

DESCRIPTIONS OF NEW SPECIES OF UPPER PALEOZOIC FOSSILS FROM CHINA.

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The Carnegie Expedition to China, in charge of Mr. Bailey Willis, obtained a small number of Carboniferous fossils, which were placed in my hands for study. My report was finished over a year ago, but the publication of the paleontologic results has been held up for the completion of another portion of the investigation. As an indefinite, perhaps a long, time may elapse before the full report passes the press, it seemed desirable to fix such species as appeared to be new by a preliminary publication of the descriptions, to be followed by the reprint with illustrations in the final report.

CŒLEENTERATA.

LONSDALEIA CHINENSIS, new species.

Description.—This species occurs in large masses, one fragmentary specimen having a length of 18 mm. and a width somewhat greater. The corallites are irregularly polygonal, so that it is difficult to name an average size, unusual length in one direction being compensated by narrowness in another. Perhaps 8 mm. represents the average in nearly symmetrical corallites.

Our specimens do not separate into constituent cells, but break across the walls. In sections the latter appear to be rather thick, with denticles projecting inward from both sides, and a dense median line.

Structurally each corallite is made up of three zones inclosed within an outer wall. The external zone consists of vesicles without septa, the median of septa and tabulae, while the center is occupied by a pseudocolumella having a vesicular structure. The outer zone, which is rather thick, is formed by large cysts, which, as usual, present the convex side upward and slope strongly downward toward the center. The inner surface of this zone is well marked. The septate portion is

clearly defined, and has a nearly circular shape, irrespective of the asymmetry of the corallite as a whole. This portion is rather constant in size, and in few instances does it attain a diameter of more than 4 mm. The septa, which number from 25 to 27, are irregular. They are often alternately long and short, but in parts of the same corallite may be equal, or in appearance replaced by vesicular tissue. Not infrequently one of the smaller (secondary) septa is seen to bend to one side and to become confluent with a primary one. The interseptal loculi are rather abundantly partitioned by what in cross sections looks like dissepimental tissue, but in reality has more the nature of nearly flat horizontal tabulae. As previously remarked, the septa are often so contorted that they can not be distinguished from the interseptal plates with which they intersect.

The pseudocolumella, which occupies the central area, is fairly distinct from the surrounding structures and consists of relatively small concentrically arranged cysts, which are nearly vertical in position, but with the upper end distinctly inclined toward the center. The ends of the septa reach nearly or quite to the pseudocolumella, and some of them appear to connect with the plates which compose it.

As members of the genus *Lithostrotion*, Lonsdale described and figured a number of *Lonsdaleias* from Uralian Russia, some of which may be related to the form under consideration. Lonsdale discriminated his species upon characters which are not shown in ordinary conditions of preservation, not, for instance, in the Chinese material, and at the same time failed to give precise data regarding features which I was able to ascertain. On this account a satisfactory comparison of the present form with his species can not be made. It seems to be distinct from the American and European types whose descriptions I have seen. No species belonging to the genus has as yet been described from China.

Locality and horizon.—Pennsylvanian (Wu-shan limestone); near Ta-ning-hiën, East Ssï-ch'uan (Stations 1 and 2).

MICHELINEA FAVOSITOIDES, new species.

Of this species our collection contains a single specimen, which presents the following characters:

Description.—The shape appears to have been hemispherical, with a flat base and a width greater than the height. The latter dimension is estimated at about 40 mm., and the entire width at about 80 mm. The corallites are rather regular in size and shape, and usually small, few of them attaining a diameter of $2\frac{1}{2}$ mm. The septa are closely approximate, 11 to 13 occurring in the space of 5 mm. They are on the whole rather regular, but are distinctly convex and not infrequently confluent. Mural pores appear to be present, but, as shown

in transverse sections, they are rather rare and their arrangement has not been determined.

Any statement as to septa depends upon the interpretation of certain appearances in thin sections. The bounding walls are not thick and show a dense median line, which is usually more or less wavy. On either side of the median line is a tolerably thick layer, intermediate in transparency between the material filling the intertabular spaces and that of the median plate. The inner edge of this supplementary wall is somewhat strongly denticulate, the projections being in some places rather regular and in other portions of the same corallite absent or irregular. Whether these projections are really denticles or are continuous ridges has not been ascertained. The tabulae show the same degree of transparency as the supplementary wall, the projections of which can apparently with justification be interpreted as pseudosepta, the dense median line being the plane of cleavage separating the truly double-walled corallities. It is hardly possible to count the pseudosepta or to ascertain the average number present.

At first sight one might well feel somewhat doubtful where to place this species, whether in *Favosites* or *Michelinia*, the unusually small size of the corallites certainly suggesting the former genus, as well as the mural pores, which appear to be rather rare. Some support might also be found in the character of the tabulae, which, if they are somewhat too convex, too irregular, and too confluent for *Favosites*, possess these features in too slight a degree for typical *Michelinia*. On the other hand, the somewhat fluted condition of the median plate, which may be connected with the development of pseudosepta, together with the apparent presence of well-developed pseudosepta themselves, seem to distinguish it structurally from *Favosites*. The range of the latter genus, furthermore, appears to terminate with horizons early in the Mississippian, while the present form is of much later occurrence. *Michelinia*, on the other hand, is already known in upper Carboniferous and Permian (?) terrains. On this account it has seemed that the form under consideration should be denied to *Favosites* and placed with *Michelinia*.

Kayser figures an unidentified species of *Michelinia* from China which differs from the present one in the much greater size of the corallites. By the same character *Michelinia favositoides* may be distinguished from other members of the genus known to me, even from the small-celled Russian species *M. concinna* Lonsdale.

Locality and horizon.—Pennsylvanian (Wu-shan limestone); near Ta-ning-hián, East Ssī-ch'uan (Station 3).

CARNEGIA, new genus.

The characters of this genus are included in the diagnosis of the type species as given below:

Type of the genus.—*Carnegia bassleri*.

CARNEGIA BASSLERI,^a new species.

This name is introduced for what appears to be a new genus of Stromatoporoid corals. Until Waagen and Wentzel described some forms from the Salt Range of India the known occurrence of this group would have warranted the statement that it passed out of existence before the commencement of Carboniferous time. The discovery of a different but related type in an area so close geographically, and in strata of such similar age as are those of India and China, is thus deprived of most of its surprise. The Chinese form possesses characters which forbid joining it with any of the established genera whose descriptions have been before me, and it represents, with little doubt, a new genus. On the other hand, as but a single specimen is known, and as in this group, more than in many others, the difficulty is great of distinguishing between specific and generic characters without the comparisons which several generically related species afford, I have adopted the plan of including the genus and species in a single description.

Description.—The growth of *Carnegia bassleri* is in small lenticular masses, having a slight thickness relative to their spread. One example, for instance, has a thickness of but 4 mm. and a diameter of 35 mm. The structure is fine and dense, and seems to be entirely without the lamellate appearance which gives this group its name.

In transverse section the cœnosteum is seen to be made up of walls and apertures, both possessing a very irregular and tortuous pattern. The walls are especially vermicular and inosculating, giving off disconnected spurs and dividing the inclosed space into small separate apertures. The entire course of the walls seems to be made up of curves, and the outlines of the apertures are of course correspondingly curvilinear. The walls are relatively thick, and where projecting spurs are given off these often appear to be rounded and enlarged at the disconnected end, as if terminating in a pillar. Similar enlargements can be observed also in other portions of the walls. The zooidal apertures are nearly equal in size, and the whole structure seems to be quite regular, but not infrequently several of the apertures are confluent, although the larger one thus formed is so tortuous that it fails to have this appearance in the *tout ensemble* of the section. Astrorhizæ appear to be entirely absent.

In longitudinal section the skeleton is seen to be composed of continuous zooidal tubes and continuous walls, the latter being, as already

^aThis species is named after Mr. R. S. Bassler.

shown in transverse section, relatively thick. The zooidal tubes are rather closely tabulate, and the walls are perforated. The perforations are of unequal sizes and irregular distribution. It is without doubt owing to these interruptions in the radial walls that in cross section two or more of the zooidal tubes appear to be connected into a single large vermicular one. Sometimes, owing perhaps to the influence of tabulae and porous developments, the walls in longitudinal section have a nodose appearance, somewhat as in *Stenopora*. Of course the two genera are otherwise widely different and have different affinities.

In the lower part of the cœnosteum the zooidal tubes are narrow and bent inward toward the point of origin, as in colonies of compound corals and bryozoans. In this region the walls are thin and the pores and tabulae much less plentiful.

This form appears to be but distantly related to those described from the Salt Range of India, and it presents more structural affinities with the older genus *Stromatopora*. From this, however, it is clearly distinguished by the pattern of the apertures and by the absence of astrorhizae and of latilaminae. The zooidal tubes and bounding walls are much more continuously and regularly developed and the walls themselves apparently somewhat different in construction. They appear to be dense, and but for the local thickening, which may represent radial pillars, structureless. *Cornegia* seems to belong to the Stromatoporidae, but to be distinctly different from any of the genera at present assigned to that family.

Locality and horizon.—Pennsylvanian (Wu-shan limestone); near Liang-ho-k'ou, East Ssi-ch'uan (Station 7).

BRYOZOA.

FISTULIPORA WILLISIANA,^a new species.

Description.—This species grows in thin, epithecate expansions, occurring in considerable numbers in the limestone of which it appears to constitute a paleontologic feature of some importance. The largest fragment seen measures 15 mm., but the original size may have been considerably greater. The thickness of the typical specimen is but little over one-half mm. The growth is irregular and contorted. Maculae are present, but their size and distribution have not been determined. The zoecia are quite small; they occur six or seven in a distance of 2 mm., and are situated at intervals of about one or two times their own diameter. A lunarium is well developed. Mesopores are usually large and, as a rule, separate the zoecia in single rows. They are about the size of the zoecia themselves, and in some cases are even larger.

^aThis species is named for Mr. Bailey Willis.

This species is distinguished by its thin, lamellate growth and by the small size of the zoecial tubes.

Locality and horizon.—Pre-Pennsylvanian (?); near Ta-miau-ssī, East Ssī-chu'an (Stations 6, 8, and 9).

GEINITZELLA CHINENSIS, new species.

Description.—The growth of this species is dendroid, specimens occurring in long cylindrical trunks, from which, in some instances, spring smaller branches. All the specimens examined are fragmentary, the largest having a length of 110 mm. They vary much in point of size. The largest yet noted has a diameter of 17 mm., but the average is nearer 15 mm. In some specimens low monticules, more or less distinctly elongated in a transverse direction, form a noticeable feature, which may have been present in all. The mature region, where the cells had a horizontal direction, measures 4 mm. in a large example.

In thin sections the species shows the usual structural variation where different stages of development are examined. From seven to eight cells occur in a linear distance of 2 mm. The acanthopores are large, and vary greatly in number and appearance in sections made at different points of the same zoarium. In longitudinal section a few scattered diaphragms occur just before the cells thicken their walls and bend into a horizontal direction.

This species is closely related to *Geinitzella columnaris* Schlotheim, as identified by Waagen and Wentzel in India, but it hardly seems that the Chinese form can be immediately placed with that species. Waagen and Wentzel state that *G. columnaris* rarely attains a size of 5 mm., and that a diameter of but 2 mm. is often met with. The Chinese form is thus seen to be at least three times as large. So far as observed also, it is never incrusting, a mode of growth which the Indian form is said to exhibit. In thin sections, however, the two species are extremely similar. One distinction which appears to exist is that the cells are a little larger in the Chinese form. Waagen and Wentzel do not state this character in their description, and certain discrepancies which appear to exist between different degrees of magnification said to be represented by their figures, make it impossible to obtain altogether reliable measurements from that source. Apparently *G. columnaris* presents nine or ten cells in 2 mm. The presence or absence of tabulae is not stated in the text of their description, but none are represented in their figures. The Chinese form certainly possesses tabulae, and it seems likely that they will also be found in that from India.

With the differences above noted it seems inadvisable to refer the Chinese form to *G. columnaris*, though it is possible that it will prove

no more than a variety, better marked, however, than any of the varieties recognized by Waagen and Wentzel.

Locality and horizon.—Pennsylvanian (Wu-shan limestone); near Ta-ning-hiën, East Ssi-ch'uan (Stations 1 and 4).

BATOSTOMELLA MEEKANA,^a new species.

This form has not been found free, and the following description has been drawn up from thin sections. It evidently occurs as cylindrical, probably branching, stems, of which some grow to a diameter of 4 mm., while others were only about 3 mm. thick.

Description.—The cells are slightly oval in outline, one diameter being a little greater than the other. In the mature region they are separated by intervals about equal to one-half their own diameter, and number about five in 2 mm. longitudinally. The acanthopore-like granules are relatively few, and as a very prevalent rule occur in single rows between the apertures. On the average about eight surround each cell, but as they vary greatly in distribution sometimes more (as many as 12 and 13) and sometimes less can be counted. They are also very irregular in point of size, some having a diameter twice or even three or four times as great as others. Very often they appear to be in two well-marked grades of size, but sometimes another intermediate grade can be recognized, and it seems likely that there is no absolute classification to which they can be reduced in this respect. While in a general way the large and small granules appear to be regularly distributed, no definite system or arrangement can be made out. In sections longitudinal to the tubes, the thickened or mature region is quite shallow, about twice the width of the apertures. The latter, however, here appear of much smaller diameter than in the transverse section, being only about half as wide as the intercellular granuliferous spaces, which therefore present nearly square areas in thin sections cut longitudinally.

This form is structurally very closely related to *Rhombopora lepidodendroides*, but is clearly distinct from that widely distributed American species. Kayser identified *Rhombopora lepidodendroides* in the Lo Ping fauna. From this *Batostomella meekana* seems to be distinct, as it without much question is if the Lo Ping form is correctly identified. Of the two species of *Rhombopora* described by Waagen, from India, it may be distinguished from *R. polyporata* by the much smaller number of granules. Though more similar to *R. obliqua*, it also differs in several particulars. It is a more robust form. The cells are more nearly circular and apparently of larger size, since, according to Waagen's figure, only about three occur longitudinally in 2 mm. Furthermore, Waagen states that the granules are all of a size

^aThis species is named for Mr. F. B. Meek.

in his species, which is conspicuously not the case in the one under consideration.

Locality and horizon.—Pennsylvanian (Wu-shan limestone); near Ta-ning-hiën, East Ssi-ch'uan (Station 4).

FISTULIPORA WAAGENIANA,^a new species.

Description.—Of this species our collection contains but one specimen, which displays the following characters: The form is that of a hollow cylinder, the diameter of which is 25 mm., the length of the fragment being 45 mm. The thickness of the zoarium varies somewhat, but has an average of about 5 mm. It can not be determined whether the original shape was incrusting, hollow cylindrical, or solid cylindrical. So far as can be observed, there is no epitheca upon the inner surface, nor is there any flexing of the cells toward a point of origin. From this circumstance it can perhaps be inferred that the original form was a solid cylinder, of which the axial portion, including the immature region of the cells, has by some means been destroyed.

In thin sections the zœcial tubes are seen to occur about four in the space of 2 mm. Their distribution, however, is quite irregular. They have very thick walls, which in some cases are almost in contact and in others are separated by distances equal to about the inner diameter of the tubes. In the region of maculæ their distance is sometimes two or three times the diameter. The cells are of course nearly circular, and as a rule separated by rather large mesopores in single rows. Near the surface the spongy tissue of the mesopores gives place to solid investment, in which, though the inner portion of the tubes has still a circular section, the outer boundary, more or less clearly shown, is sharply polygonal. A lunarium is as a rule entirely absent, but in rare cases indistinct but certain traces of the structure can be observed. It is also more or less regularly developed in young stages. Tabulæ are rather few and distant, and they are developed at very irregular intervals. The vesicles observed in longitudinal sections vary greatly in size. As a rule they are but gently convex, the upper and lower surfaces often being nearly flat and parallel.

This species is clearly distinct from American forms of similar geologic age, and also from *F. parasitica*, the only species described by Waagen and Wentzel from the Salt Range. It is also very distinct from *F. tuberosa*, a member of the Lo Ping fauna described by Kayser.

Locality and horizon.—Pennsylvanian (Wu-shan limestone); near Ta-ning-hiën, East Ssi-ch'uan (Station 2).

^aThis species is named for Mr. William Waagen.

BRACHIOPODA.

SPIRIFER BLACKWELDERI,^a new species.

This form has been obtained at two localities, and occurs in considerable abundance in the shape of casts of separate valves. The following characters have been observed:

Description.—The shape of the ventral valve is subquadrate. The convexity is high, the beak large, erect, gibbous. The area is well defined, high, and concave. The foramen is large, its width at the base being almost one-third that of the whole area. The cardinal angles are rounded and the cardinal line considerably shorter than the greatest width. A narrow and moderately deep sinus traverses the shell, becoming gradually broader and less well defined toward the front. The sinus is not divided by plications, nor do any ribs mark the sides. On the interior there are two strong dental plates, but no septum.

The dorsal valve is transversely subelliptical in outline. The cardinal extremities are rounded, and the hinge line is shorter than the greatest width. The beak is small and depressed. A moderately high, rather well-defined mesial fold passes downward, gradually widening in its course.

The surface lacks ribs either upon the sides or on the fold and sinus, but is marked by very fine radiating striae.

I know of no Carboniferous species which really requires comparison with the present. In general appearance it suggests a *Reticularia*, such as *R. lineata*, but the fine, continuous, line can hardly be interpreted as marks left by the spines which characterize that group.

The development of fine subsidiary lirae seems to be a much more common feature in the English *Reticularias* (see *R. lineata* var. *reticulata*), judging from Davidson's description and figures, than in the American, where it is essentially unknown. We have at least one, though a little known, form possessing this character, which was apparently described by Swallow as *Spirigera prouti*. I am not prepared to speak positively as to the internal structure of this type, but dental plates and septa seem to be absent or but slightly developed. In the American *Reticularias* (*R. pseudolineata*, etc.), and I suppose in the European ones, there is a median septum in both valves, while the ventral valve possesses long dental plates as well. The Chinese shell thus differs in structure from the *lineatus* group of *Spirifers*, although it shows some points of superficial resemblance.

S. blackwelderi differs from *S. lineatus* as identified by Kayser from Chinese specimens, as well as from any other Chinese species identified or described by him, nor can it be found among the shells de-

^aThis species is named for Mr. Eliot Blackwelder.

scribed by Waagen from India or by Tschernyschew from Russia. In fact, closer parallels can be drawn with certain Silurian forms, such as *Spirifer radiatus*, than with those usually found in the Carboniferous. In the *radiatus* group, as in *S. blackwelderi*, the ventral valve possesses dental plates, but while socket plates, and sometimes a low septum, are found in the dorsal valve of the former, that of *S. blackwelderi* appears to be without those structures.

Locality and horizon.—Pennsylvanian (Wu-shan limestone); near Ta-ning-hiën, East Ssi-ch'uan (Stations 1 and 2).

NOTOTHYRIS WILLISIANA,^a new species.

Description.—Shell small, subspherical. Ventral valve subovate, gibbous, rapidly and rather suddenly contracting at the beak, which is strongly deflected and truncated by a relatively large foramen. Toward the front this valve is marked by a narrow, moderately strong but shallow sinus extending about half the length. There should be other modifications of the mesial portion to correspond with the plications on the accompanying valve, but if present they are obscured in the typical specimen. On each side of the sinus traces of some six or seven ribs are found. Only about four of these are developed as plications on the shell, the remainder appearing on the margin, as denticulations. Even these four, however, are obscure, and decrease in intensity in proportion to their distance from the sinus.

The dorsal valve is subcircular in outline, highly gibbous. Beak small, pointed, slightly prominent. There is a strong, deep, ill-defined mesial sinus, which projects in front as a sort of linguiform extension corresponding to a deep emargination of the front of the opposite valve. The sinus, which dies out long before reaching the hinge line, is subdivided by a strong mesial fold, extending about as far from the edge as the sinus itself, and each of the two channels thus formed is apparently again subdivided by an obscure plication limited to the marginal region. On each side of the sinus there are about six plications, shown rather by denticulations at the edge of the shell than by folds upon its surface.

Internal structure unknown. Shell strongly and finely punctate.

As only a single specimen of this form was found, it was impracticable to mutilate it for the purpose of ascertaining its internal structures; therefore the generic position of the species is somewhat conjectural. The shell structure and configuration consigned it at once to the Terebratulidæ, and in the character last mentioned it much more closely resembles the genera *Notothyris* and *Hemiptychina* than the plicated *Diclasmas*. It is somewhat uncertain whether this fossil should be regarded as having a dorsal sinus in which a mesial rib has been

^aThis species is named for Mr. Bailey Willis.

developed, or a dorsal fold with two deep channels upon its sides, but the former interpretation seems to be more natural. Upon that view the species under consideration would be one of the *antiplicatae*, and its generic position would be with *Notothyris* in preference to *Hemiptychina*. On one side of the specimen may be noticed an appearance similar to that often observed in *Dielasma* when fracture or cleavage takes place along the dental plates, but in the present case this may be due to exfoliation of the thick shell. Of course the presence of dental plates would debar this form from *Notothyris* and *Hemiptychina* alike.

In its specific relations this form differs sufficiently from any of the species whose descriptions have come into my hands to make a detailed comparison unnecessary. It is perhaps as near to *N. inflata* Waagen and *N. djoulfensis* Abich as any.

Locality and horizon—Pennsylvanian (Wu-shan limestone), near Liang-ho-k'ou, East Ssi-ch'uan (Station 7).

PELECYPODA.

AVICULIPECTEN? RICHTHOFENI,^a new species.

Description.—What appears to be the left valve of this species presents the following characters: Size small, general shape semielliptical, slightly inclined backward. Length and breadth approximately equal. Hinge line nearly as broad as the greatest width. Outline somewhat retracted below the ill-defined wings, but spreading again, and with the sides and front broadly rounded.

The surface is marked by angular ribs situated at relatively wide intervals. The flat interspaces are marked by very fine radiating liræ. New ribs are introduced interstitially, probably by the enlargement of one of the liræ. The whole is crossed by fine, somewhat lamellose concentric liræ.

A shell supposed to represent the left valve has an outline similar to that of the right, but of course is inclined in an apparently opposite direction. There is no byssal sinus, and the broad wings are undefined. The convexity is a little lower than that of the right valve, and the beak less prominent.

The surface is without ribs or radial marking, and is in fact nearly smooth, showing only delicate, somewhat unequal and irregular concentric lines.

This species is represented in our collections by a number of right valves and only two left valves. All the larger examples of the right valve are imperfect, so that measurements can not be made, but the length indicated is certainly less than 15 mm. The large specimens,

^aThis species is named for Baron von Richthofen.

so far as one can be told, do not differ, except in size, from the smaller ones.

It can not be definitely stated that the flatter and nearly smooth shell here described as the right valve of the species really had that relation. The correspondence in size and shape, however, and occurrence in the same beds render this interpretation quite probable. If so, however, it is certain that the form under consideration is not an *Ariculipecten*, since a byssal sinus, which is well developed in that genus, is here inconspicuous or absent.

In shape and sculpture this form recalls to a certain extent some of the Russian species of *Aricula*. *A. kazánensis* De Verneuil, of the Russian Permian, is perhaps the nearest of these, though it is still considerably different. *Aricula elegantula* Stuckenburg, of the Gschelian, is still more different.

Locality and horizon.—Post-Pennsylvanian (?) (Kui-chóu series); near Ta-ning-hien, East Ssī-ch'uan (Station 5).