

Observations on the Microscopic Shell Structure of *SPIRIFER CUSPIDATUS*,
Sowerby, and some similar American forms.

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In his valuable and accurately illustrated work on the British Carboniferous *Brachiopoda*, page 45, Mr. Davidson states that *Spirifer cuspidatus*, Sowerby, "belongs to the genus *Spirifer* proper, and not to the subgenus *Cyrtia*," as he and others had supposed. He also adds that "no specimen of *S. cuspidatus* I have hitherto been able to examine, has exhibited a deltidium in its entire condition, but which, in all probability, was not perforated by a circular foramen, as seen in true types of the subgenus *Cyrtia*." In a note at the bottom of the page containing his explanations of plate viii., however, of the same work, he corrects the above statement as follows: "At page 45, I stated that no specimen of *S. cuspidatus* I had hitherto been able to examine possessed its deltidium, and that I considered it was, in all probability, not perforated by a circular foramen, as in the true types of the subgenus *Cyrtia*. Subsequently, however, Mr. S. P. Woodward showed me the internal cast of the ventral valve of a specimen in the British Museum, thought to have belonged to *S. cuspidatus*, and derived from the Dolomitic carboniferous limestone of Breton Hill, in which there is evidence that the deltidium was in reality perforated by a circular foramen as in *Cyrtia*." Of this internal cast, as well as of a gutta-percha mould made from it, Mr. Davidson gives good figures, on plate ix. (figs. 1 and 1a) of the work above cited.

From these remarks, and the accompanying figures, it seemed to be nearly or quite demonstrated, that *S. cuspidatus* is a true *Cyrtia*, as had formerly been supposed by Prof. McCoy and Mr. Davidson, and, as it is also the type upon which Sowerby had founded his older genus *Spirifer*, it would follow, as a matter of course, that *Cyrtia*, Dalman, could only be regarded as an exact synonym of the typical section of *Spirifer*, Sowerby, which view was adopted in the work on the Palæontology of the Upper Missouri, by the writer and Dr. Hayden. It will also be observed that the shell structure of *Spirifer* is there described as being impunctate, in accordance with the views of Dr. Carpenter and Mr. Davidson in regard to the group to which we propose to restrict it, after separating, generically, the punctate types *Spiriferina* and *Cyrtina*.

Some examinations I have recently had an opportunity to make, however, of the shell structure and internal characters of several American forms, closely allied to, if not in some instances identical with, *Spirifer cuspidatus*, as well as of a supposed authentic British example of that species, in the collection of Mr. Worthen, at Springfield, have given rise to doubts in regard to the correctness of some of these conclusions.

I was led to make these examinations by observing in Mr. Worthen's collection excellent specimens, apparently of *Spirifer capax*, Hall, (very similar to *S. cuspidatus*, Sowerby) from Clarksville, Missouri, showing exactly the form and internal characters of a genus *Syringothyris*, proposed by Prof. Winchell, in the Proceedings of the Academy for January, 1863. It will be remembered that Prof. W. described the type of this genus as having the form and general external characters of *Spirifer cuspidatus*, but differing in the possession of a curious internal tube connected with the inner side of a kind of deep-seated, false deltidium, or transverse plate passing across between the dental laminae. He also states that the shell structure is impunctate.

On examining the specimens above alluded to in Mr. Worthen's collection, I at once observed their exact agreement in all internal characters, as well as in the form, ornamentation, &c., with *Syringothyris*, but soon saw, while looking at them with a good pocket lens, some evidences of a punctate structure, and, on afterwards placing fragments of the shell under a high magnifier, where they could be examined by transmitted light, they were found to be beyond doubt punctate. Subsequently I mentioned this fact to Prof. Win-

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chell, at Chicago, and requested him to re-examine his typical specimens of *Syringothyris*, to see if he could discover any traces of punctures. He afterwards informed me that he had done so, but could see no evidences of punctures, and he kindly gave me a slip of glass upon which were fastened, with Canada balsam, fragments of his typical species and of another not yet described, in neither of which any punctures were visible.

In this connection, however, it is proper to remark, that all of these fragments are either very small, or so opaque and badly preserved, that the punctures might not be apparent, even if they exist. It is also worthy of note that in several shells of this type which I have examined, the punctures are very small, and so distant that fragments large enough to show clearly the punctures as seen in the various types of *Terebratulidæ*, might be without a single puncture. From these facts, and others to be mentioned farther on, I am strongly inclined to think Prof. Winchell's specimens are not in a good condition for showing the shell structure, and without intending to attribute any carelessness or want of discrimination to that gentleman, that these species may yet be found to be punctate when other specimens in a better state of preservation are obtained.

On looking farther through Mr. Worthen's collections, I saw other species of this type, and examined their shell structure with the following results: first, a form from Missouri, believed to be *Spirifer subcuspidatus*, Hall, from the Keokuk division of the subcarboniferous series, (and thought by Mr. Davidson, from an examination of examples from Illinois, to be identical with European forms referred to *S. cuspidatus*), was examined, and found to be unquestionably punctate. The punctures are small and scattering, but owing to the fact that they were, in the specimens examined, filled with dark opaque matter, they could be very clearly seen by transmitted light, in thin fragments saturated with Canada balsam. The interior of this shell is unknown to me.

Next, specimens of apparently another species or variety, (scarcely, if at all, distinguishable, by external characters at least, from certain forms of *S. cuspidatus* as usually understood), from the fine-grained sandstone of the Knobbs, back of Albany, Indiana, were examined, and also discovered to be clearly and unquestionably punctate, the punctures being small and scattering as in the last. Internal casts of this shell, from the same locality, show it to possess *exactly the internal characters of Syringothyris*, Winchell.

Having thus found the punctate structure clearly visible in the several American forms mentioned, a specimen of *S. cuspidatus*, sent by Mr. Davidson to Mr. Worthen from Millicent Island, was examined, and quite unexpectedly found to be also clearly punctate, like the American forms. This Irish specimen is not in a condition to show the interior, but on removing some of the matrix from the foramen it was found to possess, near the beak at least, the transverse plate, or deep-seated false deltidium, seen in *Syringothyris*, though it was impossible to determine, without spoiling the specimen, whether or not the characteristic tube exists in connection with its inner side.

Now when it is remembered that as careful, conscientious, and accurate an observer as Dr. Carpenter, has pronounced the structure of *Spirifer cuspidatus* impunctate,* after a thorough examination, the question naturally suggests itself, whether there may not be *two* closely similar, but really very distinct, British types confounded under the single specific name *S. cuspidatus*? that is, one with a punctate structure and another without it. If so, and the punctate structure is here, as I am much inclined to believe, coincident with the pecu-

* After speaking of the fact that Mr. Davidson had, on other grounds, divided the *Spirifer* group into sections, which it was also found could be distinguished by their shell structure, Dr. Carpenter remarks that "under the subgenus *Cyrtia*, he [Mr. Davidson] places these impunctate species, which, like *C. trapezoidalis*, have a perforation for the passage of a pedicle; besides these species I have examined *C. cuspidata*, [= *Spirifer cuspidatus*], and am fully satisfied that in neither of these do any perforations exist." (*Davidson's Introduction to the Classification of the Brachiopoda*, p. 34.)

liar internal characters of *Syringothyris*, it becomes a matter of some interest to know upon which of these types Sowerby formed the genus *Spirifer*. If it was upon the one with a punctate structure and an internal tube, then *Syringothyris* would apparently be an exact synonym of the genus *Spirifer*, which would differ from the ordinary types usually referred to that genus, such as *S. striatus* for instance, (= *Trigonotreta*, group of Kœnig,) as widely as the latter differs from *Spiriferina* and *Cyrtina*. If, on the contrary, Sowerby's type was an impunctate shell without the internal characters of *Syringothyris*, or in other words a *Trigonotreta*, then *Syringothyris* would stand as a distinct group, differing from *Spirifer* proper in as important characters as those distinguishing *Spiriferina* and *Cyrtina*.

Since seeing some of the internal casts of *Syringothyris*, in Mr. Worthen's collection, showing the peculiar appearances produced by the impressions left by the false deltidium and its attached internal tube, I have been struck with their similarity to the figures given by Mr. Davidson, (on plate ix. of his work already cited), of an internal cast of a supposed example of *S. cuspidatus*, thought to indicate the presence of a perforation through the deltidium. It is also worthy of note that Mr. Davidson refers this specimen to *S. cuspidatus* with doubt, and says it denotes the presence of a "tubular" perforation. Hence, I am very much inclined to the opinion that it rather indicates the internal characters of *Syringothyris*, than of an actual perforation through the deltidium, as in *Cyrtia*,* and thus seems to sustain the view that there may be at least a part of the British specimens referred to *S. cuspidatus*, possessing the internal characters of *Syringothyris*. This opinion receives further support, too, from the fact that Prof. McCoy, in describing *S. cuspidatus* from Irish examples, says it has an "internal, deep-seated pseudo-deltidium, without perforation, leaving only an opening at its base."

It is to be hoped that those who may have duplicate authentic British examples of *Spirifer cuspidatus*, may be induced to make sections across the beak of the ventral valve, with the view of ascertaining whether or not any of them have the internal tube of *Syringothyris*, and if so, to ascertain whether the punctate structure is coincident with the presence of this internal appendage.

It may be proper to repeat here, for the information of those who may be disposed to make such observations, that in all of these shells I have examined, the punctures are very small, scattering and not arranged with the regularity seen in most types of *Terebratulide*, or in *Cyrtina*, *Spiriferina*, &c. Where they happen, as is often the case, to be filled with matter of the same color and translucency as the fibers composing the shell, it is exceedingly difficult to see them. When very small fragments only are examined, they may likewise be readily overlooked, as the fragment may contain but one or two of them, in which case they might not attract attention. Where they are filled, however, with dark or opaque matter, and a fragment, say 0.03 of an inch or more in diameter, is examined with a moderately low power, they are very distinctly seen, and cannot be for a moment mistaken for any appearance produced by a merely accidental cause.

NOTE.—It may not be out of place to add here, that the writer and Mr. Worthen have ascertained that the Coal-measure species, *Spirifer hemiplicatus*, (Hall,) is a distinctly punctate shell, and that it has not the internal characters of *Spirifer* or *Spiriferina*, but those of *Orthis*, excepting that there are in the ventral valve three prominent, very closely approximate, and nearly parallel laminæ, extending from the beak forward to near the middle of the valve. Hence we regard it as the type of a new group, probably a section of the genus *Orthis*, for which we have in MSS. proposed the name *Spirilasma*, M. & W.

* It is not improbable, however, that the tube in *Syringothyris* may have sometimes, in young shell, been connected with an external opening through the deltidium, though none of the specimens I have seen shows such an opening.