

ART. XXI.—*Triticites*,* a New Genus of Carboniferous Foraminifers;† by GEORGE H. GIRTY.

WHEN, in the course of preparing a report on the Permian fauna of the Guadalupe Mountains, I came to study the species described by Shumard as *Fusulina elongata*,‡ my attention was engaged by a structural difference of some mark between it and the form from the Coal Measures strata of the Mississippi Valley, commonly identified as *Fusulina cylindrica*. I was consequently led to consider the structure of typical *Fusulina*, and found that the Guadalupian species, and not the common Pennsylvanian one, agrees with the Russian form. The discriminating character which is shown by Fischer-de-Waldheim's original figures of *Fusulina*, by specimens from Russia, and by most figures and descriptions in manuals,§ etc., resides in the partitions which separate adjacent chambers in the same concentric series.

As is well known, each chamber is formed by a narrow prolongation of the outer wall in the direction of revolution, followed by a sharp deflection toward the axis to meet the volution below. The partition thus formed is not, however, complete, minute apertures being left along its lower margin.¶ In true *Fusulina* this partition wall is strongly and regularly fluted in a radial direction, and the arrangement is such that the concave flexures of one partition are opposite the convex flexures of the next, the approaching curves coming in contact more or less precisely along a line. Thus what would otherwise have been a single long chamber extending unobstructed from end to end, is divided into a large number of chamberlets. These are usually quite regular and have the shape of prisms with subrhombic section. The regular fluting of the partitions is often well shown by the aperture, but no intimation of it is conveyed by the straight depressed sutures which prominently mark the external surface. Apparently the fluted structure is not introduced until just after the wall has assumed a radial direction, when it is concealed by the overlap of the succeed-

* From *triticum*, a grain of wheat.

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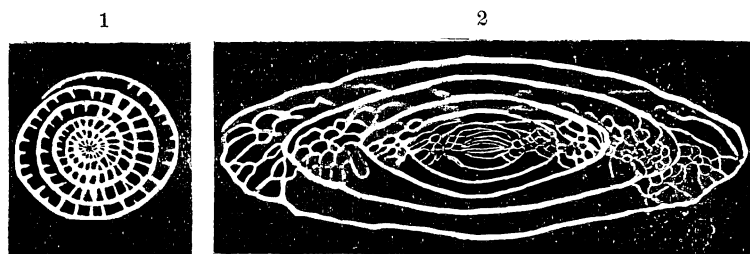
‡ St. Louis Acad. Sci., Trans., vol. i, 1859, p. 388.

§ As, for instance, on p. 31 of Steinmann and Döderlein's *Elemente der Paläontologie* (Leipzig, 1890), on p. 104 of Zittel's *Handbuch der Paläontologie*, Bd. I (Munich and Leipzig, 1876-1880), on p. 32 of Zittel's *Textbook of Palaeontology* (London and New York, 1896), on p. 136 of Nicholson and Lydekker's *Manual of Palaeontology*, vol. i (Edinburgh and London, 1889), etc. See, also, *Geology of Russia*, etc., by Murchison, de Verneuil, and Keyserling, vol. ii, 1845, pl. i, fig. 1c.

¶ Indicated by the frequent failure of the partition walls to extend to the preceding volution.

ing wall. Let, however, the outer wall be removed by weathering or by artificial means, and the surface is seen to be very regularly divided into rhombs, which the eye naturally follows in spiral rows.

In the form from the Mississippi Valley for which the name *Triticites* is proposed, the partitions are for the most part straight, and not fluted except in the immediate vicinity of the axis, so that the greater portion of each chamber is not divided into chamberlets. There is also a slight formal difference between *Triticites* and *Fusulina*, since the former seems not to occur in the elongate subcylindrical shapes often found in the latter. *Triticites* is usually subglobose or spindle-shaped, but as *Fusulina* likewise develops these forms, configuration is of but limited importance in discriminating the two genera.



Transverse section.
× 10.

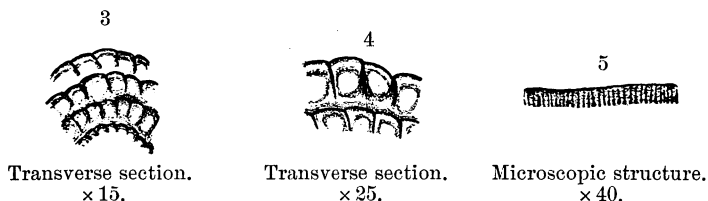
Longitudinal section.
× 10.

Externally they will many times look almost precisely alike, except for the aperture, which, if exposed, will at once serve to distinguish them. In weathered specimens the long almost parallel lines of the partitions in *Triticites* are in marked contrast to the reticulation formed by these structures in *Fusulina*. Transverse sections in the two genera are sometimes nearly alike. In each case a spiral wall is seen from which in *Triticites* simple projections extend at regular intervals toward the center, reaching in some cases nearly, and in others completely, to the preceding volution. This is well shown by fig. 1, which represents *Triticites secalicus*. A transverse section through *Fusulina* presents a similar appearance, save that the partition walls are frequently represented by looped or forked lines, instead of by simple ones. The radial walls are seen in many cases to be incomplete, and it is probably by means of the apertures thus left that communication between succeeding chambers was maintained. In longitudinal section the difference is more apparent. The concentric walls of *Fusulina* enclose between them lines, sometimes straight, sometimes curved, often loop-shaped, which are the edges of the inter-

sected fluted partitions, the direction of which is seldom the same as that of the section. In longitudinal sections of *Triticites* there extends along the axial line a band of anastomosing walls, sometimes constituting a more or less regular network, but usually disordered and confused. Aside from this the space between the concentric walls over the median and larger portion of the volutions is uninterrupted, except as some irregularity permits the section to cut one of the longitudinal partitions. Fig. 2 represents a longitudinal section through *Triticites secalicus*. The undivided chambers are well shown in this section, and the wrinkled partitions near the ends of each chamber, which by their recurrence produce a band through the axis. This difference in longitudinal section would probably escape no trained observer, but its significance can be appreciated only when interpreted in terms of the complete organism.

The minute wall structure of *Triticites*, though it does not seem to differ from that of *Fusulina*, deserves to be noticed. The wall in these shells is composite, apparently consisting of two substances, of different character, or, at all events, of different density. Thus, when thin sections are examined, three different tints, with more or less well-marked boundaries, are seen, namely, the transparent calcitic filling of the chambers, the translucent substance of which most of the wall is composed, and an outer opaque layer whose distribution will be described somewhat carefully. This opaque layer is much thinner than that which is translucent, and seems to represent merely an external coating upon the upper and front sides of each chamber wall. It usually appears as a strong dark line in thin sections, which defines the translucent wall of one chamber from that of the next, and it forms a plane of dehiscence along which the chambers and volutions tend to separate. A certain amount of variation is manifest by this layer and its conduct in the partitions is different from that in the revolving wall, an indication of individuality in these structures of which there is further evidence. In the revolving wall it occasionally happens, chiefly in local areas, that no intensification of tint is seen along the outer surface, the whole wall being practically uniform. In other instances an intensification occurs on the inner side nearly equal to that of the outer, but as a rule, from which exceptions are but few, sections clearly show a dark coating upon the outer surfaces of the revolving wall. This layer is seen to be continuous from the revolving wall to the partitions and it thus defines to the eye the limits of each chamber from that adjacent to it. The growth of the shell is, therefore, seen to be the result of a repetition of similar stages, each of which consisted of a prolongation of the shell first in a

revolving and then in an axial direction. While as a rule the dark line of the dense layer defines the external surface of the partition as well as of the revolving wall, the thick inner layer apparently being continuous from one to the other, occasionally it interrupts the latter and as it assumes an axial direction fans out and either divides, so as to bound both sides of the partition, or spreading, involves it in a nearly uniform dark tint. In this case obscure radial lines, probably of structural origin, can sometimes be made out. The partitions, as we shall shortly see, have otherwise a different structure from the revolving wall. The distribution and behavior of this dark coating seems to me to indicate that it is an original and intrinsic feature of the shell structure, and that it does not represent the contact between two walls nor the plane along which testaceous material was deposited from two sides. Somewhat in contradiction, however, stands the fact that where the walls have become detached the dark layer is often not conspicuously



retained upon either of them. Figs. 3 and 4, drawn from *Triticites secalicus*, show the general microscopic structure of the wall, the thin outer dense layer, and the thick inner translucent layer. They show the inner wall as completely surrounding the interior of the chamber. While not of rare occurrence, it is more common for the inner layer to be developed only on the upper and outer portions of the chamber wall, the lower and inner boundary being formed by the dense outer layer of the volution and chamber preceding. It is evident that the complete inner layer, if it is extended from end to end, would cut off all communication between adjacent chambers (except through the pores). The formation of this layer, therefore, over the back and lower walls is probably due to subsequent deposition.

Part of the translucent wall is thickly penetrated by opaque rods or tubuli, whose direction is normal to its two faces, and it is this structure which has caused *Fusulina* to be described as strongly perforate. These rods or tubes are always considerably darker than the translucent wall which they pervade and are as a rule of somewhat lighter tint than the dense outer layer. They usually increase in size inward and taper toward

the opaque layer, and while in some instances they reach and connect with the latter, for the most part they diminish and disappear before completely penetrating the translucent wall. They have the same appearance whether the specimen is cut lengthwise or transversely, and their cross section was probably circular. In their distribution these rods or tubes seem to be confined entirely to the revolving wall. Occasionally they can be seen to extend part way around the turn to where the wall becomes radial, but I have never seen them in the partition wall itself. Fig. 5 represents a section through part of the revolving wall of *Triticites secalicus*. The upper margin of the figure is the outer margin of the wall. The dark lines represent what has usually been interpreted as pores or tubes. These structures can not be seen in the radial walls.

In section, therefore, the revolving wall is seen to be barred off into nearly equal stripes of opaque and translucent shades, and of these it is clear that the translucent ones represent the shell and the opaque ones what have been considered pores.

Carpenter described the minute structure of "*Fusulina*" in 1870, and his conclusions have been followed or concurred in by most subsequent writers. It is interesting to note that his investigations were made upon specimens from Iowa which with great probability belonged not to *Fusulina* but to *Triticites*. One can hardly doubt that he also studied specimens of real *Fusulina*, and it is difficult to understand why he disregarded the differences which have led me to distinguish *Triticites* as a distinct group. Though he does not mention or figure the dark layer which coats the walls upon their outer side and which in sections defines the outline of each chamber, and though other writers have not, whose work has come into my hands, I am quite satisfied as to its existence and persistence.* The interpretation of its significance, on the other hand, is a matter of uncertainty. The presence and conduct of this dark superficial layer and its relation to the so-called tubuli have led me to entertain some doubt as to whether the shell in this genus is as usually stated, perforate.

Carpenter remarks upon the complexity of the partition walls in the terminal portions of *Triticites* in the following terms: "The irregularities which are noticeable in *sections* made either longitudinally or transversely through the terminal portions of the shell, seem explained by the disposition of the alar prolongations which is revealed by *fracture*; for this shows that the alar prolongations, as they pass to a distance from the median plane, tend to interdigitate with each other,

* Material of both *Fusulina* and *Triticites* has been examined, and from a number of localities and horizons sufficient to show that these characters are constantly present and are not the result of peculiar preservation.

in such a manner as to produce great apparent confusion when they are brought into view by section.”* While this is perhaps equally true of *Fusulina*, the simplicity of the partitions in *Triticites* over their median portion renders their complexity near the ends peculiarly striking. From the passage above quoted, from Carpenter’s figures, and from the localities and horizons from which his American specimens were obtained, there can be no doubt that they belonged to *Triticites*, instead of to *Fusulina*.

I am in some uncertainty about the taxonomic value which should be given to the differences above noted between *Fusulina* and *Triticites*. It is evident that they are of degree only, though very marked in the case of the forms under discussion, intermediate stages being unknown. I would regard *Triticites* in any other group as a good subgenus, though probably no more; but among forms whose simple structure puts a certain limit upon differentiation, it seems that somewhat different standards should be employed, and I believe that the group of *Triticites* can be given generic rank.

The type of *Triticites* is not a new species. In 1823 Say† described two species from Kansas and Nebraska under the name of *Miliolites secalicus* and *Miliolites centralis*, which from evidence intrinsic and extrinsic belong without question to the group of fossils for which the name *Fusulina cylindrica* has since come into general use. J. W. Beede‡ was, I believe, the first to recognize the real character of *Miliolites secalicus* and to revive this specific name for the American form, but he did not discriminate it from *Fusulina cylindrica* Fischer-de-Waldheim, which he relegated to synonymy. While I had little doubt that the American species was distinct from the Russian one, I have continued to use for it the name *Fusulina cylindrica*, because it seemed to me undesirable to disturb the current terminology until several essential points could be determined with reasonable finality. In the present paper I have sought to show that the American form is not only specifically distinct from *Fusulina cylindrica*, but can probably be referred to a different genus, for the type of which *Triticites secalicus* is selected. This species was first described from the Missouri River near the Platte. The material upon which my interpretation of *Triticites secalicus* is based, and upon which the term *Triticites* immediately rests, was obtained from the Platte River near its junction with the Missouri. The locality and horizon, therefore, can be said to be essentially the same,

* Monthly Microscop. Jour., vol. iii, 1870, p. 182.

† Account of an Expedition from Pittsburgh to the Rocky Mountains, etc., under Major Stephen H. Long, vol. i, 1823, p. 151, footnote.

‡ Univ. Geol. Surv. Kansas, Rept., vol. 6, 1900, p. 10.

and as my material agrees with Say's description as far as it goes, I have little doubt that it is the same species for which the name was first employed. My investigations have been carried sufficiently far to show that most if not all of the so-called *Fusulinas* of the Mississippi Valley belong to *Triticites*. I am not prepared to express an opinion as to whether several or, as has generally been assumed, but a single species occurs there. The second species described by Say, under the name of *M. centralis*, is doubtfully distinguished by the characters pointed out by its author. Say's description of *Miliolites secalicus* is framed in the following words, and can be amplified from the descriptions and figures here presented :

"29. On the Missouri near the Platte occur masses of rock, which seem to be almost exclusively composed of a remarkable petrification, belonging to the family of concamerated shells. This shell is elongated, fusiform, and when broken transversely, it exhibits the appearance of numerous cells disposed spirally as in the *Nummulite*, but its longitudinal section displays only deep grooves. The shell was therefore composed of tubes or syphons, placed parallel to each other, and revolving laterally as in the genus *Melonis* of Lamarck, with which its characters undoubtedly correspond. But as in the transverse fracture, its spiral system of tubes cannot be traced to the center in any of the numerous specimens we have examined, it would seem to have a solid axis, and consequently belongs to that division of the genus that Montfort regards as distinct, under the name of *Miliolites*, which seems to be similar to the *Fasciolites* of Parkinson, and altogether different from the *Miliolites* of Lamarck. Our specimens are conspicuously striated on the exterior, which distinction, together with their elongated fusiform shape, sufficiently distinguish them as species from the *sabulosus* which Montfort describes as the type of his genus. No aperture is discoverable in this shell, but the termination of the exterior volution very much resembles an aperture as long as the shell.

The length is three-tenths of an inch. And its greatest breadth, one-twelfth.

We call it *Miliolites secalicus*, Say. Mr. T. Nuttall informs me, that he observed it in great quantities high up the Missouri.

In the same mass were some segments of the *Encrinus*, and a *Terebratula* with five or six obtuse longitudinal waves."