

ART. XVI.—*Remarks on Prof. Geinitz's views respecting the Upper Paleozoic rocks and Fossils of Southeastern Nebraska*; by F. B. MEEK.

THROUGH the politeness of Prof. Geinitz, I have received a copy of his interesting and accurately illustrated work on the Upper Paleozoic rocks and fossils of southeastern Nebraska.* The numerous excellent figures he has here given, of many of our fossils not previously illustrated, will certainly be a great assistance to students, and place them under many obligations to the distinguished author. Being very reluctantly compelled to differ widely from him, however, in regard to many of his identifications and interpretations of these fossils, and feeling it to be a duty to correct errors into which he has fallen, it is but fair to first explain the difficulties with which he had to contend in entering upon this investigation. In the first place, he was, to a great extent, unacquainted with the Coal-measure fossils of this country, and wholly unprepared to understand and appreciate the remarkable mingling here of Coal-measure and Permian types and the frequent alternation of beds containing these two types of fossils, through a considerable thickness of strata. In addition to this, he was necessarily compelled to identify, and form all his conclusions respecting, a number of species described in this country, from descriptions alone, unaccompanied by illustrations; while the collections were submitted to him with erroneous views respecting the relations of the beds from which they were obtained, to the Coal-measures of that region.

It is also proper to further explain, for the information of general readers not familiar with Natural History, that differences of opinion in regard to such matters often arise from the fact that there are two schools of observers amongst paleontologists, as well as amongst investigators in recent zoology. Those of one of these schools give a very wide latitude to genera and species, while those of the other restrict both within more precise limits. That is to say, the first often include in a single genus types which those of the other school distribute into two or more genera, or in some cases, refer even to distinct families. Upon the same principles, those of the first school often regard as mere varieties or unimportant modifications of the same species (if they notice the differences at all) forms that the others consider specifically distinct. As might be expected, these different views respecting the value and importance of distinctive characters sometimes lead to very different conclusions, not

* Carboniferous and Dyas in Nebraska, von Dr. H. B. Geinitz, M. d. k. L.-c. A. d. N. Dresden, 1866.

only in regard to the geographical range of living animals, but also amongst paleontologists, in regard to the geological range, and duration in time, of extinct species and genera; and, as a consequence, respecting the ages and relations of formations. It is proper to add here, however, that the developments of modern zoology are constantly forcing upon our attention the absolute necessity for closer and closer attention to less striking differences in distinguishing genera and species, before we can hope to arrive at reliable conclusions in paleontology.

When it is understood that, out of a list of about ninety species of fossils enumerated by Prof. Geinitz from the beds in Kansas and Nebraska which he regards as belonging in part to the Carboniferous, and in part to the Permian, he identifies about fifty of these species with European, and in part East Indian forms, it will be readily understood by any one familiar with our fossils, that he must be one of those who admit very great diversities of characters as being consistent with specific identity. But before entering upon the discussion of differences of opinion respecting species, it may be well to mention some of the cases where we differ in regard to genera.

First the impropriety of referring to the genus *Turbonilla*, founded upon very small recent shells, ornamented with regular longitudinal costæ, and provided with a *sinistral apex*, shells with only revolving costæ, and a non-reversed apex, such as his *T. Swallowiana*, although not unfrequently done by other paleontologists, must be obvious to those familiar with living Mollusks. That these shells have not a sinistral apex, is well known to the writer, from careful examinations of several allied species from the Coal-measures of Illinois, in which the spire could be traced by the aid of a magnifier, to a minute point, without showing the slightest indications of a reversed apex.* To those unaccustomed to give attention to such characters, this may seem to be an insignificant distinction, but every well informed conchologist is aware that it is found to be coexistent amongst recent shells, with important differences in the anatomy of the animals inhabiting them. For the same reason, as well as on account of their generally much larger size, we may question the propriety of referring *any* of the paleozoic shells often described by paleontologists under the name *Chemnitzia*, and *Loxonema*, to the existing genus *Turbonilla*.

Again we have good reason for believing Prof. Geinitz is far from right in referring the common Coal-measure shell *Euompha-*

* One of the little shells here alluded to, was described by Dr. Stevens from the Coal-measures of Illinois under the name *Aclis minuta* (this Jour. II, xxv, p. 259); and another by Mr. Worthen and the writer from the same horizon, as *Turritella?? Stevensana* (Geol. Report III., ii, p. 382). It is quite improbable that they belong either to the genus *Aclis* or *Turritella*, but they are certainly not *Turbonillas*.

lus rugosus Hall (not Sowerby), to the articulate genus *Spirorbis*. This shell is probably not a *Euomphalus*, but seems to be more nearly allied to the *Molluscan* genus *Bifrontia*. At any rate, of the thousands of specimens that have been found weathered out of the coal shales of the west, not a single one, so far as known to the writer, has ever been seen attached by the substance of even the first whorl of the shell to any other body; nor are we aware that any scar of attachment has ever been observed on either side of the shell, although they have been frequently examined under a magnifier with the view of determining this very question, in numerous perfect examples, entirely free from the matrix, and showing clearly all the volutions on both sides to the very center.

Nor is Prof. Geinitz's reference of his little *Murchisonia sub-tæniata*, to that genus, or *family* even admissible. It belongs on the contrary, to the genus *Orthonema* M. & W. (Ill. Report, vol. ii, pl. 31, f. 14), a group of small shells resembling *Murchisonia* in form and revolving markings, but differing in being *entirely without the slit or sinus in the lip* characterizing that whole family of shells. Prof. Geinitz did not see a sinus in the lip of his specimen, nor the corresponding revolving band, but thought a flattened space between two little revolving ridges might be a band, though he acknowledges that this view would indicate a proportionally wide flat band. In order to settle this point, however, an excellent specimen of the species *subtæniata*, was borrowed from Dr. White, the state geologist of Iowa, obtained from exactly the same horizon in the western part of that state, and on examining this by a cross light, under a good magnifier, its lines of growth were seen passing straight across the whorls, without making the slightest flexure such as we see in *Murchisonia* and other genera provided with a sinus in the lip. Several allied species of this genus are known in the Coal-measures of Illinois.

His reference of such shells as the so-called *Modiola squamosa* and *M. acuminata* of Sowerby (as illustrated in Prof. King's Perm. Foss.), to the genus *Aucella*, is also believed to be done on questionable grounds. The genus *Aucella*, it will be remembered, was founded by Count Keyserling, upon a group of Jurassic shells, differing from those mentioned above, not only in wanting their broad cardinal area, marked with linear parallel cartilage furrows, but also in possessing a little abruptly projecting anterior ear, defined in the right valve by a deeply impressed linear furrow extending from the beak to the margin, and terminating there in a sharply cut byssal emargination. Now on examining Prof. King's excellent figures of testiferous examples of the English shells mentioned above, it will be seen that they show no traces whatever, of this little anterior ear, though his

figures of internal casts illustrate clearly the broad furrowed cardinal area of *Myalina*, to which genus these shells appear to belong.

It is true Prof. King's figures respecting *internal casts* of these shells, show a little projection between the beaks (as do some of our American species of *Myalina*), that might be mistaken for little ears,* but it is easy to see from perfect specimens showing that outside of the anterior margins of the shell, that these are not external ears, but the casts of a little cavity upon a kind of shelf or septum in the beaks, as stated by Prof. King. Prof. de Koninck mentions this little shelf and its concavity, in describing the genus *Myalina*; and although a more or less variable character, sometimes even in different individuals of the same species, evidences of its existence can generally be seen in the different species of that genus.

Prof. Geinitz has figured in his valuable work "Dyas" under the name *Aucella Hausmanni* (of which he regards the English species *squamosa* and *acuminata* synonyms), German examples of a shell that show, in one of the figures, some indications of a little anterior ear; but if it is really such, and not due to the accidental compression of the valves, as its absence in his other figures indicate, and the shell otherwise agrees with *Aucella*, we may well question its identity with the English forms mentioned above. It is also worthy of note, that Goldfuss's figures of the type of his species *Hausmanni* show no traces whatever of such ears. These shells sometimes have a slight prominence of the anterior margins of the valves, as we see in *Modiola*, but as we know by examining numerous examples of the allied American forms, there is never a defined ear, or sinus, but on the contrary, the margins of the valves fit closely there, and round up to the extremity of the hinge exactly as in *Modiola*.

Another mingling of distinct types under one generic name, is Prof. Geinitz's reference of such shells as the so-called *Monotis speluncaria*, and *Pinna prisca*, to the genus *Avicula*. The first of these types, it will be remembered, is exceedingly unlike the recent shells upon which the genus *Avicula* was founded; being nearly circular, plano-convex shells, with scarcely any perceptible obliquity, and almost destitute of proper alations at either extremity of the hinge. These and other differences led Prof. King to separate the species *speluncaria*, from the genus *Avicula*, and to place it provisionally in the genus *Monotis* Bronn, in which he has, until recently, been generally followed, both in this country and in Europe. On comparing the American

* A precisely similar cavity exists between the beaks of *Amphicalia*, Hall, from the Upper Silurian; and internal casts of these look very much like little ears, which the writer at one time supposed them to be; but good specimens of the shell preserving perfectly the anterior margins of the valves, show clearly that there is no external anterior ear whatever.

shells of this type, in 1864, with authentic European examples of the type of Bronn's genus *Monotis* (*M. speluncaria* of the St. Cassian beds), the writer was led by the very nearly equivalent character, and entire *absence of any traces of a byssal emargination* in the latter, to regard these two forms as belonging to distinct genera, and consequently to propose for the *speluncaria* group, the name *Eumicrotis*,* not being at that time, nor until very recently, aware that Beyrich had nearly two years previously proposed to separate this group from *Monotis*, on precisely the same grounds, under the name *Pseudomonotis*.† Prof. Geinitz thinks that if this type should be separated at all from *Avicula*, it should be referred to *Aucella*, which was also sometime back suggested by Prof. McCoy. Although this would be more nearly correct than to refer such shells to *Avicula* or *Monotis*, a strictly systematic classification of all the various groups of the *Aviculidae*, would forbid such an association.

If those who hold that a natural classification requires the separation of such forms as the genera *Cassianella*, *Pseudomonotis* and *Avicula*, surely they will very decidedly protest against the reference to the latter genus of such shells as the so-called *Pinna prisca* Münster, (= *Avicula pinnaeformis* Geinitz).‡ Indeed it seems scarcely possible to conceive of two bivalves within the limits of the same family, more unlike than this and *Avicula*; almost the only character by which it can be distinguished generically from those slender, straight, elongated Carboniferous species of *Pinna*, being the position of its nearly obsolete beaks a little behind the rather pointed anterior extremity, instead of being terminal. Conchologists will readily understand how unlike *Avicula* it must be, when it is mentioned that Prof. Geinitz at one time even referred it to the genus *Solen*.

* This Jour., II, xxxvii, 216.

† The note of only about one page in which Beyrich proposed the name *Pseudomonotis* for this genus (*Zeitschr. der Deutsch. geol. Gesselsch.*, xiv, p. 10), being unaccompanied with illustrations, or a conspicuous heading to distinguish it from other matter, had escaped the attention of the writer in preparing a classification of the *Aviculidae*, or the name *Pseudomonotis* would have been adopted. In the same note Prof. Beyrich proposed another genus *Cassianella*, with the *Avicula gryphaeta* of Münster as its type. For this, the writer, on the same grounds, proposed the name *Gryphorhynchus*, in 1864. Beyrich's names for both of these genera, however, having priority of date, will have to take precedence. Although neither of these genera would be admitted by those who give such wide limits to groups, it is manifest that such distinctions are attracting the attention of systematic workers everywhere. For instance, Laube adopts *Cassianella* as a good genus in his beautiful Monograph of the St. Cassian fossils recently published. He also there proposes, on apparently good characters, a genus *Hörnnessia*, for a group of which the so-called *Gervillia socialis* of authors is the type; though it is probable this will prove to be a synonym of Mr. Gabb's genus *Rhynchopteris*, published in the California Report in 1864, and founded upon a shell presenting similar external characters, and from near the same horizon, in Nevada.

‡ For this type the writer proposed the name *Aviculopinna*, in 1864, (this Jour., vol. xxxvii, cited above).

The propriety of referring the little Permian and Carboniferous shells for which Prof. King proposed the name *Bakevella*, to the genus *Gervillea*, is, to say the least, very doubtful. Although these types are unquestionably closely related, the uniform smaller size of the species of the former group, the more nearly equal convexity of their valves, usually smaller number of cartilage cavities, and generally less elongated form in proportion to the length of the hinge line, are characters which, when viewed collectively, indicate generic differences. The most important distinction, however, is found in the hinge teeth, which although variable in both groups, differ in that those on the posterior side of *Bakevella* are elongate, linear and directed parallel to the hinge line, instead of being shorter and oblique; while those in front of the beaks range obliquely forward and downward, instead of forward and upward, as in *Gervillea*. Again *Bakevella* has the anterior muscular scar proportionally larger, so much so indeed that Prof. King referred the genus to the *Dimyaria*, though it belongs to the *Avicula* group near *Gervillea*.

Again, in including in the genus *Pecten* the Paleozoic shells for which Prof. McCoy proposed the name *Aviculopecten*, Prof. Geinitz ignores important distinctions that have been known for fifteen or sixteen years past, to clearly separate these groups. These are the proportionally larger size of the posterior ear in *Aviculopecten*, instead of the reverse, and its broad *Pterinea*-like cardinal area, or hinge plate, with parallel longitudinal cartilage furrows, and in general without traces of a central cartilage pit under the beaks. Even Woodward, who was the most extremely conservative of all modern conchologists, in regard to generic distinctions, not only separated these shells from the genus *Pecten*, but even placed them doubtfully in the family *Aviculidae*. No well informed conchologist would at the present time refer to the genus *Pecten*, as properly restricted, any Paleozoic species.*

He is also behind the present state of conchological science in placing in the genus *Arca* forms like the so-called *A. striata* Schlot. (sp.), with the posterior hinge teeth linear, elongated and ranging parallel to the cardinal margin. These belong to the genus *Macrodon* of Morris and Lycett. Even Woodward separates this group from *Arca*, but without sufficient reason includes it as a subgenus under *Cucullaea*. There are no true *Arca*s in the Paleozoic rocks.

Another unnatural mingling of distinct types is his reference of typical *Ledas* (properly *Nuculana*), to the genus *Nucula*.

* Prof. Agassiz, who has gone over the whole family *Pectenidae* with great care, and his usual thoroughness, does not, if correctly understood by the writer, refer any of the fossil species from older rocks than the Tertiary, to the genus *Pecten*, as properly restricted.

Woodward, Carpenter, Gray, H. & A. Adams, Deshayes, Chenu, in short, all good conchologists admit this as a distinct *genus* from *Nucula*; while Carpenter, H. & A. Adams, Mörch, and other late systematic writers, separate it as the type of a distinct *family* from the *Nuculidæ*.

But the most unaccountable error into which Prof. Geinitz has fallen, is in placing in the genus *Rhynchonella*, *Spirifer hemiplicatus* of Hall, the type of the new genus *Syntrilasma*, Meek & Worthen (Ill. Geol. Report, ii, 321). Being a somewhat peculiar shell, if the cardinal region of the valves was hidden in the matrix, and the surface striæ somewhat obscured, it might be mistaken for a *Rhynchonella*; but the most surprising thing is that he should have referred it to that genus, when the very specimens figured by him show it to have a straight hinge line, and a well defined cardinal area,* divided in the ventral valve by a triangular open fissure, while another figure shows it to have in the dorsal valve, the crura and *cardinal process*, as in *Orthis*. The fact is, this shell does not even belong to the *Rhynchonellidæ*, as its punctate structure and other characters show. The fact that Prof. Geinitz, after referring it to *Rhynchonella*, speaks of it as "this rare and beautiful *Terebratula*," would also seem to indicate that he does not even regard the distinctions between these two genera (well known to be the types of two distinct families), of much consequence.

Again Prof. Geinitz overlooks important distinguishing characters, when he refers (without even a recognition as a subgenus) to the genus *Orthis*, a typical *Streptorhynchus* (properly *Hemipronites*). The distinctions between these types are well defined, so much so that even Mr. Davidson, who is always cautious and conservative in admitting even subgenera, considers it a good subgenus; while most of the highest authorities in various departments of recent zoology view differences of no greater importance as being of full generic value.

Any of the numerous collectors of western Coal-measure fossils will at once recognize the spines figured by Prof. Geinitz (pl. iv, fig. 29), and referred by him to *Actinocrinus*, as those of *Zeacrinus mucrospinus* McChesney. These spines, probably belonging to two or more allied species, are widely distributed in our Coal-measures, from West Virginia and Pennsylvania, to

* It is scarcely necessary to explain here that when Prof. de Koninck speaks of an area, in describing *Rhynchonella angulata* Linn (to which species Prof. Geinitz refers the shell under consideration), he alludes to a flattened oval space on each side of the shell, converging to the beaks at an angle of about ninety degrees, and not to a true cardinal area, such as that term is applied to in describing Brachiopods generally. If any one, however, has any doubts on this point, these will at once be removed by turning to Mr. Davidson's excellent figures and description of *R. angulata* (Monogr. Brit. Carb. Brach., p. xix), prepared after a careful study of Linnæus's original specimen.

Nebraska, and southward to Texas and New Mexico; while they may be at a glance distinguished from those of any of the forms usually referred to *Actinocrinus*. They belong indeed to different parts of the crinoid, being modified second radial pieces, while those of *A. cornigerous*, and *A. Gouldi*, with which Prof. Geinitz compares them, are modified vault-pieces, that rise obliquely upward out of the vault from above the horizon of the arms. This difference in the position and relations to the other parts, of these spines, imparts an entirely different form to the head or larger extremity, from those of any of the Sub-carboniferous crinoids, that renders it very easy to distinguish them. It is unnecessary to inform any one acquainted with western fossils, that no species of *Actinocrinus*, even giving that genus its widest limits, has yet been found above the horizon of the St. Louis Limestone, of the Sub-carboniferous series, and the only two species found thus far up belong to the *Batocrinus* section.

Having thus pointed out what are believed to be errors in regard to generic references, respecting which students who may use Prof. Geinitz's work ought to be informed, some remarks on the specific relations of these fossils may not be out of place.

First a little planorbicular shell (fig. 6, pl. 1), referred by Prof. Geinitz to *Serpula* (*Spirorbis*) *planorbites* Münster, is certainly, as he suspected, the same figured and described by Prof. Hall from the Coal-measures of Illinois under the name *Euomphalus rugosus*, in the Iowa Report. The reasons, however, for not believing it to belong even to the same primary division of the Animal Kingdom as the genus *Spirorbis*, have already been stated. That it is also clearly distinct specifically from the European *S. planorbites*, even if they could be forced into the same genus, is more positively certain, as I know from a direct comparison with authentic foreign specimens of the latter.* Of the Nebraska shell I have numerous specimens before me, from various localities in that region, as well as from Kansas, western Iowa and from Illinois. On comparing these with German examples of *S. spirorbites*, they are easily distinguished by having the whorls always *very distinctly* quadrangular, and broadly flattened on the outer side, instead of presenting an oval section with a rounded or subangular dorsal side as in the German species. The latter also has its deepest umbilical concavity on the left side (placing the shell with the mouth turned downward and away from the observer), instead of the reverse. Prof. Geinitz had also observed that there is a shallow furrow around the middle of the side of the whorls in the Nebraska fossil, where there ought to be a prominence to make it correspond to the *S. spirorbites*, but thinks this is due to the accidental pressing inward of this prom-

* All the foreign specimens of Permian fossils alluded to in the paper belong to the Museum of the Smithsonian Institution.

inence. This obscure furrow, however, is a natural character in the *E. rugosus*, though not always equally well defined, and sometimes becoming obsolete. Finally it attains a size of from four to six times that of the *spirorbiles*. The latter, as shown by Prof. Geinitz's figures in his "Dyas," as well as by the specimens, varies considerably in some respects, but the American shell is *very* constant and regular in form, and in most of its characters.

I differ, if possible, still more decidedly from Prof. Geinitz, in thinking *Spirorbis helix* of King identical with this; and doubt the identity of King's species with the true *S. spirorbiles*. If our shell is identical with any European species, it agrees most nearly with the Carboniferous species *Euomphalus carbonarius* Sowerby (= *E. quadratus* McCoy, Carb. Foss. Ireland, pl. 5, fig. 22), which it quite nearly resembles, though even these forms are clearly distinct.

Murchisonia subtaeniata Geinitz, Carb. und Dyas, pl. 1, fig. 18. As already stated this is a true *Orthonema*, and will have to take the name *O. subtaeniata*.

Bellerophon interlineatus Portlock. Geinitz, ib. This may or may not be identical with Portlock's species. At any rate it occurs in the Coal-measures of Kansas. The *B. carbonarius*, and *B. Montfortianus* N. & P. mentioned by Prof. Geinitz among other fossils from the beds he refers to the Dyas, are well-known Coal-measure species in the West. His *B. Marcouanus* seems to be a good new species.

Macrocheilus Hallianus Geinitz, ib., fig. 7. This probably belongs to the genus *Soleniscus* Meek & Worthen (Illinois Report, ii, pl. 31, fig. 15), as it presents much the appearance of specimens of the type of that genus with the beak and lower part of the outer lip broken away. If the specimen figured has had an *accidental* depression made on the columella above the fold, it may even be the typical species originally described from the Coal-measures of Illinois.

Allorisma elegans King. Geinitz, ib., f. 21. If we may judge from the published figures and descriptions of this species, there can be little room for doubting that the Nebraska shell figured under that name is a distinct species, even after making liberal allowances for variations. If so, it may be called *Allorisma? Geinitzi*, though it seems very doubtful whether it is a true *Allorisma*. It appears to be congeneric with, and allied specifically to, species described by Dr. Shumard from the Coal-measures of Kansas and Missouri, under the names *Leptodomus Topekaensis*, and *L. granosus*. It is probable that all these shells should be referred to the genus *Sedgwickia* of McCoy, as properly restricted to the types for which that name was first proposed (see Paleont. Upp. Missouri, p. 38).

Solenomya biarmica de Vern. Geinitz, ib. The specimen figured

is too imperfect for satisfactory identification or to show any reliable characters for distinguishing it from forms in our Coal-measures.

Astarte gibbosa McCoy. Geinitz, ib., fig. 23. This agrees quite nearly with McCoy's figure, but to establish *positive* specific identity would require a comparison of specimens showing the hinge and interior, which *might* even show them to belong to different genera. They are probably both Edmondias, however, and look unlike *Astarte*. Dr. White finds them in the Upper Coal-measures of Iowa.

Astarte Nebrascensis (n. sp.), and *A. Mortonensis* Geinitz, ib., as well as the form he figures *A. Vallisnerianus* King, have more the aspect of *Astarte*; but the latter looks less like Prof. King's figures than the form figured as a new species *A. Nebrascensis*. At any rate, specific identifications, and even generic references of such shells, can be admitted only provisionally, until the hinge and interior is known.

Schizodus obscurus Sowerby, and *S. Rossicus* de Vern. The forms figured under these names on plate I, resemble these European shells quite nearly; but it must be obvious that in a genus like this, in which species vary more or less in outline, and present so few characters for identification, little reliance can be placed upon identifications from external characters only, especially when the specimens were obtained at so widely distant localities. The form referred to *S. obscurus* (figs. 30 and 31), looks more like Prof. King's figures of *S. Schlotheimi* Geinitz, as well as more like natural casts of that species now before me from Germany, than like Sowerby's or King's figures of *S. obscurus*, which shows more elevated, and more ventricose beaks. From a tracing of the type of Prof. Swallow's *Cypricardia? Wheeleri*, described from the Missouri Coal-measures, it appears almost certain that it is the same here figured under the name of *S. obscurus*. Young examples of *S. alpina* (= *Dolabra? alpina* Hall, Iowa Rep., pl. 29, f. 2) from the Lower Coal-measures, in some of its variations, rather nearly resemble the form referred by Prof. Geinitz to *R. Rossicus*, though that is doubtless a distinct species. Dr. White finds both of the shells figured by Prof. Geinitz near the middle of the Upper Coal-measures of Iowa.

Arca striata Schlot. Geinitz, ib., fig. 32. As already explained, the shell figured by Prof. Geinitz under this name is a true *Macrodon*. It is the same species described by Mr. Worthen and the writer (Proceed. Chicago Acad. Sci., i, p. 17) from the Coal-measures at Springfield, Illinois, under the name *M. tenuistriata*. It differs clearly from the European *M. striata*, however, of which I have good examples at hand for comparison, in having its radiating lines very much smaller, or reduced to minute obsolescent striae on the middle and anterior half of the valves. The speci-

men figured by Prof. Geinitz only retains the shell at the posterior end, where the striæ are stronger, and agree more nearly with those of the European form. Through the politeness of Dr. White, I have had an opportunity to compare good gutta-percha casts of the hinge of this shell, from the same horizon in western Iowa as the Nebraska City beds, and they agree well with the Illinois shell. I am aware that *M. striata* varies in the size of its striæ, but it never has them reduced to very minute or obsolete lines on the anterior part of the valves, like the American species, which is quite constant in this character. I agree with Prof. King and others in believing some of the European forms Prof. Geinitz thinks identical with the species *striata*, are specifically distinct.

Nucula Kazanensis de Vern. Geinitz, ib., f. 33-34. The figures of the species *Kazanensis*, originally published in the Geology of Russia, being merely from imperfect moulds left in the matrix, do not afford a reliable means for comparison, though they look like the Nebraska shell. Whatever may be its relations, however, to the *Kazanensis*, it will be readily recognized by those familiar with the western Coal-measure fossils, as the form described by Dr. Stevens from the Coal-measures of Illinois under the name *Leda bellistriata*. Of course it is not a *Nucula*.

Nucula Beyrichi Schloth. Geinitz, ib., 36 and 37. This has the form of a true *Nucula*, and agrees pretty well in form with Prof. Geinitz's figures of German examples of that species given in Prof. Geinitz's "Dyas," but less nearly with specimens sent from Germany under that name. They are probably the same described by McChesney from the Coal-measures under the name *N. parva*.

Clidophorus Pallasi M. V. & K.* Geinitz, ib., pl. II, fig. 3, (fig. 4 appears to represent some other shell.) This figure was evidently made from the internal cast of a shell very near, if not identical with, *Pleurophorus occidentalis* Meek & Hayden, to which genus at least it certainly belongs. It may, or may not be, identical with some of the German shells referred to the Russian species *Pallasi*; but if we are to be guided in regard to the true characters of the type of that species by the figures and description published by its founders in the Geology of Russia, the Nebraska shell, which is shown to have the posterior hinge-teeth at least of *Pleurophorus*, must be a very different type, since the Russian species is both figured and described as being "completely edentulous." The Russian species is therefore not a *Pleurophorus* (= *Clidophorus*) at all, but is more probably, as suggested

* If *Pleurophorus* and *Clidophorus* are synonyms, or only sections of the same genus, it is *Pleurophorus* and not *Clidophorus*, as Prof. Geinitz seems to think, that must take precedence, as King proposed the former genus, naming the so-called *Arca costata*, as its type, in 1844, while *Clidophorus* was not published by Prof. Hall until 1847.

by Prof. King, a *Cardiomorpha*. It also differs from the Nebraska shell in having the internal ridge bounding the anterior muscular scar (as shown in the figures and mentioned in the description) ranging obliquely backward and downward at an angle of 45° to the axis of the valves, instead of nearly at right angles to the same, as shown in the figure of the Nebraska species.

I have now before me an internal cast, and a specimen showing the exterior, of what are strongly suspected to be two very distinct types, that came from Germany with the name *Clidophorus Pallasi* attached. The one showing the exterior agrees quite well with some of Prof. King's figures of his *Cardiomorpha modioliformis*, which Prof. Geinitz cites as a synonym of the Russian species *Pallasi*; but the other specimen, that is, the internal cast, shows that it, at least, is a true *Pleurophorus*, as it has a hinge with teeth like the Nebraska shell; while one of Prof. King's figures of a cast and his description show that his *modioliformis* is edentulous, like the species *Pallasi*.

From these facts, it seems highly probable that two types are, at any rate sometimes, confounded in Germany, under the name *C. Pallasi*;* that is, one edentulous, agreeing perhaps specifically with Prof. King's *modioliformis*, and another with a toothed hinge, or in other words a true *Pleurophorus*. If the Nebraska shell belongs to any European species, it is far more probable that it is identical with *Pleurophorus costatus*, with casts of which, now before me from Europe, Prof. Geinitz's figure closely agrees.

Clidophorus (Pleurophorus) occidentalis M. & H. Geinitz, ib., tab. ii, fig. 6. The shell figured under this name is certainly not the *P. occidentalis* Meek & Hayden. In that species, the beaks are, as described, narrow and projecting beyond the termination of the hinge, being in fact nearly or quite terminal, while its dorsal outline is straight or even a little concave from the beaks posteriorly. The form figured by Prof. Geinitz is, so far as known to the writer, new, and may be called *Pleurophorus subellipticus*.

Cl. (Pleurophorus) simplus von Keyserling. Geinitz, ib., fig. 5. Prof. Geinitz did not have specimens of this shell from Nebraska, but gives a figure copied from Dana's Geology of a specimen from the Permian rocks of Kansas. It is the *P. subcuneatus* M. & H., and occurs both in the Permian and Permo-carboniferous beds. It varies considerably in form, and some of the varieties like that figured in Prof. Dana's Geology resemble *P. simplus*, though among all of the hundreds of examples I have seen, not one is proportionally so slender and elongated as the figure of the Russian shell. Nor have any of them the posterior hinge-teeth prolonged nearly so far backward.

Clidophorus solenoides Geinitz, ib., fig. 7. This is a good species of genus ?

* Prof. King says Prof. Geinitz formerly confounded *Pleurophorus costatus* with the edentulous so-called *Mytilus Pallasi*.

Aucella Hausmanni Goldf. Geinitz, ib., fig. 8. This is doubtless a *Myalina* resembling the *M. squamosa* of England, but it is less nearly like *M. Hausmanni*, as figured by Goldfuss, and quite unlike Prof. Geinitz's figures of German specimens referred to that species. It is doubtless the same as *Myalina Swallovi* of McChesney, from the Missouri Coal-measures. I have also seen a similar form from beds in Nova Scotia, referred by good authorities to the Sub-carboniferous.

Mytilus concavus? Swallow. Geinitz, ib., fig. 9. This is not the form described by Prof. Swallow, which has angular instead of rounded umbonal slopes. It may be a *Myalina* but it is *certainly* not a true *Mytilus*.

Myalina perattenuata M. & H. Geinitz, ib., fig. 10-11. Correctly identified, but it is specifically distinct from *M. permiana* Swallow (cited by Geinitz as synonym), which has less attenuated beaks.

Myalina subquadrata Shumard. Geinitz, ib., figs. 25 and 26. Correctly identified. It is common in the upper Coal-measures of this region, and has been found by Dr. White in the same horizon in Iowa.

Avicula speluncaria Schlot. Geinitz, ib., fig. 12. As already stated, this belongs to Beyrich's genus *Pseudomonotis*. The specimen figured by Prof. Geinitz is not from Nebraska, but was sent to him by Prof. Dana from the Permian beds of Kansas, and is the same shell described by Dr. Hayden and the writer under the name *Monotis Hawni*.* It nearly resembles the European species *speluncaria*, and may *possibly* be identical, but good European specimens of that species now before me can be distinguished from the American form. At any rate we have a specimen from a bed of nearly black limestone, far down in the Coal-measures at Leavenworth, Kansas, agreeing even more nearly with *P. speluncaria* than *P. Hawni* does. Similar forms occur at different horizons in the Coal-measures and Permo-carboniferous beds in Kansas, and have been found in the Upper Coal-measures of Iowa, by Dr. White.

Avicula pinnæformis Geinitz, ib., fig. 13. From specimens of this shell shown to me by Dr. White from the same horizon in Iowa, I am sure it is specifically distinct from the so-called *A. pinnæformis*, and there can be little doubt that it even belongs to the distinct genus *Pinna*.

Gervillia parva M. & H. Geinitz, ib., 14. This differs from the *Bakevillia parva* M. & H. in having a broad shallow depression extending to the anterior basal margin from the umbonal region, farther back than that defining the anterior ear from the

* The species *Hawni*, will have to take the name *Pseudomonotis Hawni*, and the Illinois shell, supposed to be a variety of the same but probably distinct, may be called *P. sinuata*. (See Ill. Geol. Report, ii, pl. 27, fig. 12-13.)

swell of the umbo in *B. parva*. It is an interesting fact, however, that there is a little shell, of which we have specimens for comparison, in the Nova Scotia beds, referred by the highest authorities to the Sub-carboniferous, agreeing with it in this character as well as apparently exactly in all other respects.

Gervillia longa Geinitz, ib., ii, fig. 15. A good species, but its position in the genus *Gervillia* is very doubtful. It occurs in Iowa, in a bed referred by Dr. White to the upper part of the Lower Coal-measures, with other fossils of that horizon.

G. (Avicula) sulcata Geinitz, ib., fig. 16. Also a good species.

Pecten neglectus Geinitz, ib., fig. 17. Appears to be a good species, but should be called *Aviculopecten neglectus*.

Pecten Missouriensis? Shumard. Geinitz, ib., fig. 18. This is certainly not the *Aviculopecten Missouriensis* of Shumard, which is not known from any horizon above the St. Louis limestone of the Sub-carboniferous series. It is the shell called *P. occidentalis* by Dr. Shumard, and afterward named *P. Cleave-landicus* by Prof. Swallow. It is one of the most widely distributed of our Coal-measure shells throughout the West, and ranges up through the Permo-carboniferous beds into the Permian of Kansas. No form nearly allied to it has ever been found in the western Sub-carboniferous rocks, but specimens now before me from rocks in Nova Scotia, so referred by the most reliable authorities, seem to be undistinguishable from it.

Pecten Hawni Geinitz, ib., fig. 19. This seems to be quite similar to *Pecten Broadheadii* of Swallow, described from the Missouri Coal-measures. If distinct from that species it should be called *Aviculopecten Hawni*, unless it may possess internal characters showing it to be the type of an undescribed genus. Dr. White finds it in the upper beds of the Lower Coal-measures of central Iowa.

Rhynchonella angulata Linn. Geinitz, ib., tab. iii, fig. 1-4. As it has already been shown that the shell figured under this name is not a *Rhynchonella* at all, little need be said in regard to its specific relations to the European true *Rhynchonella angulata*. I hope, however, that I shall be excused for adding here, that the practice of positively identifying species from widely distant parts of the earth upon such merely superficial points of general resemblance, and thus complicating and vitiating all conclusions respecting the geographical and geological range of species, cannot be too carefully avoided.

Camarophoria globulina Phillips. Geinitz, ib., fig. 5. Of this shell I have numerous examples from the same position, as well as from other horizons of the Upper Coal-measures of Missouri, Kansas, Nebraska and Iowa. It has generally been referred to *Rhynchonella Uta* of Marcou, who has himself identified it with that species. On comparison with authentic European examples

of *Camarophoria globulina* of Phillips, it is found to be very similar in external characters, but there is an insurmountable difficulty in the way of referring it to that species,—that is, because sections across the beaks, as well as internal casts, show it to be a true *Rhynchonella*?

Retzia Mormonii Marcou (sp.). Geinitz, ib., fig. 6. This is the species described by Dr. Shumard from the Coal-measures as *R. punctulifera*, and his name probably has priority. It is a very common Coal-measure and Permo-carboniferous form in the west. Prof. Marcou mentions finding it at Nebraska City associated in bed C of his section with the other species referred by him and Prof. Geinitz to the Dyas;* though Prof. Geinitz does not mention it among the Dyas fossils at all, but refers it to the Carboniferous, giving Plattsmouth as the locality. Prof. Geinitz makes the California *R. compressa* a synonym of this, but the reasons for doing so are not very apparent, the two shells being quite different; he might with more propriety make the *R. Mormonii* a synonym of the European species *R. radialis* Phillips.

Athyris subtilita Hall, a form generally referred to *A. plano-sulcata* Phillips, *Spirifer planoconvexus* Shumard, *S. cameratus* Morton, and *Streptorhynchus crenistria* (properly *Hemipronites crenistria*), the so-called *Orthisina Missouriana*, figured or mentioned by Prof. Geinitz from beds he refers in part to the Dyas, and in part to the Carboniferous, all occur together, with the *Rhynchonella Uta*, *Retzia Mormonii*, and all of the *Producti* mentioned by him, as well as *Fusulina cylindrica*, in the same or alternating beds of the Coal-measures and Permo-carboniferous beds in Kansas, while *Athyris subtilita* ranges up into the highest beds containing Permian types.

Prof. Geinitz makes Mr. Davidson's East Indian *Spirifer Moosakhaliensis* a synonym of *S. cameratus* Morton. In this, however, he is certainly mistaken. Out of all the thousands of specimens of *S. cameratus* found in our western Coal-measure and Permo-carboniferous rocks, not one shows the distinct regular concentric lamellæ seen on that species, while there are other differences not to be overlooked.

Spirifer laminosus McCoy. Geinitz, ib., fig. 19. This is positively not *S. laminosus* McCoy, but merely a variety of *Spiriferina Kentucensis*, of Shumard. It agrees with *S. laminosus* in no specific character excepting the possession of regular laminæ of growth, *S. laminosus* having a high flat area like a *Cyrtia* (to which group Prof. McCoy referred it), and a broad rounded mesial fold and sinus without longitudinal plications. One of McCoy's figures of a distorted specimen seems to show a plication in the sinus, but it is only necessary to consult Mr. Davidson's excel-

* See Bull. Soc. Geol. France, t. xxi, p. 137, 1864.

lent figures and description of this species in his Monograph of the British Carboniferous Brachiopoda, or Prof. McCoy's description in his British Paleozoic fossils, to be convinced that the two shells are totally distinct. Indeed they probably belong to distinct subgenera or genera, as the *S. Kentuckensis* seems to be punctate like *Spiriferina*.

He is probably right in making Prof. Swallow's so-called *Orthisina Missouriana* a synonym of *Plicatula striato-costata* Cox, which I had done some years since. Dr. White and Mr. St. John, however, have ascertained that it possesses some very extraordinary internal characters, showing it to be typical of a new genus. Although this shell closely resembles Mr. Davidson's East Indian *Streptorhynchus pectinifera*, with which Prof. Geinitz thinks it identical, they must be specifically distinct, if Mr. Davidson's figure represents the striæ correctly as running parallel to the plications to the front margin, instead of converging toward the top of the plications near the front.

If Prof. Geinitz is correct in identifying the shell he refers, without figure or description, to *Productus horrescens* with *P. Rogersii*, it is the same described by Dr. Owen under the name *P. Nebrascensis*. Dr. Owen's figure gives a very incorrect idea of this shell, and would never be recognized as even representing an allied form, but the locality from which he obtained his specimens and his comparisons with *P. Humboldtii* d'Orbigny, led to the belief that his type was the same as the *Rogersii*. In order to settle this question I borrowed Dr. Owen's typical specimens, labelled by himself, from his brother, Prof. Richard Owen, and found it to be the common Coal-measure shell generally known in the west as *P. Rogersii*. Out of thousands of specimens of this species, showing the hinge and interior of both valves, examined under all conditions and of all ages, not one has ever been seen showing any traces whatever of the cardinal area and hinge-teeth of *Strophalosia*. In short it is a true *Productus* closely allied to *P. scabriculus*.

Productus cora, *P. semireticulatus*, *P. costatus*, *P. punctatus*, &c., mentioned but not figured by Prof. Geinitz, are doubtless the same Coal-measure forms usually so referred in the west, and ranging in part up into the Permo-carboniferous. That he figures under the name *P. Flemingii*, is the same Coal-measure and Permo-carboniferous shell described by Dr. Norwood as *P. Prattenianus* (as indicated by Prof. Geinitz), which is also closely allied to *P. æquicostatus* Shumard, though it is certainly not the *P. Calhounianus* Swallow, nor *P. Flemingii*, as Prof. G. thinks. The other shell he figures under the name *P. Koninckianus* de Verneuil, looks exceedingly unlike the figures of the type of that species, being more probably only a larger individual of the same he figures as *P. Flemingii*.

Productus Cancrini de Vern. Geinitz, ib., iv, fig. 6. Whatever relations the shell here figured bears to German specimens identified with *P. Cancrini*, it certainly differs from the original Russian type of that species, both in its proportions and in the prominence of its beak. At any rate I know it to range far down in the Coal-measure rocks of Kansas, below the horizon of the beds referred by Marcou and Prof. Geinitz to the Mountain limestone.

Productus Orbignianus de Koninck. Geinitz, ib., figs. 8 to 11. Prof. Geinitz seems to be right in regarding this form as the same as *P. splendens* and *P. Wabashensis* N. & P. But Mr. Davidson, however, who ought to know, refers both of these, from specimens sent him from the typical localities, to the Carboniferous species *P. longispinus* Sowerby. The shell figured by Prof. Geinitz is widely distributed and very abundant in our Coal-measures, and in Kansas ranges up into the Permo-carboniferous.

Productus horridus Sow. Geinitz, ib., fig. 7. There is no room whatever, to doubt but this is a young individual of the last mentioned species. That shell varies much in the distinctness of its costæ, which are sometimes almost entirely obsolete on even adult shells, and in young examples like this they are often not indicated at all, as may be seen by examining the the umbo of mature specimens. If *P. horridus* was known to occur in these rocks, it might be thought *possible* that this might be its young, but under existing circumstances, (that species being unknown in America), it would certainly require a considerable stretch of imagination, to see in this little shell a species which at maturity attains nearly one hundred times its size.*

Chonetes mucronata M. & W. Geinitz, ib., tab. iv, figs. 12, 14. This is correctly identified; and his *C. glabra* (ib., figs. 15 to 18) seems to be a good species. Both of these species, however, range far below this horizon in Kansas and Nebraska, even below the horizon of the beds referred by Professors Marcou and Geinitz to the Subcarboniferous.

Cyathocrinus ramosus Schlot. Geinitz, ib., fig. 19. Is from a European specimen, and given for comparison with the next, to which, however, it has no near relations. *C. ramosus* has not yet been found in any of our rocks.

Cyathocrinus inflexus Geinitz, ib., fig. 20. This species was long since described by Dr. Shumard from the Coal-measures of Missouri, under the name *Poteriocrinus hemisphericus* (Acad. Sci. St. Louis, i, p. 221). It is widely distributed in the western Coal-measures. Several specimens of it are in the Illinois collection from different localities in that state; and it is now known

* Since this was written, I have had an opportunity to examine extensive collections obtained by the Nebraska geological survey in charge of Dr. Hayden, at Nebraska City and all the surrounding country, and can assert *positively* that the little shell here figured is the young of that referred by Prof. Geinitz to *P. Orbignianus*.

to occur at Omaha, in the beds referred by Prof. Marcou to the Mountain limestone. The separate crinoid plate (fig. 27) given by Prof. Geinitz on the same plate, is a first radial piece of the same species as the above, or of *Erisocrinus*, it being impossible to distinguish this part of these *Crinoids* when found detached. The fig. 28 of same plate, evidently represents the subradial piece of the *C. hemisphericus* from the anal side, being truncated above for the reception of the first anal piece and strongly incurved below. The columns figured on this plate as *Actinocrinus*? probably belong to the same crinoid, or to *Zeacrinus mucrospinus* McChesney, the spines of which are figured there erroneously as those of an *Actinocrinus*. As already stated, no *Actinocrinus* has yet been found in this country above the St. Louis Limestone.

Eocidaris Hallianus Geinitz, ib., tab. v, fig. 1, is probably a good species, and correctly referred. The corals figured on the same plate and referred to *Cyathaxonia*, are very like Coal-measure species of the West. One of them may be the same described by McChesney from the Coal-measures of Illinois under the name *C. prolifera*. The *Fusulina* figured on the same plate as *F. cylindrica* and *F. depressa*, range through our whole Coal-measures, of Iowa, Missouri, Kansas and Nebraska, and far up into the Permo-carboniferous of Kansas.*

As the so-called *Fenestella elegantissima* Eich., *F. plebeja* McCoy, *F. virgosa* Eich., and *Polypora papillata* McCoy, figured on plate v, are all identified from fragments showing but the non-poriferous side, such identifications are of course not to be relied upon in determining the age of rocks.

Polypora marginata McCoy. Geinitz, ib., fig. 11. The poriferous surface of this looks very unlike McCoy's species.

Polypora biarmica von Keyserling. Geinitz, ib., fig. 13. If the figures of this, and the form described by Count Keyserling are even nearly correct, they are clearly distinct.

Synocladia virgulacea Phillips. Geinitz, ib., 14. Prof. Geinitz has correctly identified this with the type for which Prof. Swallow proposed the name *S. biserialis*. It differs, however, clearly from the *S. virgulacea*, in having a row of little short spines (not mere granules) along the middle of each longitudinal branch, between the two rows of pores, and particularly in having but two rows of pores, instead of from three to five. Prof. Geinitz's figure shows the nonporiferous side, but his artist (who deserves great credit for his accuracy) has well represented the impressions of the row of little spines along the middle of the poriferous side, in impressions left in the matrix.

(To be continued.)

* Since this was written, I have this fossil in abundance, and many of our other common Coal-measure forms, from Nebraska City, obtained above the horizon of the very beds from which the so-called Dyassic fossils were obtained.