ART. XLI.—*Observations upon some of the Brachiopoda, with reference to the genera Cryptonella, Centronella, Meristella, and allied forms*; by JAMES HALL. Abstract of a paper read before the Albany Institute, February 3d, 1863.¹ (Communicated by the author.)

IN the study of the Palæozoic Brachiopoda, we are often forced to rely upon the general external form, and texture of the shell, for determination of the generic relations, until more extensive collections may furnish us with weathered specimens, or with crystalline or silicified ones, which, admitting of being cut, and macerated in acid, will enable us to ascertain the true interior characters.

In many instances, so nearly do very distinct genera approach each other in their external form, that reliance on this alone is very uncertain, and will surely lead to much confusion, if insisted upon as the means of generic determination.

For a long time, and until we began to learn something of interior structure, a large number of species, now known to belong to distinct genera, were embraced in the designations *Terebratula* and *Atrypa*. At a later period, when the genus *Rhynchonella* had been established in its application to many Palæozoic species, we find numerous species, which from external form had been referred to that genus, possessing characters incompatible with it.

One of the most common of these is *Terebratula cuneata* = *Rhynchonella cuneata* = *Retzia cuneata*, and which will probably

¹ From the Transactions of the Albany Institute, with some verbal corrections and the introduction of subsequent observations by the author.

be found to differ from true *Retzia*, taking its place near *Rhynchospira*.

So long as we remain unacquainted with the interior of the shell, we are compelled to refer the species to some genus having similar external forms, though the fibrous or punctate texture may in many instances prove a valuable aid in these references.

Among the forms most difficult to determine, are the numerous smooth or finely striated terebratuloid shells, having either ovoid, elongate, sub-circular or transverse forms. Among the genera of one family which in recent times have been established and proposed to receive these, are *Athyris* (= *Spirigera*), *Merista* (= *Camarium*), *Meristella* and *Charionella*; while the subdivisions of the terebratuloid forms in another direction have given *Terebratula* proper, *Terebratulina*, *Waldheimia*, *Terebratella*, *Centronella*, *Cryptonella*, *Rensseleria*, etc.

The first four are of the athyroid type, and have internal spires, as in *Spirifer*. *The shell in all these is fibrous, and we have therefore in the external shell the means of separation from those of the other type.*

In all the latter group we find modifications of the internal appendage, called in *Terebratula* the loop; but in none of them do spires exist. Moreover, *in all these the external shell is punctate*; and we do not yet know a punctate shell, of the external character here indicated, which contains internal spires.²

The external characters, therefore, of the terebratuloid forms may be made useful in indicating the family relations of the species, and may prevent us from referring to the family of *Spiriferidae* those which belong to the family of *Terebratulidae*.

In the *Thirteenth Report on the State Cabinet*, published in 1860, I proposed the name of *Meristella* for certain forms which I regarded as separable from *Athyris* and *Merista*; and for the semi-plicated forms otherwise of similar character, I suggested the name *Leiorhynchus*. At the same time I described under *Terebratula* the following species: *T. Lincklaeni*, *T. rectirostra*, *T. Lens* and *T. planirostra*; under each one, distinctly stating the shell structure to be punctate, which character at that time afforded me the principal means of distinguishing these from athyroid species of similar form, as *Meristella Haskinsi*, *M. Barrisi* and *M. Doris*, which, with *Atrypa scitula* (4th Dist. Report) = *Meristella scitula*, have at a later period been placed by Mr. Billings among the typical forms of his Genus *Charionella*.

Having ascertained some farther characters of these punctate Terebratuloid shells, I proposed in the *Fourteenth Report on*

² The plicated forms of *Retzia* and *Rhynchospira* are of course not included in the designation above made. *The Nucleospira* also approach the terebratuloid forms, but these shells have an area on the ventral valve and a different hinge structure.

the *State Cabinet*,³ page 102, the name *Cryptonella*, giving as one of the characters "shell structure finely punctate." I remarked in a concluding paragraph:

"The species of this genus are more elongate than *Merista* and *Meristella*, and those now known are less distinctly marked by mesial fold and sinus; while the beak is more attenuate, often a little flattened, and rarely so closely incurved as in the genera cited. The punctate structure of the shell is a distinguishing feature."

In the *Fifteenth Report on the State Cabinet*, I gave (at page 161 [133], pl. 3) some illustrations of the muscular imprints, dental lamellæ, etc., with figures of a single additional species from the Lower Helderberg group.⁴

³ Made to the Legislature April 10th, 1861, and published in July, 1861.

⁴ In the *Canadian Naturalist and Geologist* for October, 1862, we find the following exposition of the relations of the genus *Cryptonella*:

"The genus *Cryptonella*, illustrated on pl. 3, p. 133, is precisely identical with *Charionella*, described by me in the *Canadian Journal* of March, 1861, p. 148, and illustrated in the May number, pp. 273, 274. It includes the species described by Prof. Hall in the Thirteenth Report under the names of *Meristella Haskinsi*, *M. Barrisi*, *M. Doris*, *Terebratula Lincklaeni*, *T. rectirostra*, *T. Lens* and *T. planirostra*, [*T. planirostra*]. Besides these, the *Atrypa scitula* of the New York Reports, *C. Circe*, and apparently a number of European species belong to it. *Cryptonella* was first published in July or August, 1861, three or four months after the learned author became acquainted with its characters through the study of my papers."

The following is the description of the genus *Charionella*, copied from the *Canadian Journal* (March, 1861), No. xxxii, p. 148:

Genus CHARIONELLA. "Since the foregoing article on Devonian fossils was written, I have ascertained the generic characters of the so-called *Atrypa* or *Athyris scitula*. It has internal spires with their apices directed outwards, as in *Athyris* and *Spirigera*, but the dorsal hinge-plate has its anterior margin and a large portion along the middle anchylosed to the bottom of the valve. In another congeneric species, the middle portion of the same plate is obsolete, there remaining only two small, thin, nearly vertical septa (socket plates), one on each side of the cavity of the umbo. The perforation in the beak of the ventral valve is bounded on the lower side by a deltidium of either one or two pieces, or by a portion of the shell. The mesial septum in the dorsal valve is either rudimentary or entirely absent.

"The several species of this group, at present known to me, resemble *Athyris*, but are not so convex, and are besides more elongate ovate, or approaching to *Terebratula* in general form. I shall give further details and some figures in the next number of the *Journal*.

"The genus is only proposed as a sub-genus, to be retained in case *Athyris* is divided."

In the *Canadian Journal*, No. xxxiii, p. 273, we have "*Charionella Circe*, n. sp." (referring to the illustrations). "The first figure exhibits a specimen with the dorsal valve partly removed, showing the internal spires. The other two figures are a side and ventral view of another specimen."

"By treating partially silicified specimens of this genus with acids, I have ascertained that the structure of the hinge plate differs from that of *Spirigera* in being either obsolete along the middle or anchylosed to the bottom of the valve. In *Athyris* (= *Meristella* Hall) there is a well developed hinge plate, supported beneath by a strong mesial septum, which extends sometimes nearly to the front of the valve. In *Charionella* there is either no mesial septum, or one that is merely rudimentary. In one specimen there is a remarkable partition, which runs obliquely from near the beak to the margin near the front. It completely divides the internal cavity into two parts. This I believe to be not a mesial septum, but a

In September, 1862, Prof. A. Winchell, in his "*Descriptions of fossils from the Marshall and Huron Groups, of Michigan*," published a description of *Centronella Julia*, in which he describes the loop, which is proved not to be in accordance with that of *Centronella* as described and illustrated in the *Canadian Naturalist and Geologist*, vol. iv, April, 1859.

Through the kindness of Prof. Winchell, I have been put in possession of some specimens of this species, with parts of others illustrating the internal structure, together with drawings representing the loop.

An examination of the external characters shows that the shell has the form and texture of *Cryptonella*. "Both valves with regular lens-like convexity, shell obsoletely striate concentrically, and having a minutely punctate structure." The form and other characters of the cast are like those of species referred by me to *Cryptonella*. In the ventral valve are two delicate, slightly curving dental lamellæ, which are shown in casts by a narrow slit on each side of the beak. "The casts exhibit on the ventral side a delicate impressed line extending from the beak to the middle, and on the right and left of this a fainter one; on the dorsal side, a median impression, with two fainter ones on the right and two on the left." These characters appertain to the casts of *Cryptonella* (see fig. 9), as shown in the ventral side of large individuals; having three defined, slightly impressed spaces, limited by narrow lines which extend to the middle of the shell, below which there are sometimes vascular impressions visible.

On the dorsal side, we have the median impressed line with two fainter ones on each side, which, in some conditions of preservation, are obscured by the muscular impression; and below these are frequently seen diverging vascular impressions.

The internal loop of *Cryptonella Julia*, illustrated from drawings of Prof. Winchell, is shown in figures 1 and 2, which are four times enlarged, and are thus described: "A delicate ribbon-like loop originates from the stout blunt crura on each side of the socket-valve, having its flat sides at first vertical; the two branches of the loop proceed at first in lines parallel or a little convergent, and then gradually diverge, widening as they proceed, and assuming an inclined position, until, approaching the front of the valve by a regular curvature, the lower edge has become anterior, giving the band an angle of 30° with the plane

temporary wall formed by disease of the animal, because both spires are crowded into the smaller of the two cavities, the larger being empty."

The genus *Charionella*, therefore, clearly belongs to the *Spiriferidæ*, and the typical species cited are, in part those originally placed by me under the genus *Meristella*, in 1860 (*Thirteenth Report on the State Cabinet*, p. 84), and in part under *Terebratula*, from the characters of which I proposed the genus *Cryptonella* in 1861. The former belong to the *Spiriferidæ*, and the latter to the *Terebratulidæ*.

of the shell: approaching the median line, the band rapidly widens, and the front margin is drawn forward in a long acumination, while the inner margin is regularly concave, except that near the median line it turns abruptly forward so as to meet that line at an acute angle. The loop thus forms an urceolate figure on its inner margin, and on the outer a somewhat oval one, truncated behind and attenuately acuminate before. In the median line where the two branches meet, both are suddenly deflected downwards, forming a double vertical plate, not quite reaching the ventral valve; the upper edge of which, when

viewed from the side, is flatly roof-shaped, while the lower edge describes two convexities, the greater anterior, leaving a notch between them. The surfaces of the loop and median plate are covered with minute obliquely conical pustules, in some places seeming to become spinulous."

Fig. 1. Dorsal view of *Cryptonella Julia*, showing the loop and horizontal plate. —Fig. 2. Profile view showing one band of the loop with the vertical plate. From drawings, four times enlarged, by Prof. Winchell.—Fig. 3. Front view of the loop. —Figs. 4 and 5. Ventral and dorsal views of the cast of a more oblate form of *C. Julia* enlarged to correspond with figs. 1 and 2.—Figs. 6 and 7. Ventral and dorsal views of *Cryptonella Meta*, from the Schoharie grit.

Fig. 4 is given simply to show the dental lamellæ of the ventral valve; the delicate impressed line in the centre and a fainter one on each side, described by Prof. Winchell, are not shown in the figure. These marks, however, are shown in figs. 6 and 9, and characterize the ventral valves or casts of this valve in all the known species of the genus.

In the *Fifteenth Report on the State Cabinet*, I gave the accompanying fig. 8 of the dorsal valve, and fig. 9 of the interior of a ventral valve. Figures 10 and 11 are dorsal and profile

views of *Cryptonella eximia*, from the Lower Helderberg group, the earliest species of the genus known to me.

Figs. 8 and 9. Dorsal and ventral views of *Cryptonella* (generic illustrations).—Figs. 10 and 11. Dorsal and profile views of *C. eximia*.

The genus *Cryptonella* may be characterized as follows:

GENUS CRYPTONELLA Hall, 1861.—Shells terebratuliform, equilateral, inequivalve, elongate or transverse, ovoid or sublenticular in form, without median fold or sinus, or with these features very slightly developed towards the base of the shell. Ventral valve with the beak extended or incurved, and terminated by a circular foramen which is limited on the lower side by two small triangular deltidial pieces (these are sometimes not visible externally, and the lower side of the foramen is concealed by the umbo of the opposite valve). Shell-structure finely punctate; surface marked by fine concentric striæ, which are sometimes obsolete. Valves articulating by teeth and sockets, the dental lamellæ of the ventral valve extending in thin vertical plates into the cavity of the valve. The muscular impressions of the dorsal valve are strongly marked above, and extend, in two narrow, gradually widening impressions, more than halfway to the base. The ventral valve shows elongated muscular and vascular impressions below the rostral cavity.

In the dorsal valve, the hinge-plates, or bases of the crura, support a slender loop, the two limbs of which are flattened, with the faces vertical; and in its extension forward, the upper margins are inclined towards each other, and, gradually widening, become joined, and thence extending forward, form a single lanceolate plate, which may be more or less attenuate in front. These laminæ of the loop, after becoming thus conjoined and spreading laterally, are abruptly deflected in a vertical plate along the median line, extending into the cavity of the ventral valve, as shown in figure 2, which, while looking upon the dorsal side of the loop, may sometimes

Cryptonella.

be seen projecting backwards between the bands of the loop, as well as extending in front, as shown in fig. 12.

In casts of the ventral valve, we find the marks of two thin dental lamellæ extending to a greater or less distance below the beak. Along the median line in the ventral cast, there is usually a narrow flattened space limited by a slender line; and on each side a less distinct narrow space, limited in the same manner. In the cast of the dorsal valve, there is a median impressed line, and two of less strength on each side of this.

The species of this genus, known to me, are the *Cryptonella* (*Centronella*) *Julia*, and those described as *Terebratula* in the *Thirteenth Report on the State Cabinet*, and which in the *Fourteenth Report* were referred to *Cryptonella*, viz. *Cryptonella* (*T.*) *rectirostra*, *C. (T.) Lens*, *C. (T.) planirostra*; and *C. eximia*, of the *Fifteenth Report* as well as a new species from the Schoharie grit.

The *Terebratula Lincklæni*, which has the external characters of *Cryptonella*, and which I have referred to that genus, presents some slight differences in the muscular impressions, which, taken together with its rotund form, are suggestive of true *Terebratula*, to which genus it may possibly belong.

The species of the genus *Centronella* heretofore described have the ventral valve highly convex or subangular in the middle, with the dorsal valve flattened or concave in the middle, or with a median depression, and convex at the sides.

The character of the genus, as given in the descriptions and illustrations of Mr. Billings, are as follows.

GENUS CENTRONELLA, *Billings*,* 1859. — "Generic characters: Shells, having the general form of *Terebratula*. Dorsal valve with a loop consisting of two delicate ribbon-like lamellæ, which extend about one-half the length. These lamellæ at first curve gently outwards, and then approach each other gradually, until at their lower extremities they meet at an acute angle; then, becoming united, they are reflected backwards towards the beak in what appears to be a thin flat vertical plate. Near their origin, each bears upon the ventral side a single triangular crural process. Name, from the Greek *κεντρον*, a spur. This genus is intermediate between *Terebratula* and *Waldheimia*. In the former, the loop is short, not exceeding greatly one-third the length of the shell, and not reflected. In the latter, it extends

Fig. 13 (4). Interior of the dorsal valve, showing the loop.—Fig. 14 (5). Longitudinal section, showing the position of the loop in the interior.

* Description and figures copied from the *Canadian Naturalist and Geologist* for April, 1859: the figures enlarged three diameters.

nearly to the front, and is reflected, but the laminæ are not united until after they are folded back."

In *Centronella*, as thus illustrated, we have a simple loop, or the two limbs becoming united at an acute angle at the point of greatest anterior extension, whence they recurve in a thin vertical plate which is not attached at either margin; approaching, in some respects, to *Waldheimia*.

This internal feature is accompanied, in the cast of *C. Glans-fagea*, the typical form of the genus, by other differences which distinguish it from the casts of typical species of *Cryptonella*.

Fig. 15. Ventral view of cast of *Centronella Glans-fagea*.—Fig. 16. Dorsal view of cast of the same.—Fig. 17. Profile view of the same.

In the cast of a ventral valve of *C. Glans-fagea*, fig. 15, we have the filling of a deep rostral cavity; the dental lamellæ have been thick and strong, not extending as thin plates into the cavity of the shell as shown in several species of *Cryptonella*, but having a thick blunt lower termination which leaves no space, or scarcely an appreciable one, to be filled between it and the shell. The spur, or filling of the rostral cavity, is striated; at its base in the centre, on the body of the cast, is a depression; and on each side are fainter striated impressions, indicating the points of muscular attachment.

The interior of the ventral valve of *Centronella impressa*^a shows similar strong rounded and blunt dental lamellæ, with a deep rostral cavity and muscular markings, which would give a cast similar to that of *C. Glans-fagea*.

The cast of the dorsal valve of *C. Glans-fagea* presents a slightly concave surface, and on each side of the apex two large and deep cavities made by the bases of the crural processes; and between them is a narrow filling of stone. The centre is marked by a double muscular impression, the two parts separated by a narrow groove: above this, and at the base of the crura, are some points marked as if for muscular attachment (see *b*, fig. 16).

^a A very distinct species from *C. Hecate* (Billings) of the Oriskany Sandstone, which differs mainly in size from *Centronella* (*Rhynchonella*?) *alveata* (Hall), *Tenth Report on the State Cabinet*, 1857.

The interior of *C. impressa* presents a very strong double process below the beak of the dorsal valve, corresponding to those in *C. Glans-fagea*.

The external form of all the species heretofore referred to *Centronella* is a distinguishing feature, and, when proved to be accompanied by an internal apparatus so different from that of *Cryptonella*, will serve to separate them from all the allied forms.

As before remarked, it has been mainly upon modifications of this internal loop, or the apohysary system, that the separation of most of the genera in the family of *Terebratulidæ* has been made.

In *Cryptonella*, we observe considerable analogy with *Rensselaria*, where the slender bands of the loop expand and unite in

Fig. 18. Dorsal valve of *Rensselaria Suessana*, showing the internal processes.—Fig. 19. Longitudinal section of the same, showing the relations of the parts.—Fig. 20. Interior of dorsal valve of *R. ovoides*.—Fig. 21. Longitudinal section of the same.

a broad plate, which is obtusely or acutely attenuate in front, and on the ventral side marked by a ridge along the line of junction; from which, at the posterior margin, proceeds a slen-

der process in the ventral cavity. We may readily conceive of this central longitudinal ridge or carina, along the cicatrix of the two parts, being produced into a thin vertical plate, projecting backwards in the line of the process from the base of the conjoined lamellæ in *Rensselaeria*, when it would much resemble the median plate of *Cryptonella* (see figures 18, 19, 20 and 21.)

From the data here given, it will be seen that the genus *Cryptonella* is nearly related to *Centronella*; differing in the external form of the typical species, and in some features of the cast.

Since the preceding observations were printed, I have received from Dr. Rominger a figure illustrating the interior of *Centronella Glans-fagea*, as observed by him (fig. 22). Admitting the identity of the species, this figure of the loop is quite different from that given by Mr. Billings for *Centronella Glans-fagea*; and shows essentially the same character as that of *Cryptonella*. Should this internal structure prove to be the true structure of *Centronella*, the minor differences pointed out in the form of the shell and of the cast, between *Centronella Glans-fagea* and authentic *Cryptonella*, are scarcely sufficient to establish generic distinctions.

Centronella Glans-fagea.

Interior showing the loop, from a figure by Dr. C. Rominger.

At a later date however,* Mr. Billings has published *Centronella Hecate*, giving, in fig. 99a "a specimen with the dorsal valve removed, showing the loop which is covered with minute crystals of silex." In this species, having all the external characters of a congener of *C. Glans-fagea*, no indication is given that any difference had been observed in the character of the loop, from that published in 1859.

Under these circumstances, I hesitate to unite, under a single generic term, these varieties of form with an internal structure so different from that observed in authentic *Cryptonella*, until a reëxamination of the original specimens of Mr. Billings shall confirm his first observations, or show them to correspond with the last named genus.

It is not probable, however, that materials for other genera, or for reference to existing genera, are yet exhausted, among the *Terebratulidæ* of the Upper Silurian and Devonian rocks. While engaged in these investigations, Dr. C. Rominger has kindly sent me a fossil from the Hamilton shales, of Thunder Bay, Michigan, in which the terebratuloid loop is distinctly visible. The form of the shell is ovate, not very unlike *Cryptonella*, but more rotund, the lateral edges more incurved, and the space

* Canadian Journal, May, 1861, p. 272.

below the beak of the ventral valve not so great, nor the deltidial plates so conspicuous as in species of that genus. On a critical examination of the interior, after cutting away the crystalline filling of the shell nearly to the loop, I am unable to find any difference between it and true *Terebratula*; and we have, so far as I know, for the first time the positive determination of this genus in our Devonian rocks. The position and proportions of the loop are shown in fig. 23, which is an outline of the shell from the dorsal side, twice enlarged. Fig. 23a is an enlargement of the loop, showing the crural processes.

Figures 23 and 23a, Illustrations of *Terebratula Romingeri* Winchell.

At the same time, Dr. Rominger has also sent me specimens of *Terebratula melonica* of Barrande, one of which he has prepared so as to show in a very satisfactory manner the loop in its entire extent. The specimens correspond with those I have received from M. de Verneuil under the same name, and therefore we must regard them as authentic. The external form of *T. melonica* is not unlike some of the less gibbous of *Cryptonella*,

Fig. 24. Dorsal side of *T. melonica*, showing the crural processes directed downwards.—Fig. 25. Ventral side of specimen, looking into the dorsal valves.—Fig. 26. Profile view of same, the figures twice enlarged.

and is much less gibbous than the usual forms of *Waldheimia*. The lamellæ are nearly parallel and near together, and the loop is extended four-fifths the entire length of the shell, when it is recurved, and, turning back, extends two-thirds of the distance to the beak of the dorsal valve; and the crural processes are farther from the base of the loop than is represented in the typical figures of *Waldheimia*, and are opposite the extremity of the recurved loop.

The above figures illustrate all that has been observed in this species.

(To be continued.)