

ART. XXXVI.—*Descriptions of a few new species, and one new genus, of Silurian Fossils, from Ohio ;** by F. B. MEEK.

PROTASTER ? GRANULIFERUS Meek.

DISK small, apparently circular ; rays rather slender, and of unknown length. Dorsal surface of disk and rays covered by an integument composed of innumerable minute grains of calcareous matter. Ventral side of disk not well exposed in the specimen but apparently provided, in the interradian spaces, with minute spines directed outward. Oral pieces not well exposed in the specimen. Arm-pieces regularly alternating, but apparently rectangular at their inner ends, and not interlocking along the minute mesial impressed line, longer transversely than in the direction of the length of the rays ; each largely excavated at its anterior outer end so as to form a large pore, or pore-like depression, and divided transversely by a furrow into two parts, the anterior one of which is very short, and the posterior longer and marked by a minute pit at its

* These fossils are to be fully illustrated and described in the report of the Ohio Geological Survey.

inner end; about eight or nine of these pieces in each range of each ray included within the margin of the disk. Outer arm-pieces (adambulacral of some) smaller than those of the inner ranges, and placed edge upward, with an oblique outward direction so as to imbricate outward or toward the extremities of the rays; each bearing one or more minute articulating spines.

Breadth of disk, about 0.43 inch; breadth of arms at their inner ends, 0.10 inch.

The only specimen I have seen that is certainly known to belong to this species is very imperfect, being merely an incomplete disk, and the inner ends of the rays. It does not conform to the characters of *Protaster* given in Prof. Forbes's diagnosis, in all respects, since its disk, especially on the upper side, is covered by an integument composed of a vast number of very minute grains of calcareous matter, instead of distinct imbricating scales. It is therefore not improbable that perfect specimens would show other characters that would warrant the establishment of a new genus or sub-genus for such forms, in which case the name *Alepidaster* might be applied to the group, which would probably also include *Protaster gregarius* of Meek and Worthen.

I have intentionally avoided, in the foregoing description, the use of the terms ambulacral and adambulacral pieces, applied by some in describing the arms of species of *Protaster* and similar forms, because it seems doubtful whether these terms can be properly applicable to such types. I should certainly think not, if these types belong to the *Ophiuroidea* (in which no ambulacral furrows exist) instead of to the *Asteroidea*. According to Dr. Wright, however (see Brit. Foss., *Echinodermata*, p. 32), *Protaster Miltoni* of Salter has a well developed madreporiform body, and hence would belong to the *Asteroidea*. Yet it is very curious that these types seem to have no proper ambulacral canals, and we have apparently no positive evidence that the viscera of the animal were not confined to the disk, as in the *Ophiuroidea*.

Locality and position.—Middle part of Cincinnati group of the Lower Silurian, Moore's Hill, in Indiana; Mr. Dyer's collection.

PALÆASTER INCOMPTUS M.

Small; rays rather short, or only about once and a half as long as their breadth at the inner ends, and rapidly tapering to their outer extremities, which are more or less angular. Disk equaling in breadth the length of the rays. Dorsal side of rays composed each of three rows of about nine pieces* each, that

* In some of the rays these appear, but this is probably due to the exposure of one of the marginal rows of the rays by oblique pressure.

are wider than long, and increase rather rapidly in size inward to the margin of the disk, which is made up of smaller pieces; a few very minute pieces apparently sometimes occur between the rows on the dorsal side of the rays. Surface of dorsal pieces a little roughened, but apparently without spines. Madreporiform piece rather small, a little oval, or almost circular, nearly flat, and marked by very fine, irregularly interrupted radiating striae. Ventral side unknown.

Greatest breadth across, between the extremities of rays on opposite sides, 0.90 inch; length of rays, 0.35 inch; breadth of same at inner ends, about 0.22 inch; length of madreporiform pieces, 0.08 inch; breadth of same, 0.07 inch.

This species seems to be related to *P. matutinus* Hall, but has proportionally shorter and broader rays, that are also less pointed at the extremities. Its dorsal pieces are also less close-fitting, and appear to have at some points a few very minute intercalated pieces between the rows of the rays. This latter character, however, is not clearly visible in the specimen. A more important distinction is the absence, in the species under consideration, of the circle of stellate pieces seen on the dorsal side of the disk of *P. matutinus*, which, according to Prof. Hall's figure, published in the 20th Regents' Report, seems to want the well-defined madreporiform pieces seen in the species under consideration, or at least not to have it distinguishable from four other radiately marked pieces that alternate with the stellate pieces mentioned. As in that species, this has the two inner marginal pieces, that connect with each other at the axis of the rays, rather decidedly larger than those next to them, but of different form, being wider than long instead of the reverse, or with their greater diameters arranged transversely, and each provided with a kind of mesial protuberance on the inner side.

The only specimen of this species I have seen is firmly attached to a foliated expansion of coral, so as to conceal the ventral side entirely. It was evidently lying dead on its back, on the bottom of the sea, when the coral commenced growing upon its ventral side; and afterward the coral not only covered this side entirely, but grew some distance in all directions, even beyond the extremities of its rays. This gives it much the appearance of having firmly attached itself to the coral parasitically; but this is evidently not the case, because it is its entire ventral side that is attached out to the very extremities of its rays.

Locality and position.—Cincinnati group of the Lower Silurian, at Cincinnati, Ohio. Mr. Dyer's collection.

Note.—A fine star-fish recently sent to me by Mr. Dyer, from the Cincinnati rocks, presents many features indicating close rela-

tions to *Palæaster granulosus* of Hall; and yet a critical comparison with his description (he has not yet published a figure of that species), leads me to think it most probably distinct. It has about the same *proportional* length and breadth of rays; but instead of being "obtusely rounded at the extremities," the rays are acutely angular at the ends. Again, instead of having the marginal and adambulacral pieces numbering, in a space of one inch and a quarter from the apex of a ray, twenty-five of the first, and forty-two to forty-three of the latter, on each side of the ambulacral furrow, it shows in the same space *twenty-eight* marginal and *thirty-two* adambulacral pieces on each side—the number of adambulacral pieces being about ten less on each side in the same space from the apex—a rather decided difference, thus also showing the inner rows to be composed of proportionally larger pieces. Its two rows of ambulacral ossicula are, as in *P. granulosus*, composed of short wide pieces (numbering about thirty-two in the space given above), with each a linear-ridge running across its entire breadth as in that species, but this ridge does not show the obliquity mentioned in Prof. Hall's description.

On the upper side there are near the middle, of each ray, about fourteen rows of small alternating convex pieces. All of the pieces are granular, and each of the marginal and adambulacral pieces has a minute tubercle for the articulation of a small spine, the largest of which are about 0.10 inch in length. Those of the dorsal side also seem to have supported much more minute spines. The specimen is not in a condition to show the oral pieces, or the madreporiform piece.

It differs materially from *P. Dyeri*, not only in being much smaller, but in the entirely different form and more numerous rows of its dorsal pieces, which are also decidedly more close-fitting. If this should prove to be a new species, I would propose to call it *Palæaster speciosus*.

Its dimensions are as follows: length of rays 1.40 inch; breadth of do. as flattened somewhat by pressure, 0.62 inch; breadth of disk, about 0.80 inch.

RHYNCHONELLA NEGLECTA, var. SCOBINA.

Shell rather small, sub-trigonal, compressed, or sometimes in large specimens quite gibbous, with the mesial fold very prominent and narrow. Dorsal valve bearing on the mesial fold four plications, the middle two of which are more prominent and larger than the other two, one of which latter occupies each slope of the fold; lateral slopes each provided with about six angular plications; beak incurved. Ventral valve with mesial sinus corresponding to the fold of the other valve, and bearing three plications, the middle one of which is usually somewhat larger than the others; lateral slopes each with about six plications; beak small, pointed and arched, but not strongly

incurved, projecting moderately beyond that of the other valve. Surface ornamented by fine marks of growth, and numerous minute, distinct, regularly disposed granulations.

Length of one of the largest, and most gibbous specimens, 0.55 inch; breadth of do., 0.50 inch; convexity of same, 0.53 inch. Other individuals of near the same length and breadth have a convexity of only 0.25 inch.

This form agrees almost *exactly* in general outline, as well as in the number and arrangement of the plications, with *A. neglecta* Hall, from New York, Niagara and Clinton groups. But if that shell has been correctly figured and described, from well-preserved specimens, it must be distinct from this, as there are no surface granulations illustrated in the figures or mentioned in the description of the New York species; while they are quite *distinctly and beautifully* defined on those before me from Ohio. As the New York Niagara fossils are usually found in a good state of preservation, it is very improbable that such a character could have escaped attention in *R. neglecta*. I therefore feel strongly inclined to regard the shell under consideration as a distinct species; but as it agrees so closely in other characters with *R. neglecta*, have concluded to view it, for the present, as a variety of that shell, under the name *scobina*, which can be retained for it should it prove, as I think it will, to be a distinct species.

It is possible that the internal characters of the species will be found to differ generically from those of *Rhynchonella*, a distinctly granulated surface being unusual in that genus.

Locality and position.—Clinton group, Dayton, Ohio. Found by Prof. Orton.

PLEUROTOMARIA (SCALITES?) TROPIDOPHORA M.

Shell rather small, obliquely rhombic in general outline, as seen in a side view; height somewhat greater than the breadth; spire conical, with an apical angle varying from 70° to 90°; volutions four to four and a half; each flattened, or sometimes slightly concave above, with an outward slope from the suture to a prominent angle that passes around the middle of the body-turn, and below the middle of those of the spire, to which it imparts a somewhat turreted appearance; suture moderately distinct, but not channeled; lower side of body-volution sloping rapidly inward from the mesial angle, a little below which there usually revolves an obscure, undefined ridge; aperture rhombic subquadrate; surface nearly smooth, but sometimes showing under a magnifier very obscure lines of growth, that curve very strongly backward as they approach the angle around the middle of the body-volution, both above and below—thus indicating the presence of a deep sinus in the lip, that

widens rapidly forward, though there is no defined revolving band at the angle.

Length or height, 0.55 inch ; breadth about 0.50 inch.

This shell possesses some of the characters of both *Pleurotomaria* and *Scalites*. In general appearance it is most like some types of the former ; but it seems to be entirely without the revolving band seen on the species of that genus. Its lines of growth, however, have the very strong, oblique backward curve seen in those of *Scalites* (in which group there is no revolving band), thus showing that its lip, when entire, must have had a deep notch at the termination of the angle of the body-whorl. This notch, however, does not appear to terminate in a deep sharply cut slit, as we most generally see in *Pleurotomaria* ; but it seems to have terminated at, and widened rapidly forward from, the angle of the volutions. Specifically, this shell is related to *Pleurotomaria selecta* of Billings, from which it differs in having its striæ of growth nearly obsolete, and in wanting the revolving angle just below the suture, seen in that species.

Locality and position.—Cincinnati group, at Cincinnati, Ohio. Mr. A. S. Miller's collection.

Genus DICRANISCUS* M.

Shell inequivalve, hinge line straight, rather long, hinge provided with teeth and sockets. Ventral valve with a well developed cardinal area, divided in the middle by a triangular fissure sometimes partly closed above by a very small false-deltidium ; beak imperforate ; interior without dental or other laminae, or processes of any kind ; muscular impressions unknown. Ventral valve without a well developed area, but provided with an extremely prominent, bifurcating cardinal process, and on each side of the base of this with a prominent brachial process directed obliquely outward ; while just outside of each of the latter there is a socket for the reception of the teeth of the other valve ; muscular impression small, and placed in the bottom of the valve some distance in advance of the hinge. Shell substance very thick about the hinge, and showing an imperfectly fibrous structure when broken, the fibers being arranged at right angle to the surface of the valves.

I have had specimens of this remarkable shell under consideration for nearly a year ; but have been waiting for others to be found that would show its characters more clearly, all of those seen being fragmentary. Somewhat better specimens have recently been found by Prof. Orton, but none nearly entire have yet been discovered. Those now at hand, however,

* Dimin. of *δίκρανος*, a two pronged fork ; in allusion to the long bifid cardinal process.

give the means of making out its generic and specific characters with some degree of detail, though we yet want specimens showing the exact form of the entire shell, and the muscular impressions of the ventral valve.

With regard to its family affinities, it would be unsafe to venture an opinion without better material for study. I know of no other brachiopod with so long a cardinal process excepting *Stringocephalus*; but it differs entirely from that genus in wanting the prominent mesial internal septum in the ventral valve, as well as in having the beak of this valve very short—even less produced than that of the other valve, and the foramen very small with no perforation through the minute false-deltidium sometimes covering the upper part of the foramen.

It is probably more nearly related to *Stricklandinia* of Billings; but on comparing some of the specimens sent to him by Prof. Orton, Mr. Billings writes that he thinks it entirely distinct from his genus, which he says has no such cardinal process. The ventral valve of our shell also differs in having no trace of the triangular internal chamber, seen under the beak of *Stricklandinia*.

DICRANISCUS ORTONI M.

Shell truncato-suboval, or suborbicular, with front narrowly rounded; hinge-line less than the greatest breadth. Ventral valve less convex than the dorsal, and provided with a moderately deep mesial sinus not extending to the beak; cardinal area rather low, well defined, and standing nearly at right angles to the plane of the valves, but slightly arched backward; beak very small and scarcely projecting beyond the margin of the area, with its point sometimes slightly arched. Dorsal valve moderately convex, and rising into an undefined mesial fold or prominence on the anterior slope; beak rather prominent, or at least more so than that of the other valve, and more incurved; area wanting or very narrow and obscure; cardinal process very long, a little curved, rounded, and rather slender below, and divided above for about half way down, the divisions being moderately diverging, slender, and somewhat furrowed on their posterior sides above. Surface smooth.

As I have seen no entire specimens, I cannot give measurements, though the shell probably attained a length of one inch and a quarter, with a breadth of about one inch, and a convexity of perhaps three quarters of an inch.

It was some time before I could believe that the separate ventral valves of this shell really belonged to the same species as the dorsal; because I could not understand how so very prominent a cardinal process as that possessed by the latter could possibly be received into a ventral valve with no deeper concavity than is presented by these specimens. It was, there-

fore, not until Prof. Orton found a broken specimen with portions of the two valves united, and showing this process in place, that I was aware that the dorsal valve has its beak so incurved as to give this cardinal process an oblique forward direction within the other valve. Even then, however, it seems to touch the bottom of the ventral valve.

The specific name is given in honor of Prof. Edward Orton, who discovered the only specimens of the species known.

Locality and position.—Summit of the Clinton group, near Dayton, Ohio.

NOTE.—Among the specimens sent to me from Cincinnati, Ohio, by Mr. A. S. Miller of that city, there are two examples of an *Orthis*, agreeing in form and general appearance with *O. plicatella*, but differing in being considerably larger, and in having a *decidedly* lower ventral area, with the beak of the same valve more incurved than in any authentic specimens of that shell I have ever seen. It also presents a curious triple arrangement of the costæ, caused by each of them giving off a smaller one on each side at about half the distance between the beak and free margins, the main rib always continuing larger and much more prominent than the others to the margin; while the spaces between each bundle thus formed are proportionally wider and deeper than we see in *O. plicatella* as usually found. These characters give this shell a peculiar appearance that leads me to think it will probably be found to belong to an undescribed species. As I know nothing of its internal characters, however, and the species of this type of *Orthis* are known to be quite variable, I feel some doubts about the propriety of describing it as a new species. It seems to me, however, to differ from the *O. plicatella* and *O. fissicosta* in more important characters than they differ from each other. Should other collections show this form to be a distinct species, I would propose for it the name *O. triplicatella*.

The larger of the two specimens seen measures 0·70 inch in length, 1·40 inch in breadth, and 0·40 inch in convexity.