Benton and Henry.

Nearly all of the species given by Dr. Roemer in his monograph are found in this bed. There are a few, however, which, so far as my observations extend, are confined to the bed next above, having been seen, *in place*, only in these rocks; the most important, perhaps, is *Pentamerus galeatus*. *Spirifer macropleura*, (*S. Niagaraensis*, var. *oligoptychu* of the monograph) although in New York a Lower Helderberg form, is properly included in this fauna as it occurs in this as well as in the overlying bed. *Calceola Tennesseensis*, Roemer, is the same as *C. Americana*,

Safford, described in a previous number of this Journal, (vol. xxix, p. 248). The latter name must give place to the former. On a future occasion I shall have remarks to make upon other species given in Dr. Roemer's monograph.

No. 6. *Lower Helderberg*.—We come now to a bed of strata presenting a fauna quite different from that illustrated by Dr. Roemer. It occurs well marked at numerous points within the glade region and in the counties mentioned. The place of this bed is immediately below the Devonian shales and sandstones cropping out, when present, from beneath those on the hill-sides. At many points it is the surface rock. Many of the glades, with naked summits, present only Niagara rocks. Some, however, are capped by this formation. This division, as a bed, and looking over the whole region, is to a considerable extent cut up and fragmentary.

In thickness it varies much; at some points it is entirely absent, No. 7 or 8 resting immediately upon the Sponge-bearing bed; then again it swells out to 60 or 70 feet, and perhaps to as much as 100 feet although I have not any where, as yet, measured so great a thickness.

So far as it regards the particular section presented, it is not certain that No. 6 is wholly, or even in part, *Lower Helderberg*, no characteristic fossils having been seen. It marks, however, the horizon of these rocks. Within a few miles of this point, the bed holding this position is well characterized in good sections.*

To my mind it is evident, that this bed was subjected to very considerable denudation before the deposition of the Devonian shales and sandstone; hence its variable thickness, or its absence when, in complete sections, the latter rocks are present. Going further back, I have reason to think that the floor of Niagara rocks, upon which this bed rests, was also previously subjected, (but not in so great a degree,) to denudation, and hence the varying thickness of the Niagara bed. This, too, will explain what appears to be the fact, that where the Niagara bed is thin the other becomes thicker, the two in this respect being, to a certain extent, complementary to one another. The Helderberg sediments filled up the hollows and basins of the partially denuded Niagara floor.

Lithologically the bed under consideration cannot easily be distinguished from the one below it. But its fossils, as a whole,

* I take this opportunity of expressing my thanks to my friend and former pupil, A. B. Gant, Jr., of Cravens Mills, Wayne county, for valuable assistance rendered me in my investigations on Indian and Eagle creeks. Mr. Gant has discovered several most interesting localities of fossils in both Wayne and Hardin counties. His ability and zeal promise much more with reference to the interesting geological features of this region.

are quite different. Here the characteristic sponges of the Niagara bed disappear; and so do the crinoidal forms so well illustrated by Dr. Roemer.

In their places we have other species, mostly brachiopods, the larger portion of which are known to occur in the Lower Helderberg rocks of New York. Below is a list of some of the described species. These have all been collected by the writer from the bed in question. Most of them may be found in all, or nearly all the counties bordering the Tennessee river. With the exception of the last, they have all been compared directly with New York specimens.

<i>Eatonia</i> (<i>Atrypa</i>) <i>singularis</i> .	<i>Rhynchonella</i> <i>mutabilis</i> , Hall.
<i>Merista</i> ("") <i>laevis</i> .	<i>Orthis</i> <i>subcarinata</i> , Hall.
" ("") <i>bella</i> , Hall.	" <i>oblata</i> , Hall.
<i>Rhynchospira</i> <i>formosa</i> , Hall.	" <i>varica</i> , Hall.
" <i>globosa</i> , Hall.	<i>Spirifer</i> <i>perlamellosa</i> , Hall.
<i>Nucleospira</i> <i>ventricosa</i> , Hall.	<i>Strophomena</i> <i>punctulifera</i> , Conrad.
" <i>concentrica</i> , Hall.	<i>Phacops</i> <i>Hudsonicus</i> , Hall.
<i>Pentamerus</i> <i>Verneuili</i> , Hall.	<i>Anisophyllum</i> <i>Agassizi</i> , Edwards
" <i>galeatus</i> , Hall.	and Haime.

Dr. Roemer's beautiful species, *Rhynchonella Tennesseensis*, as well as *Athyris tumida*, as he has it, ought perhaps to be included in the Lower Helderberg fauna; I have seen many perfect individuals of the first in these rocks, and but a few uncertain fragments in the debris of the Niagara, or Sponge-bed; of the second species, but few individuals have come under my observation and I am more in doubt as to its true position.

The following among the brachiopods given in the monograph are common to the two beds; *Atrypa reticularis*, *Rhynchonella Wilsoni*, *Orthis elegantula*, *Spirifer* ("Niagarensis") *macropleura* and *Strophomena depressa*.

Within a few months I hope to be able to present a more detailed and systematic account of these rocks, together with complete lists of the fossils they contain.

Lebanon, Tenn., January, 1861.