[Annals N. Y. Acad. Sci., Vol. XXI, pp. 119–156. 26 August, 1911.]

ON SOME NEW GENERA AND SPECIES OF PENNSYLVANIAN FOSSILS FROM THE WEWOKA FORMATION OF OKLAHOMA[1]

By George H. Girty

CONTENTS

Introduction

Geographically the Wewoka formation is typically exposed in the northwestern portion of the Coalgate and the southwestern portion of the Wewoka quadrangles of Oklahoma. Lithologically it consists of alternating bands of sandstone and shale,—four sandstone and three shale members—and it has a thickness of about 700 feet.[2] Geologically the Wewoka formation is part of the Pennsylvanian series and in the Oklahoma section lies above a considerable thickness of Pennsylvanian rocks, but it probably correlates with the lower portion of the Pennsylvanian section of Kansas.

The fauna of the Wewoka formation, so far as known, occurs in the two lower shales, from which the fossils weather free and for the most part in an unusually perfect condition of preservation. The fauna is highly differentiated, comprising not less than 148 species, and it is not

[1] Published by permission of the Director of the United States Geological Survey.
[2] U. S. Geol. Survey, Geol. Atlas, Folio 74. 1901.

confined chiefly to the brachiopoda like so many Carboniferous faunas, but presents all the zoölogical groups in just proportion. The greater part of the fauna, as one would expect, consists of species already in the literature, but a considerable number of new forms, both genera and species, have been obtained. These are described below, but a report containing descriptions and figures of the entire fauna has been completed and submitted for publication as a bulletin of the United States Geological Survey.

Descriptions of Genera and Species

Protozoa

Fusulina inconspicua sp. nov.

Shell small, sub-cylindrical to somewhat fusiform. The average length is perhaps 3 mm., with a diameter of about 1 mm., but specimens 3.5 mm. long are not uncommon. A few have a length of 4 mm., while one example provisionally referred to this species is nearly 5 mm. long and 1.5 mm. in thickness. Different specimens vary appreciably in proportions, some being slender and others more robust. As is common in this genus, young specimens are relatively more slender than mature ones. For the most part, this species is of very regular growth with a sub-cylindrical shape abruptly rounded at the ends. Some specimens taper more distinctly than others. In general, this appears to be an immature character, appearing in young shells more than in mature ones and being retained to a later stage in some than in others.

Initial cell rather large, about .1 mm. in diameter. The largest measured had a diameter of .11 mm., others .099 mm., still others .084 mm., and others even smaller. It seems reasonable to infer that the initial cell varies in size in different specimens, but that the smaller measurements are in many cases due to the section not passing through its center. The walls are thin, the septa and outer wall being nearly equal in thickness. The specimens studied do not show the minute structure. In mature specimens (1 mm. in diameter) five or even six revolutions of the outer wall can be counted in addition to the initial cell. In a mature specimen (1 mm. in diameter) some 23 septa occur in the outer volution, and this appears to be about normal. The specimens examined may not show this character with accuracy, but the sutures or superficial lines formed by the septa are indistinct and not depressed. They are straight or nearly straight at the surface, but a little below, the septa appear to become strongly plicated.

Height of final chamber about .07 mm. or .08 mm.; thickness of the outer wall about one third to one fourth as much, or .028 mm. to .02 mm.

This diminutive species, which occurs in great numbers at the one horizon in the Wewoka formation where it is found at all, is readily distinguished from all other American species thus far known, by its much

smaller size, and from some of them by its elongated and cylindrical instead of fusiform shape. In size, it resembles the European *F. minima*,[3] but is somewhat larger, more slender in shape, and less fusiform. The shape is suggestive of *F. lutugini* Schellwien[4] and *F. longissima* Möller,[5] but the size is very much smaller.

Horizon and locality: Wewoka formation: Coalgate quadrangle, Okla.

Spongiæ

Wewokella gen. nov.

The general shape of the present form is that of a cylinder with a large tubular cloaca. No dermal layer has been observed. The walls are rigid and made up of large spicules interlaced with one another. The typical spicular element appears to be the tetraxon, but many spicules do not show this shape and appear to be elongated, irregularly branched and more or less contorted. In general, however, the trend of the spicules is longitudinal.

The form for which this title is introduced is rare in the Wewoka formation, only two specimens having come to hand. They might perhaps be referred to the genus *Doryderma*, were it not for the fact that they indicate a form which has a large central cloaca instead of a number of axial canals, and in which the radial canals of *Doryderma* are also apparently wanting. The general relationships of the type are nevertheless supposed to be with that genus, which has also been cited from Carboniferous strata.

Type species, *Wewokella solida*.

Wewokella solida sp. nov.

Sponge body irregularly cylindrical, attaining a diameter of at least 25 mm. Center occupied by a large tubular cloaca, the walls being about 7 mm. thick and showing no evidence of being pierced by radial canals. If a dermal layer was originally present, it has been lost. The walls now are made up of large spicules, of which the typical shape is probably 4 rayed with one of the rays more or less elongated. At the same time, some of the rays may be aborted so that many of the spicules seem to be irregularly branched. They are so interwoven as to make up a wall of considerable rigidity, to aid in which the spicules may be partly cemented, although it is doubtful if they anastomose. The structure, then, while very varied in detail makes on the whole a homogeneous wall which apparently is the same on the inside as on the out. Among the large spicules are other tetraxons of conspicuously smaller size.

Horizon and locality: Wewoka formation: Coalgate quadrangle, Okla.

[3] Paleontographica, vol. 55, p. 167, pl. 13, fig. 23. 1908.
[4] *Idem*, p. 177, pl. 17, figs. 2, 3, 7, 8, 12-14.
[5] *Idem*, p. 163, pl. 13, figs. 14-20.

Cœlenterata

Lophophyllum profundum var. radicosum var. nov.

Associated with individuals having the character of *Lophophyllum profundum*, occur other specimens which differ strikingly in the profuse development of hollow, spiniform stolons. Correlated with this character are usually a more rapid expansion, a more irregular growth, a rather straighter shape and the possession of a thinner, more knife-like pseudo-columella. The stolons which are usually broken off close to the epitheca, disclosing their tubular structure, are especially developed in the lower portion of the corallum. It seems doubtful whether these structures served primarily for support, since they are found in specimens having an unusually broad and secure attachment and are absent from others in which the point of attachment is small, and the anchorage apparently insecure.

The stolons vary from large and very abundant to small and reduced to only one or two in number. In this way, a gradual transition is effected between the two forms which in their extreme expressions look very much unlike each other, while among intermediate and less strongly characterized specimens, a dividing line can hardly be drawn. The forms with more or less straight, irregular, rapidly expanding coralla graduate on the one hand into those with very abundant stolons, and on the other into the narrow, more or less curved, regular coralla of typical *profundum*. It seems to be true, however, that the narrow, regular growths seldom exhibit any development of the root-like process.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Coalgate quadrangle, Okla.

Echinodermata

Hydreionocrinus patulus sp. nov.

This species is based on a somewhat imperfect calyx which is distinguished by its low convexity. The median portion of the under side is strongly concave and the height of the whole is but little greater than the thickness of the plates. These peculiarities may, however, be somewhat enhanced by compression.

The general shape is pentagonal, with angular notches at the corners and a wider irregularity at the azygous angle. The plates themselves are thick and they are highly tumid on the outer side. They tend to recurve near the margins so that the sutures are not as depressed as the general curvature of the surface, if continued to the edges, would make them. The plates near their margins tend to be rather regularly and finely crenulated and the infra-basals and adjacent portions of the basals are finely granulose. Unless lost through erosion, these markings do not extend to the other plates.

The infrabasals form a small pentagon of which the radius of the scar of the stem occupies half the distance from the center to the side. The scar is

small, crenulated about the circumference, and with a diminutive round axial canal. The basals are irregularly hexagonal, shaped more like a triangle with its basal angles truncated. That to the right of the azygous plates is slightly larger than the others and not symmetrical.

The radials are seven-sided, twice as wide as high, the base of the heptagon being uppermost and very long. The two apical sides are also long and somewhat concave, while the two lateral sides are short. The two plates near the azygous group are unsymmetrical, and have the apical sides of unequal length. Just below the upper margin of each of the radials occurs a short slit-like excavation. Above this on the broad upper side of the plate, there is a triangular depression defined by two elevations or ridges which also bend outward and extend along the outer margin of the upper surface. A somewhat similar triangular excavation marks the inner side of the upper edge of the thick plate.

The azygous basal is subquadrate, much longer than wide, in reality being 7-sided with a relatively broad base. The sides are formed by a broken line of which the lower portion is much shorter than the upper. The upper side is also made by a broken line, the dextral part of which is long and oblique and the sinistral short, merely truncating the angle which the other would otherwise make with the left side. This plate is therefore bounded below by the infrabasal, on the right and left sides by the basal and the radial, and on the upper side by the two other azygous plates. The second and third azygous plates are missing from the specimen, as are also the brachials.

Hydreionocrinus patulus resembles *H. discoidalis* and *H. crassidiscus*. From the former it may be distinguished by its larger size, more convex plates, granulose surface and by the shape and arrangement of the azygous plates. The azygous basal in the present species is differently shaped, so that it is in contact at the right with the radial, thus separating the second azygous plate from the adjacent basal on that side.

The relationship with *crassidiscus* is rather more close. The basals ("subradials") are however described as all hexagonal, while here they are five-sided, except the azygous one, which is seven-sided. The azygous basal does not in *crassidiscus* reach the second basal "as is usual in this genus." Furthermore, in the present species, the second azygous plate intervenes between the first and the radial to the right.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Okla.

Annelida

Enchostoma serpuliforme sp. nov.

Attached to a large undetermined Orthoceras are some slender tubular organisms seeming to belong to the genus *Enchostoma*. One, from which the present description is drawn, has a diameter of 1 mm. or less and winds about on the Orthoceras to a length of almost 140 mm., without appreciably

increasing its diameter. Neither the initial point nor the true aperture appears to be shown. The cross-section must have been nearly circular. The shell substance, when preserved, is lamellose, phosphatic, of a light bluish color and in places distinctly nacreous. For the most part, however, the shell appears to be missing and only the muddy infilling of the tube remains, of a rusty color and partly with a dark limonitic coating. Where the entire organism is removed, its place is represented by a groove. As the original test of the Orthoceras is now absent, this impression naturally occurs on the mold of the inside and the explanation of the phenomenon is difficult. I think we can not assume that the organism was originally attached to the inside of the Orthoceras, because of the septa. It may, however, have been attached to the outside or have been partly imbedded in the shell, through the gradual solution of which these external bodies, insoluble under prevailing conditions, were brought into contact with the mud which filled the interior. This hypothesis, however, is unsatisfactory, because the specimen is not bent but broken by the compression which it has suffered, showing a rigid condition at the time the force was applied.

The shape and phosphatic appearance of this organism are characteristic of *Enchostoma*, but such Enchostomas as I have heretofore seen are free and of larger size. The small size, sessile condition, and probably false appearance of having been partly imbedded in the shell of its host, are very suggestive of the organism which I have here called *Serpulopsis insita*, but none of the specimens of *Serpulopsis* shows any evidence of having had a phosphatic shell. They are also small and very much shorter. The true relationship of this form and its position in the animal kingdom remain problems as yet unsolved.

Horizon and locality Wewoka formation, Wewoka quadrangle, Okla.

Serpulopsis gen. nov.

This name is introduced for some small tubular organisms which enlarge very gradually and are frequently much contorted during part of their growth. They have the habit of attachment to other organisms and are more or less imbedded in the shell of their host. They always keep near the surface, but are perhaps as seldom completely superficial as they are completely imbedded.

I can scarcely doubt that the fossils on which this genus is founded belong to White's *Serpula insita*, which, consequently, is taken as the type.

Serpulopsis is distinguished from *Serpula* by its burrowing habit, which is in fact abnormal for the annelids. Even if the excavations alone and not the tubes which ordinarily occupy them were known, it would be impossible to refer these structures to the boring sponges which they somewhat suggest, because of their strictly superficial, linear and not inosculating character. In some respects, they suggest *Rhopalonaria* among the Bryozoa, but, while specimens frequently occur together in considerable numbers, they appear to form groups of independent indi-

viduals and not colonies, nor is there any evidence that the individual tubes were composite. On the whole, therefore, it seems more probable that this fossil was an abnormal type of annelid.

Type species, *Serpulopsis insita.*

Conularia crustula var. **holdenvillæ** var. nov.

A few specimens from the Wewoka agreeing in a general way with *C. crustula* differ in having the sculpture on a much finer scale. Unlike typical *crustula* also, these specimens are more or less compressed and distorted, the other form which aparently had an unusually thick rigid test not having suffered much in that way. About 25 costæ occur in a linear distance of 5 mm., and thus they are much more closely arranged than in the typical form.

Among the specimens examined this variety is readily distinguished by its sculpture, the difference being so marked that it seems desirable to discriminate it as a new variety if not as a new species. It may possibly be a young stage of *C. ræperi*, the only other Pennsylvanian *Conularia* which has been described, although this form tapers more rapidly than *C. ræperi*, which has nearly parallel sides.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Coalgate quadrangle, Okla.

Brachiopoda

Rœmerella patula sp. nov.

Shell rather small for the genus, rarely exceeding 18 mm. in diameter, though in one instance reaching nearly 30 mm. Shape slightly oval in some specimens, apparently circular in others.

Convexity of dorsal valve low, regular. Apex small, slightly though conspicuously eccentric, situated about two thirds of a radius from the posterior margin. Outline from the apex to the front slightly curved, so that the shape is not truly conical, being somewhat inflated in the apical portion.

Curvature of the ventral valve usually compound, more or less strongly convex over the posterior portion and more or less strongly concave at the front and sides. The prominent portion projects above the reflexed rim. The point of highest convexity is usually well marked and is situated diametrically opposite to that of the dorsal valve, or about two thirds of a radius forward from the posterior margin. On the slope posterior to the point of greatest elevation the pedicle fissure is situated. It is a conspicuous feature, rather long and narrow, with strongly introverted sides. It extends in mature shells from the point of greatest elevation half way to the posterior margin and is surrounded without interruptions by the characteristic sculpture.

The sculpture, as usual, consists of narrow, sharply raised concentric liræ with considerably wider, flattened interspaces, which are also finely striated. The liræ are somewhat irregular and are probably stronger and more persist-

ent on the ventral than on the dorsal valve, on which they are often evanescent about the margins for a greater or less distance. They vary considerably in different specimens, being more closely arranged in some than in others, occurring from nine to eleven in 3 mm. They also vary on the same specimen in proportion to their distance from the apex, and are more crowded on the posterior than on the anterior side; consequently, the measurement given above is a relative one, representing the condition toward the front in well-grown specimens. Exfoliation obliterates much of the concentric marking and instead often brings to view fine radial lines and striæ, probably due to setæ which projected from the margin of the shell.

On the interior, the dorsal valve has a short septum passing longitudinally through the apex, and extending farther on the anterior than the posterior side of it. There are also two symmetrical ridges, straight, parallel and close together for some distance anterior to the apex, rapidly diverging and somewhat curved near it, so as partly to surround it. Between the straight extended anterior portion of these arms there is a medium groove which extends backward and graduates into the septum, which has depressed sides. The curved arm-like markings probably represent the boundary of a line of muscular attachment. In one specimen these lines are, near the apex, distinctly expanded into oval areas, one on each side, each of which is separated by an oblique line of division into two scars. These areas, without much question, are the loci of pairs of muscles.

The internal markings of the dorsal valve described above are conspicuous on most of the specimens examined, which are usually preserved as internal molds. They vary in detail in different examples. This peculiar structure seems to be identical with that upon which Hall and Clarke based the subgenus *Rœmerella*, and while there may be a little doubt as to whether it is really of subgeneric value, it will, together with the configuration, readily distinguish this form from other Pennsylvanian discinoids. Some specimens, especially if incompletely exfoliated, fail to show this structure, however.

Rœmerella patula is rather abundant in the Wewoka formation and usually occurs as dissociated valves in small concretions. Occasionally, however, the two valves are found in conjunction, though usually more or less displaced.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Coalgate quadrangle, Okla.

Streptorhynchus oklahomæ sp. nov.

There are in the Wewoka collection two specimens which appear to belong to the genus *Streptorhynchus*. They are preserved as internal molds and show dental callosities in the ventral valve without any trace of a septum. In the dorsal valve, the socket plates are fairly well developed and one specimen has a low dorsal septum. In point of convexity the dorsal valve is only gently

convex, the ventral rather high and more or less contorted. The shell contracts at the hinge, the area being moderately high and strongly inclined backward. The sculpture consists of fine, regular, subequal liræ (in one specimen more or less distinctly alternating). In the type specimen the liræ are equal over the median portion and separated by intervals slightly greater than their own width. Here they occur ten in 5 mm. Toward the sides they are rather more distantly spaced and are alternating.

The rarity of this genus in our Pennsylvanian rocks constitutes an *a priori* argument against these specimens belonging to *Streptorhynchus*. On the other hand, it is difficult to understand how the process of fossilization, while permitting the dental callosities to be preserved, could obliterate all trace of the septum.

Horizon and locality: Wewoka formation; Coalgate quadrangle, Okla.

Chonetes granulifer var. **armatus** var. nov.

The fossils included under this title occur associated with *C. mesolobus* var. *decipiens*, and with the more closely related *C. granulifer*. They are of small size, 15 mm. being the maximum width observed, of moderate convexity where not compressed, subquadrate shape, rather prominent beak, and faint though distinct insinuation. About seven cardinal spines occur on each side of the beak.

The surface is marked by obsolescent liræ and by numerous small though prominent spines.

This variety is distinguished from *C. granulifer* by the smaller and less projecting beak, the nearly obsolete liration, and the number and prominence of the spines, although the latter character may be to some extent the result of preservation. With the evidence at hand, however, I would not feel justified in regarding these shells as true representatives of *C. granulifer*.

Horizon and locality: Wewoka formation; Coalgate quadrangle, Okla.

Chonetes mesolobus var. **decipiens** var. nov.

1899. *Chonetes mesolobus*. GIRTY, U. S. Geol. Survey, Nineteenth Ann. Rept., pt. 3, p. 576.
Upper Coal Measures: Atoka quadrangle, Oklahoma.

1903. *Chonetes mesolobus*. GIRTY, U. S. Geol. Surv., Prof. Paper 16, p. 357, pl. 1, figs. 20–23.
Hermosa formation: San Juan region, Colo.
Rico formation: San Juan region, Colo.
Maroon formation: Crested Butte district, Colo.
Carboniferous: Grand River region, Colo.

This form differs from typical *C. mesolobus* in having a smooth instead of striated surface. Though I was at first disposed to describe it as a new species

rather than a new variety, the lower taxonomic rank is probably more in accordance with the facts.

The peculiar configuration of *C. mesolobus* is known to everyone. The typical form is described as possessing fine, radiating striæ. Some well-preserved specimens from Ohio show this feature very clearly. The liræ are fine and moderately strong and they give rise to a large number of minute spines, a feature not mentioned by Norwood and Pratten, though it is perhaps represented by one of their figures. Mr. Beede[6] also appears to record it when he describes the surface as "coarsely punctate." He may, however, be referring to another and an altogether different feature, to more numerous perforations, which occur between the liræ instead of on them and which project as rows of spinules or pustules on the inside of the shell. These are best shown on exfoliated specimens or internal molds. The external feature to which I refer above has, also, when the shell is worn, the appearance of punctæ, but when better preserved, the punctæ show projecting edges as of downward pointing spines, very similar to the minute spines which are found on many orthoids.

The variety which is the subject of this account has the characteristic configuration of *C. mesolobus*, but the surface is entirely without radiating sculpture, marked only on the best specimens by fine growth lines. The absence of radial striation is not due to erosion or any circumstance of fossilization, for it is a persistent feature shown by an extensive series of specimens from many localities. Furthermore, the radial markings could hardly have been lost, when the more delicate growth lines had been retained.

In characteristic specimens, this difference is so strongly marked that one would be led to refer the two forms to altogether different groups, and as already noted, I was at first disposed to regard them as distinct species. When large series of specimens from different horizons are examined, however, individuals more or less intermediate in character are found. That is, associated with the smooth variety are occasional shells which show faint yet unmistakable traces of radial sculpture. Such specimens must be carefully examined, however, to determine whether this character is not adventitious, for under exfoliation the rows of internal spinules which have oblique pores connecting with them form little grooves and produce fine, more or less regular radiating markings.

The shells belonging to the smooth variety rarely show traces of the spines found on the other. Except for occasional incremental lines the surface usually appears to be quite featureless.

[6] University Geol. Surv. of Kansas, Rept., vol. VI, p. 71. 1900.

C. mesolobus var. *decipiens* is very abundant in the Wewoka formation. It is also abundant in some of the earlier Pennsylvanian deposits of the Kansas section at about the horizon of the Parsons formation.

In the literature, no citation can definitely be included in the synonymy except my own identifications of specimens obtained in Oklahoma and in Colorado. I remarked in that connection that the Colorado specimens were characteristic in every way, but I had for comparison not typical, striated *C. mesolobus,* but specimens of the present variety.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Coalgate quadrangle, Okla.

Chonetes mesolobus var. **euampygus** var. nov.

Considerable variation is shown by shells of the *mesolobus* group in the strength with which the characteristic lobation is developed. In some of the larger individuals especially, it can hardly be distinguished at all, and when, as is usually (?) the case, such specimens belong to the smooth or *decipiens* type, they simulate *C. geinitzianus* very closely. It is at least possible that *C. geinitzianus* may have had this derivation, though one would have said *a priori* that such phylogeny was of all the least probable.

It is probably true as a general statement, though not without exceptions, that the strength of the lobation varies inversely as the size of the individual. There is at all events a group of shells which stand out strongly and distinctly by reason of their small size and deep lobation. That they are mature shells is indicated by their strong convexity and by the fact that young individuals of the larger form would be more faintly lobed. Though they intergrade with the larger, less strongly lobate shells through larger examples which have an almost equal strength of lobation, they form a distinct, and as a rule an easily discriminated group which sometimes occurs alone to the exclusion of the typical variety. In sculpture, these shells seem to be allied to the variety *decipiens.* They are usually unstriated, but show traces of striæ more frequently than *decipiens.* Seldom, if ever, is the striation as strong as in well-characterized specimens of *C. mesolobus* s. s.

None of the specimens referred here exceeds 10 mm. in width, and the average is nearer 7 mm.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Coalgate quadrangle, Okla.

Productus insinuatus sp. nov.

1892. *Productus æquicostatus.* HALL and CLARKE, Geol. Surv. New York, Pal., vol. 8, pt. 1, pl. 17 A, figs. 22, 23.
Coal Measures: Nebraska.

1892. *Productus æquicostatus.* HALL and CLARKE, State Geologist New York, Eleventh Ann. Rept., for 1891, pl. 22, figs. 11, 12.
Coal Measures: Nebraska.

1894. *Productus æquicostatus.?* HALL and CLARKE, "Introduction to Study of Brachiopoda," pt. 1, pl. 22, figs. 11, 12.
Coal Measures: Nebraska.

1900. *Productus cora* var. *americanus.* BEEDE, Univ. Geol. Surv. Kansas, Rept., vol. 6, p. 77, pl. 11, fig. 2.
Upper and Lower Coal Measures: Kansas City, Eudora, Anderson Co., Kansas.

1906. *Productus cora* var. *americanus.* WOODRUFF, Nebraska Geol. Surv., Rept., vol. 2, pt. 2, p. 270, pl. 11, fig. 2.
Carboniferous: Louisville, Nebraska.

Shell of the *cora* type, rather large, widest at the hinge, more or less strongly transverse. In the immature condition, this form closely resembles *P. cora* itself, being strongly convex and more nearly quadrate. In the later stages, the growth is more spreading, especially at the sides, and the margins are flatter. Two varieties can be distinguished, one which is narrow and more highly arched and the other transverse and less convex. In the mature condition, also, the ventral valve becomes elevated and angular along the median line. Correlated with this character is an inflection of the anterior margin making a deep sinus in the outline. A sinus or depression in the shell itself is naturally absent.

The surface is marked by fine, even, rigid, rounded costæ having the peculiarities of those of *P. cora*. As in that species, the costæ bifurcate freely and sometimes this takes place simultaneously all around a shell, so that for a time the striation is much finer about its margin than over the earlier portion. In connection with the carina, the costæ in the immediate neighborhood frequently bend inward toward the median line which in some cases appears to have been without costæ. A few large plications are found at the sides near the hinge, but they seldom pass entirely across the shell. They are apt to be more persistent on the dorsal valve, however, than on the ventral. Spines are scattered over the surface of the ventral valve, but they are usually small, not causing nodes on the costæ, and they are liable to be overlooked when broken off. They appear to be few in number. A row of larger ones is developed along the cardinal line.

As the synonymy shows, this species has several times appeared in the literature under the title of *Productus æquicostatus*, but a careful reading of Shumard's description leaves little doubt that *P. æquicostatus* was a different species and one more closely similar to *P. cora* itself.

Horizon and locality: Found in the Wewoka formation, but the type specimens are from Kansas.

Pugnax osagensis var. **percostata** var. nov.

This form is more abundant in the Wewoka formation than the typical variety. In a general way, the specimens referred here agree with *P. osagensis*, the only difference or importance being the more numerous plications which are also smaller and more angular. Of these there are usually five fairly

strong on each side, but there may be four or six. Three is the usual number for the fold, but four and even five occur in rare instances. Individuals with three mesial plications and four laterals, especially when one or two of the latter are immature or imperfectly developed, might equally well be placed under *P. osagensis* itself. Apparently this variety has been referred by authors to *osagensis* unqualifiedly, but I believe it can be distinguished to advantage.

This form resembles *P. osagensis* var. *occidentalis*, which is, however, a much larger species, with on the whole, more numerous mesial plications, and it occurs in very different faunal associations.

Horizon and locality: Wewoka formation; Coalgate quadrangle, Okla.

Pelecypoda

Nucula wewokana sp. nov.

Shell small, triangular; width slightly, though distinctly, greater than the height. Beaks set well toward the posterior end, toward which they more or less distinctly point. The convexity is high. The cardinal and posterior ends are abruptly flattened or depressed into a usually well-defined escutcheon and lunule. The ventral border is regularly rounded. The anterior and cardinal lines are straight or gently convex according as the lunule and escutcheon are flat or project somewhat from the abrupt infolding of the shell along the two edges. The anterior end is strongly rounded: the posterior is subangular.

The surface is finely, sharply and regularly striated.

This species is related to *N. parva* McChesney, with which, in fact, I at first identified it. It differs, to judge by the figures of McChesney and of Meek and Worthen, in being less transverse and in having the shell at the posterior or shorter end less strongly projecting. *N. wewokana* is also very similar in outline to *N. pulchella* Beede and Rogers, but *N. pulchella* is said not to have a distinct lunule and the posterior end seems to be abruptly truncated. In the present species, the shell projects a little, so that the outline at this end is usually gently convex and formed by the edge of the shell, whereas in *N. pulchella*, it is straight and formed by the angle of flexure, which either overarches the margin or is coincident with it when viewed from above.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Coalgate quadrangle, Okla.

Anthraconeilo subgen. nov.

The shells included under this title are rather large, strongly transverse, very inequilateral, considerably produced anteriorly. The beaks point toward the shorter side. Shell closed all around. Dentition taxodont with a great many

small teeth on the anterior side and a few large teeth on the posterior. Chondrophore probably present but not observed. Anterior and posterior scars large. Probably two other smaller scars are situated near the hinge, one in front of and the other behind the beak, between it and the anterior and posterior scars. Pallial line apparently entire or with only an obscure sinus.[7] Sculpture consisting of fine regular concentric striæ.

This type in general appearance is intermediate between *Nucula* and *Leda*. From *Nucula* it differs in its transverse shape and produced anterior extremity. From *Leda* it differs in having the beak directed toward the short side, which is probably posterior as in *Nucula*. The muscle scars seem to be much as I have observed them in *Leda bellistrista*, but there is no oblique internal ridge crossing the umbonal region, and the arrangement of the teeth, chiefly to one side of the beak, is another conspicuous difference. This type also much resembles *Paleoneilo*, from which it differs in lacking an external ligament and being without the sinus, developed in the inferior contour and in the lines of sculpture. The latest species which can with safety be referred to *Paleoneilo* occur in the early Mississippian. *Anthraconeilo* differs from *Yoldia* in not gaping behind and in having the beak directed toward the shorter side.

In addition to the type species described beyond as *Anthraconeilo taffiana*, there can probably be transferred to this group three species at present included under *Yoldia*, viz: *Y. carbonaria*, *Y. knoxensis* and *Y. oweni*. The two latter differ from *Yoldia* and agree with *Anthraconeilo* in having the beaks turned toward the short side of the shell, and their inclusion in the latter is regarded as probably correct. The case of *Y. carbonaria* is more doubtful, since it seems presumptuous to suppose that so excellent a conchologist as Meek would assign to *Yoldia* a shell in which the beaks pointed toward the short side, whereas, if they point toward the long side, *Y. carbonaria* is clearly not a representative of *Anthraconeilo*. Even if the beaks point toward the long side, however, I should somewhat doubt the correctness of his reference to *Yoldia*, on account of the convexity of the shell and the prominence of the beaks.

Type species, *Anthraconeilo taffiana*.

Anthraconeilo taffiana sp. nov.

Shell rather large, transverse. Width nearly twice the height. Shape subelliptical. Posterior end strongly and symmetrically rounded. Dorsal border long, rectilinear. Ventral border convex, more strongly curved toward the posterior end, subrectilinear anteriorly. Anterior end produced, more or

[7] If a sinus is really present, the orientation here employed should be reversed; the long side is posterior and the beaks point forward, toward the short side.

less symmetrical, somewhat truncated at the narrow extremity. Greatest height about one third the shell length in front of the posterior margin. Convexity rather high, chiefly situated in the posterior third of the shell; compressed anteriorly, somewhat compressed near the posterior margin as well. Beak small, strongly incurved, pointing toward the short end of the shell.

Surface not well shown, often apparently smooth. A few examples are marked by regular, closely arranged concentric striæ, and many show more prominent irregularities of growth.

The dentition consists of about six large posterior teeth and about 30 small anterior teeth. An interval beneath the beak is probably occupied by a number of additional teeth of small size.

There is the usual complement of large muscle scars, one anterior and one posterior, situated near the dorsal border. Apparently a small elongate scar occurs between the anterior adductor and the beak, close to the cardinal line. Possibly a corresponding scar occurs also between the beak and the posterior adductor. This arrangement is, therefore, very much as I have observed it in *Leda bellistriata*, but of the curved oblique internal ridge in the umbonal region with its attachment (?) scar, no equivalent structure has been observed in the present form. The shell is considerably thickened between the beak and the large posterior adductor, however, causing a deep excavation in internal molds, sharply defining the anterior boundary of the scar. The pallial line appears to be entire, or with a faint deflection in the anterior portion. It has not been clearly seen in that portion.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Coalgate quadrangle, Okla.

Nuculopsis gen. nov.

The present genus is based upon *Nucula ventricosa* of Hall and it is distinguished from *Nucula* primarily because, though the beaks point toward the short side of the shell, that side is not posterior but anterior. The determination of this fact rests upon the occurrence of a ligamental groove or area along the hinge margin on the long side of the shell. Though varying in the distinctness with which it is shown, traces of this structure can be observed in nearly all the large number of specimens examined. It is, therefore, a real and persistent character of the species and is hardly open to any other interpretation than that which I have put upon it. The existence of this structure then, which has no homologue in *Nucula*, and its almost definitive importance in determining the long side instead of the short side of the shell as posterior, constitute the most important differences from that genus.

The shape is elliptical rather than triangular and the long side is rather produced for *Nucula* itself. The beaks are conspicuously turned toward the shorter side. The typical species has a distinct, though ill-defined and narrow, constriction near the anterior extremity. The lunule and escutcheon are poorly defined. The surface is generally almost smooth. On the interior, there are the usual large posterior and anterior adductors, in addition to which, between those scars and the beaks, a third and fourth pair of muscular imprints can be seen. The dentition consists of a continuous series of taxodont denticles not

apparently interrupted by a chondrophore. The anterior teeth are few and large, the posterior teeth numerous and diminishing in size toward the beak, where they seem to end abruptly against the large anterior teeth. A chondrophore is almost certainly present, but, unlike the structure of living shells, it seems to be situated within and below the row of cardinal teeth without extending to the beak and forming an interruption to them. This cannot, however, be positively asserted as a fact.

Type species, *Nucula ventricosa* Hall.

Limatula ? fasciculata sp. nov.

Shell of medium size, elongate, slightly oblique. Hinge line short. Anterior and posterior outlines probably nearly straight above but becoming more and more strongly curved below, where they merge with the (probably) regularly rounded ventral outline. The convexity is strong with a high area, so that a section cut longitudinally through the two valves would be wedge shaped. On the anterior side the shell descends steeply and abruptly making a rounded angle with the median portion. The posterior side seems to fall away in a low regular flexure.

The surface is marked by regularly arranged costæ or groups of costæ. Toward the anterior side, the costæ are single with relatively wide interspaces. In the median and posterior regions, the costæ are in groups of three or sometimes two, having their tops about on a level, and, in this case, the dividing striæ are essentially equal in width to the groups of costæ. The anterior side, from the angulation to the margin, is smooth. Very likely, the costæ die out toward the posterior side also.

The area is somewhat imperfectly shown by one of the two specimens obtained. It appears to be high and resupinate, so that the beak overhangs the hinge line and it is also rather concave. It is marked by several strong, broad, transverse furrows, but shows no definite pit for a resilium, though, owing to the projecting state of the beak and the concavity of the area, there seems to be an ill-defined hollow under the beak which is rather longitudinal than transverse to the area.

If Hind's *Palcolima* is a valid genus, the present species would be called *Paleolima fasciculata*, for its characters, so far as observed, are consistent with *Paleolima*, but if that genus is to be divided into subgenera along the same lines as the living *Lima*, this species would probably belong in a group as yet unnamed. For the present, however, I am not recognizing *Paleolima* as distinct from *Lima*, so that the generic designation to be used is probably *Limatula*, which is distinguished by being smooth laterally and by having the valves not gaping. The former character seems to be possessed by the *L. fasciculata*, but the latter can not be determined, as we have only dissociated valves. The only other American species referred to this subgenus is the Guadalupian form *Limatula striaticostata*. By a clerical error *L. striaticostata* was de-

scribed under the genus *Limatulina*, but as the genus was ascribed to Wood instead of de Koninck, the group which I had in mind is apparent. The form is clearly not a *Limatulina* and the proper title is *Limatula striaticostata*. It differs from the species under consideration in being much smaller, more oblique, and in having different surface ornamentation.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Okla.

Scaphopoda

Dentalium semicostatum sp. nov.

This type is represented by two fragments, which, so far as shown, indicate a straight or gently curved, slowly enlarging conical shell. The cross section is distinctly elliptical, having in the larger fragment a diameter of 7 mm. in one direction and 6 mm. in the other. The test is thick and marked by rather fine, rounded, wavy, longitudinal costæ, separated by linear striæ. These markings are confined to one side of the shell, and about four or five occur in 1 mm. There are also transverse constrictions and incremental lines which have an oblique direction to the axis. The obliquity of these markings is in the direction of the long axis of the section, so that their most distal points occur down one of the narrow sides of the shell, and the most proximal down the other. The costæ also are confined to one of the narrow sides, and they occur on that on which the transverse striæ are farthest from the apex.

This shell is somewhat similar to *D. mexicanum*. It has, however, slightly finer costæ at a considerably larger size, and these are restricted to one side of the shell.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Okla.

Dentalium indianum sp. nov.

Shell rather small, gradually tapering, very slightly curved. Section circular or obscurely elliptical. Surface marked by numerous thin, sharply elevated, longitudinal costæ which are separated by intervals of about double their own width. The number of costæ can not be counted with accuracy, but it is not far from 42. There appear to be also fine, transverse, crenulating striæ.

This form stands nearest to *D. mexicanum* by reason of its numerous fine costæ. These are, however, more numerous and are separated by relatively wider intervals, while the shell itself is gently curved instead of being straight, as in the western form.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Okla.

Gastropoda

Orestes subgen. nov.

This name is introduced for a group of pleurotomarioid shells which have a shape generally conical or slightly turreted with a gently convex basal portion. The band is not very strikingly defined and has a peripheral position distinctly below the middle of the whorl. The upper surface is in general flattened and oblique, with the zone which lies just below the suture more or less prominent and marked by nodes. The sculpture consists of fine, decussating, revolving and transverse lirae. The slit band is relatively broad and carries one or more revolving lirae which are sometimes nodulose and occasionally conceal to a greater or less degree the structural character of this part of the shell. The slit has not been observed in any of the specimens seen, but it was probably short. The umbilicus was apparently closed, but a reflexed portion of the lower part of the outer lip produces a small excavation which resembles a minute umbilical opening.

The inner lip is without a callosity. In fact, the mantle seems to have had the power to resorb the shell on the inner side of the aperture, so that this portion of the preceding volution is smooth and slightly depressed below the external ornamented areas. This has been observed in many specimens and is surely not an accidental character.

In one extreme, these shells suggest *Euconospira*, from which they differ in their less regular, conical shape, and in the development of nodes below the suture and of revolving lirae in the slit band. They suggest also *Phanerotrema*, but have a more conical shape with a slit band at once broader, less defined, marked by distinctive sculpture and situated not near the middle of the peritreme, but well below. *Worthenia* is in some respects the most nearly related group, at least in the ornamented character of the slit band. *Worthenia* has the band above the middle rather than below, narrow instead of broad, and with the lunules in the band much more prominent than the revolving lirae (in *Orestes* the lunules are hardly more than lamellose growth lines), and it has a more turreted, less conical shape to the whole. It is doubtful if any of the groups mentioned have the peculiar eroded or resorbed character of the inner side of the aperture.

Orestes, then, is referred to a subgeneric position under *Worthenia*, although its relationship to *Phanerotrema* is also obvious. The generic name is introduced in honor of Orestes St. John, one of the early paleontologists of the United States and one of the early geological explorers of Oklahoma.

Type species, *Orestes nodosus*.

Orestes nodosus sp. nov.

Shell small, irregularly conical. Diameter of last whorl about equal to the greatest height, sometimes less. Height of last volution about equal to the height of the spire above. Volutions angular, most prominent below the middle. Spire somewhat turreted. Umbilicus apparently closed, but with the lower lip folded backward upon itself so as to produce a small pit or false umbilicus. Suture considerably depressed. The shell projects strongly from the suture, then bends downward and is flat or concave below to the first carina. Thus the upper third of the upper surface forms a sort of spiral ridge just below the suture. The lateral surface is about one third as broad as the upper surface. It consists of two rather thick, rounded carinæ guarding between them a relatively broad concave channel in which the band is situated. The upper carina is better defined than the other, but does not project quite as far. The lower surface is nearly horizontal, gently convex, more tumid near the umbilicus. The swollen band below the suture is marked by a row of distantly arranged nodes which appear to be independent of the superficial sculpture.

The surface is crossed by regular and nearly equal revolving and transverse liræ of which the former are heavier and dominant, while the latter are more closely arranged. The upper surface carries about five (four to six) revolving lines, arranged at regular and distant intervals. The upper one is situated on the subsutural prominence. An additional lira is occasionally developed just above the latter, which gives the nodes a somewhat elongated double-topped appearance. The upper of the two carinæ bounding the slit is a similar revolving lira of somewhat larger size and so is the lower one. Just within these two liræ are two small edges which define the true limits of the slit band. The band is medially traversed by another fine, revolving thread, or rarely by three. The lower carina carries about two fairly heavy liræ, while the lower surface is crossed by about twelve others, some of which may be fine, and alternating with those of larger size. They are heavier and more crowded than the liræ above. The transverse liræ, doubtless following the outline of the aperture, bend strongly backward, being convex near the suture and straightened or gently concave near the band. Over the latter, they are deeply concave, producing fine, regular, closely arranged crenulations or lunules. On the under side, they run obliquely backward with a strong convex turn on the lower carina. For most of the distance, they are thus nearly straight. In the region of the suture, they seem to be fine, irregular and crowded, passing just below the nodose zone into regular, rather distant liræ which give a finely nodose appearance to the upper carina and generally tend to produce little prominences where they cross the revolving liræ. Even below the nodose zone, fine, intermediate, incremental lines are more or less conspicuous. The transverse liræ do not produce crenulations on the projecting edges of the band, but they have this effect to a greater or less extent on the revolving line or lines which traverse it.

The volutions embrace up to the edge of the band of the preceding one. They are about five in number.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Coalgate quadrangle, Okla.

Bellerophon crassus var. wewokanus var. nov.

The fossils under consideration are all of small size. They can be described most advantageously by comparing them with *Bellerophon crassus*, to which they are clearly very closely related. For this purpose, it will be best to use the figures and description given by Meek and Worthen, not only because they are the authentic ones, but because although *B. crassus* has appeared in the literature not infrequently, the citations have seldom been based on the observation of good and characteristic specimens. The most essential difference shown by the Wewoka specimens is that the umbilicus instead of being partly open, is so solidly closed that there must have been a continuous imperforate columella. The size is very much smaller; the shape of the aperture more transverse, and the band possibly more elevated.

It may be that these differences are due to stage of growth, but shells which I am referring to *B. crassus* as representing a young condition are quite different. From these the Wewoka fossils differ in the following particulars. The volutions are relatively narrower; the slit band is broader and more prominent; the umbilici are more completely closed; the sculpture, instead of consisting of rather regular, transverse imbrications, is made up of fine, incremental lines which, at irregular intervals, become fasiculate, forming small angular costæ or incipient plications.

I may add that the fissure as shown on one of the Wewoka specimens is rather deep, but I am not sure that this feature may not have been exaggerated by erosion of the projecting band. Furthermore, on the best specimens, the callosity of the inner lip appears to be imperfectly developed.

It is possible that this may prove to be the same as *B. incomptus*, but after comparing my specimens with Gurley's types, which I have had the privilege of examining, thanks to the courtesy of the Walker Museum of Chicago University, I am disposed to think that they are different. The differences appear to me to be those already mentioned as existing between the var. *wewokanus* and young *B. crassus*.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Coalgate quadrangle, Okla.

Pharkidonotus subgen. nov.

The very extensive and varied series of shells which in the course of time had been grouped under Montfort's genus *Bellerophon* have of recent years been distributed among a number of genera and subgenera. Waagen has very properly restricted the genus *Bellerophon* to types having a rather narrow, well-developed slit band, moderately deep fissure, a strong callosity on the inner lip, and sculpture consisting only of more or less strong growth lines.[8]

[8] W. Waagen, Geol. Surv. India, Mem., Ser. 13, Salt Range Foss., vol. 1, p. 130. 1887.

Our well-known Pennsylvanian species *B. crassus* and also the Upper Mississippian *B. sublævis* are therefore typical Bellerophons.

We have in our Pennsylvanian faunas a species, or perhaps a series of mutations, which presents well-marked differences from the characters possessed by typical *Bellerophon*, so that a subgeneric separation is justified, if not demanded. The dorsum is elevated into a prominent nodose carina on which traces of a slit band seldom remain. Many specimens therefore appear to lack such a structure altogether and to be related to the Indian *Warthia* and *Mogulia*. Some specimens retain unmistakable traces of a band, however, and there can be little doubt that this structure is a normal feature of this type. That it is obliterated so often is probably due to its prominent position and also perhaps to the tumid condition of the median line of the dorsum.

From *Bellerophon* this type also differs in the development of coarse, heavy, angular, transverse plications, quite distinct from the growth lines, which are not conspicuous, these plications being also in some cases strengthened at two series of points, one on each of the sides, so as to form more or less prominent nodes (connected in some cases by revolving ridges). The linear arrangement of these nodes produces two carinæ additional to the median one which is the locus of the slit band.

Type species, *Bellerophon percarinatus*.

Meekospira peracuta var. choctawensis var. nov.

This fossil is very abundant in the Wewoka formation and shows certain variations, some of which are probably adventitious. It has an acutely conical form with a very elongate spire and a narrow spiral angle. The sides are usually flat with the suture only slightly depressed, but not infrequently the sides of the spire are more undulating and the suture deeper. This is perhaps due to variation in curve of the outer surface of the whorl. In the one case the convexity is more regular; in the other, the upper surface of the volution is flattened and the greatest convexity well below the middle, where it is overlain by the succeeding whorl. The rate of increase seems to be accelerated somewhat toward maturity, so that the sides of the spire are slightly concave. As a result, when the apex of specimens is broken away, which very often happens, the frustum remaining appears to have a wider spiral angle than was really the case. In comparing these with more perfect specimens, one is somewhat surprised to find that they may belong to the typical variety, as well as to find what a large number of volutions is present when the apex is complete, the number being proportionately much greater toward the top. On the side of a specimen 14 mm. long, parts of nine volutions appear and as the apex is broken, there must have been one or two more. A full-sized specimen about 30 mm. long shows parts of ten volutions with an apical break which may possibly account for two more. The number of complete volutions in a mature specimen is probably eleven and possibly twelve.

The callus is a very distinct character in well-preserved specimens, extending half way or a little less than half way up the inner lip. It is formed by a slight backward flexure on itself of the outer lip as it passes up the axis and is there gradually lost in the aperture.

In its specific characters this species is intermediate between *Meekospira peracuta* and *Bulimorpha nitidula*, and it does not exactly agree with either species. According to Meek and Worthen, these types show the following differences: *B. nitidula* has a lower spire with fewer volutions and broader spiral angle; it is smaller, and the volutions are more rounded with more deeply depressed sutures.

The present form seems almost invariably to have a slightly broader spiral angle than *M. peracuta*, though a certain amount of variation is not absent. The agreement in this respect is then distinctly with *B. nitidula*. As for the convexity of the volutions, some specimens resemble *peracuta* and others *nitidula;* but few, perhaps none, are quite as strongly convex as in Meek and Worthen's figures of the latter species. In fact, one of their figures shows this character more strongly than the other, though both are drawn from the same specimen. The number of volutions is more like *peracuta*, which is said to have 13, than *nitidula*, which is said to have 8 or 8.5. The size is that of *nitidula*, none of the specimens attaining to the length of *M. peracuta*. In the most essential respect, the callus and reflexed lip, the Wewoka form agrees with *M. peracuta* and differs from *B. nitidula*, and, if this character is regarded as of generic importance, there can be no question about associating it with any species but *M. peracuta*. Ulrich seems inclined to associate *B. nitidula* and *B. inornata* with *M. peracuta* in his genus *Meekospira*, but the callus, which is such a marked feature of *M. peracuta*, must be a generic character, or its absence from the two other species accidental. This assumption seems unwarranted, and I am referring those two species to another genus than *Meekospira*, in which, of course, the present form must be included. Though closely related to *M. peracuta*, I can hardly place it in the same species, because of its broader spiral angle and smaller size.

Most of the specimens referred to this species are almost absolutely smooth, having but very obscure growth lines. Those from one or two localities, however, are regularly marked by more or less strong incremental lines, some of which are prominent and lend an irregularly and intermittently corrugated appearance where most strongly developed. Some of these shells, furthermore, show slight modifications of curvature in the outer surface of the volution, which gives the spire a slightly different outline from the normal. In others, however, the shape of the whorl section is entirely normal, so that no persistent difference can be pointed out, save in the increased development of the striæ of growth. It is possible that these sculptured specimens should be regarded as a separate variety, but the differences observed hardly seem to justify the distinction.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Coalgate quadrangle, Okla.

Ianthinopsis gouldiana sp. nov.

Shell rather large, subovate; length a little less than 1.5 times the greatest width. Aperture about three fourths the entire height; spire about one eighth of the whole. Volutions four or five, rather inflated, especially above, so that the upper surface of the volution appears flattened and not strongly oblique to the horizontal. Aperture fusiform, more than twice as long as wide.

Surface smooth but marked on the more gibbous portion with a few (four or five) rather coarse but faint revolving striæ. Axis solid.

The affinities of this type, represented as it is by only one specimen, are much in doubt. If it were not for the sculpture and for the shape with the most prominent part of the volutions so high up, this shell might be placed under *Sphærodoma* in the same series with *S. intercalaris* and *S. primigenia*. The striation, though faint, is unmistakably visible in a good light, but it can only be seen in the region of the aperture. The shape has doubtless been somewhat modified by compression, but not sufficiently to have produced the present result from a shell originally having the proportions of either of the species named.

On the assumption that the peculiarities presented by this form are inherent, it may be compared with the singular species described by Meek and Worthen under the name *Pleurotomaria ? tumida*. While clearly distinct from *P. ? tumida*, the resemblance in a general way is so striking that it would appear to be ultraconservative not to conclude that it is a generically related species. The most important difference of a fundamental kind is found in the statement by Meek that the columella of the Illinois form is perforated (?), while that of the Wewoka shell is certainly solid.

Meek had not observed the presence of a slit band in *P.* (*?*) *tumida*, and justly remarked that that species differs materially in outline from the usual form of *Pleurotomaria*. Suspecting that it was a representative of a new genus, he provisionally proposed the name *Ianthinopsis*. I am ready, without having determined the absence of a slit band, to accept *I. tumida* as representing a new generic type, and I am employing *Ianthinopsis* for the type specimen and for the Oklahoma shell also.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Okla.

Cephalopoda

Orthoceras tuba sp. nov.

Orthoceratoid shells are abundant in the Wewoka formation and many of them possess the singular feature of accelerated expansion, so that they flare conspicuously at the larger end, and, if the tendency were carried out to a high degree, the complete shell would have a trumpet-shape, a configuration which many of them even now suggest. This peculiarity, however, is manifested in shells of very various sizes and presumably corresponding ages, and it is found in both the chamber of habitation and in the septate portion. Both hypotheses—that the flaring condition is a feature of maturity (which is the natural supposition) and that it is the normal shape at all stages, the expanded portion being resorbed so that the shell is regularly conical except toward the aperture—are repugnant to the fact that the flaring portion is sometimes septate. On the former hypothesis, furthermore, we must also infer that the mature condition is in some specimens enormously accelerated or retarded.

Correlated with the peculiarity above described is found a relatively rapid rate of expansion, giving the regular portion of the cone a rather strong taper. The siphuncle is conspicuously excentric, though this character has been seen in only a few individuals which at the same time have the trumpet-shape in a conspicuous degree. The septation is rather frequent, about 4.5 to 5 chambers occurring within the distance of a diameter.

None of the shells having the characters enumerated possesses the peculiar secondary deposits of *Pseudorthoceras*. Indeed, they have the chambers filled with ochreous clay, and it is difficult to understand how this condition came about when the partitions are still retained. Possibly the fine mud permeated the chambers through the siphuncle, which seems seldom to be preserved in the specimens examined. For the most part, these are internal molds, but in some instances they retain a substantial outer investment.

With typical *O. tuba* I am provisionally including a group of specimens which do not show the expanded aperture, but have a similarly excentric siphuncle and similarly frequent partitions. They vary much in size and some of them are much larger than some of those which show the accelerated expansion, but in view of the extreme variation in size of the specimens possessing the latter character, it seems that this fact alone can hardly be regarded as forbidding their union under a single species. This, of course, would only be done on the hypothesis, either that the trumpet shape was not a character of importance, or that these specimens, all of which are naturally now imperfect, possessed it or would have possessed it in the complete and mature condition.

I am inclined to believe that this peculiarity of configuration is not so much a specific character as that it is either generic or else of no fixed value at all, but I feel that its significance is too little understood to warrant establishing a new genus on the evidence in hand.

It is with extreme rarity that shells of this group are found in a complete condition, and all of those examined are pretty clearly imperfect at one or both ends. A few give evidence of having been broken before fossilization. The evidence referred to consists of the occurrence of small Rœmerellas apparently in their original position of attachment upon the septa, where, of course, they could not possibly have penetrated if the shell had not been a fragment during the life of the brachiopod.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Coalgate quadrangle, Okla.

Pseudorthoceras gen. nov.

Shells small (?), straight, gradually tapering. Siphuncle nearly central, small, but considerably expanded between the septa, without, however, becoming nummuloidal. Septa simple. Funnels apparently very short and thick. Chambers partly occupied by secondary deposits which accumulated, not about the funnels and siphuncle, but about the walls. In the type species, the deposits fill about half of each chamber, thinnest toward the aperture and thickest toward the apex, and diminishing irregularly so that the outline is shaped like an incomplete letter S. The deposit appears to be more or less vesicular, perhaps as the result of weathering. Shells which are not broken at the apex do not taper to a point, but are obliquely truncated.

This type is rather clearly not a representative of true *Orthoceras*, nor have I been able to find a genus with which it can be assembled. Indeed, it is not certain that it can be included among the Orthoceratidæ, though it is for the present referred to that family. The most diagnostic features are probably the enlarged siphuncle and more especially the secondary deposits accumulated not axially, but circumferentially. In this item lies the main difference from *Orthoceras*, for in that genus, and indeed in that family, the secondary deposits are rather sparingly developed and they are accumulated about the funnels, not about the outer wall.

Type species, *Pseudorthoceras knoxense* McChesney.

Pseudorthoceras seminolense sp. nov.

Three specimens in the collection appear to belong to *Pseudorthoceras* by reason of their central siphuncle and chambers partly filled by secondary deposits and at the same time to differ from *P. knoxense* in being very much larger. These large specimens have about 3.5 chambers to a diameter and so do not differ essentially from the smaller species. One of the specimens is

compressed and seems to show a structure down one side suggesting a marginal siphuncle.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Okla.

Protocycloceras ? rushense var. crebricinctum var. nov.

Two specimens, though resembling *P. ? rushense*, are distinguished by having the annulations more closely arranged and somewhat alternating. The cross-section is elliptical as in that species, but there is an acceleration of expansion which produces a flaring shape toward the aperture. The recurrence of this latter character, which is found to a marked degree in one of the species of *Orthoceras*, is noteworthy and seems to bring its importance somewhat into doubt. Its significance is entirely unknown.

One of the specimens shows the surface to be marked by fine, subequal, somewhat wavy, thread-like, transverse lirae.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Okla.

Coloceras liratum sp. nov.

Shell small, the largest specimen seen measuring 34 mm. in the plane of revolution. Shape subglobose. Cross-section sublunate, somewhat gibbous at the sides. Surface rather regularly curved over the venter and sides, abruptly rounded inward at the umbilicus, forming two not very well-defined umbilical zones, the direction of which is nearly horizontal. At maturity, the section is about twice as wide as high. In mature-specimens, the median line of the venter is broadly and faintly impressed. The rate of increase is rapid and the depressed zone narrow considerably less than one half the width of the preceding whorl. The umbilicus is rather small and deep.

The surface is marked at the sides by fine revolving lirae, separated by wide, flat interspaces. These extend from the umbilical zone over the subangular shoulder onto the extreme sides of the venter. The revolving lirae are crossed in some cases by much more closely arranged transverse ones which make fine crenulations as they surmount them. The entire surface of the immature stages seems to be thus cancellated, but only a band on the sides of the mature shell, while on the oldest specimens and some others, the transverse markings cannot be seen. The ventral surface is crossed by fine, incremental striae, which indicate a deep, subangular V-shaped sinus, whose sides are nearly straight over the median portion but curve gracefully outward with increasing rapidity toward the sides. In one specimen, the striae are so arranged that every seventh or eighth is stronger than the others, which cross the slightly elevated spaces between in crowded though regular order.

The septa are rather far apart, about 6 mm. along the median line in a mature specimen. They are nearly straight except for a slight sinuosity across the venter caused by the shallow ventral lobe and a pair of obscure saddles. The siphuncle appears to be situated below the center (dorsad) but it is not well shown.

This species is related to *C. globulare*. It appears to be a more slender form (though specimens vary somewhat in this), with more distant septa which show a slight lobe instead of a slight saddle on the ventral surface. The sculpture of *C. globulare* is not known, so that additional differences may be discovered when those data are determined for it.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Coalgate quadrangle, Okla.

Coloceras liratum var. **obsoletum** var. nov.

Associated in most cases with *C. liratum* are specimens which show certain differences, the most constant of which is perhaps the absence of liræ on the umbilical zone. Correlated with this character the curvature at the sides is more regular, so that the umbilical zones themselves are less well defined. The incremental markings are perhaps stronger, or at least more regularly preserved. Some of the specimens are rather narrow but not all. At the same time, since the sculpture on typical *liratum* might easily be obscured, it is possible that some specimens of the latter may be included here. The siphuncle of this species seems to be ventrad or at least central, while that of *liratum* is or appears to be dorsad, but this feature is rarely shown and in the case of *liratum* not well shown by my specimens.

There seems to be a varietal or even a specific difference here, but my material is not sufficiently good to show the degree of difference or the constancy of it from *C. liratum*, or whether possibly the shells subsumed under this title are in every case conspecific.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Coalgate quadrangle, Okla.

Metacoceras cornutum sp. nov.

This species is founded on a fragment which must have had a diameter of 70 mm. exclusive of the chamber of habitation, no portion of which is retained. The whorl section is subquadrate, distinctly wider than high. The height is 23 mm. and the width 29 mm. The ventral surface is gently convex, more nearly flat on the shell itself than on the internal mold. The sides, exclusive of the prominent tubercles, are nearly flat and parallel. The lower portion of the whorl is tripartite, consisting of an impressed zone about 12 mm. wide and two umbilical zones, each about 8 mm. wide. The umbilical shoulder is abrupt and angular, the angle being somewhat greater than a right angle. The ventrolateral shoulder is also angular and furnished with large, prominent, compressed nodes. They project outward and slightly upward and are flattened on the upper surface, more convex on the lower. Those on one side alternate with those on the other and in the same row they occur on about every other chamber.

The septa are about 6.5 mm. apart, measured along the median line of the venter, and the sutures are rather strongly bent. There is a broad, deep

ventral lobe almost angular at the middle in some sutures, a broad, moderately deep lateral lobe, the point of greatest convexity being below or interior to the middle, and a gently curved internal or dorsal lobe across the impressed zone. Abruptly rounded saddles occupy the ventrolateral angles and a broad saddle flattened across the middle, each of the umbilical zones. Each of the latter, however, may be regarded as composed of two obscure saddles, one on the umbilical shoulder and one on the angle of the impressed zone with a scarcely perceptible lobe between.

The sculpture is not well shown. On the ventrolateral angles and tubercles it consists of regular, strong, sharp, transverse lirae, which are deeply curved, suggesting a broad, deep hyponomic sinus.

The test appears to be considerably thickened at the ventrolateral angles so that the internal mold differs appreciably from the perfect shell, the shell being flatter across the ventral surface, with the sides more convergent toward the umbilicus, and with the tubercles very much more produced. Indeed, on the internal mold, the tubercles are not at all prominent.

Horizon and locality: Wewoka formation; Coalgate quadrangle, Wewoka quadrangle, Okla.

Metacoceras cornutum var. **sinuosum** var. nov.

A single fragmentary specimen which retains the shell is all that represents this variety. It is smaller than the original species and with a less transverse cross-section. The nodes are rounded instead of compressed and extend part way down the sides as low, broad, obscure plications which fall far short of the umbilical-shoulder. The latter is regularly rounded and although strongly turned, not angulated. The ventral surface is marked by two obscure sulci with a gentle convexity between. The tubercles appear to be nearly opposite.

The surface is almost smooth, the incremental lines being obscure except on the tubercles, where they develop into regular, fine, though sharp lirae. They make a deep sinus on the ventral surface, are nearly straight and gently sloped backward at the sides, with a gradual change of the direction at the umbilical shoulder, beyond which on the umbilical zone they are gently concave.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Okla.

Metacoceras cornutum var. **carinatum** var. nov.

This variety is represented by two fragments which apparently show the chamber of habitation, but do not retain the septa. They are partly testiferous and partly exfoliated.

The variety *carinatum* is distinguished from either of the preceding by its more rapid expansion and more transverse shape, in which it exceeds even the original species itself. The sides are in consequence relatively very narrow. The tubercles are rounded as in the variety *sinuosum*, but owing to the shortness of the sides they make more prominent plications. The ventral surface is rather strongly rounded and without sulci. The umbilical shoulder is very angular and extended into a crest or carina,—in which a marked difference is

shown from the variety *sinuosum*, though possibly not from *M. cornutum* itself. The growth lines indicate the presence of a deep hyponomic sinus.

It may be that these shells represent a young stage of *cornutum* (though hardly of the variety *sinuosum*), but they present too important differences (the rapid expansion, greater breadth and differently shaped tubercles) to make it safe to assume this relationship without more evidence.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Coalgate quadrangle, Okla.

Metacoceras cornutum var. **multituberculatum** var. nov.

This variety is founded on a crushed specimen which presents the difference from all the others that the tubercles are smaller and more closely arranged. They appear to be somewhat compressed rather than rounded. The umbilical shoulder is subangular without the crest of *carinatum*, but more rounded than *sinuosum*. The height between the ventrolateral and umbilical angles is about 10 mm.; the width across the venter (tubercles included), about 15 mm.

Horizon and locality: Wewoka formation; Coalgate quadrangle, Okla.

Metacoceras perelegans sp. nov.

Shell rather small, so far as known not exceeding 31 mm. in diameter. Cross-section of mature whorls hexagonal, transverse; width about 20 mm.; height about 12 mm.; width of lateral zone 7 mm.; of umbilical zone 6 mm.; of impressed zone 8 mm.; of ventral zone, including tubercles, 17 mm. Ventral surface gently convex, flattened or slightly depressed along the center, gently upturned at the edges, owing to the tubercles. Lateral zone nearly flat except for the tubercles, the projection of which gives it a gently concave shape. Umbilical zone nearly flat. The lateral zone slopes gently outward from above and the umbilical zone strongly inward. In the youthful stages, the dimensions are increasingly transverse and the shape more nearly elliptical, with an angular periphery a little above the middle and with the usual recurved dorsal zone. This change in shape is effected (when considered in reverse order) by an increased inward slope of the umbilical zone and a corresponding loss of the umbilical shoulder. Both the ventrolateral and the umbilical shoulders, however, are more or less distinguished by an angulation.

The sculpture of the youthful stages is incompletely known, but the sides of the youngest example seen are marked by fine, even, transverse, rounded striæ, separated by narrow, sharp liræ. Later, the flattened sides are marked by strong, regular plications, the folds being angular and the furrows between relatively broad and rounded. On these are superposed strong, incremental striæ, much less distinct in the furrows than on the crests between them. The plicæ thus gradually formed tend to become more prominent at the ends, developing little nodes in which they terminate, the nodes appearing at an early stage and more strongly at the outer than the inner ends. At maturity the connecting ridges gradually fall of development, leaving the two rows of

nodes, the larger and more prominent along the ventrolateral shoulder, the smaller and less prominent on the umbilical shoulder. Both these loci are well defined and more or less strongly angular during the periods of adolescence and maturity.

The sculpture at maturity consists of very obscure incremental lines which tend to become sharp liræ on the tubercles, and they show a deep sinus over the ventral surface.

The septa are not well exhibited by my specimens, though this is a fairly common fossil in the Wewoka fauna. In a mature example, they are 3.5 mm. apart along the middle of the venter, and the suture is very nearly straight, depressed, however, into a shallow ventral lobe and with very obscure saddles on the ventrolateral shoulders. In this region, the suture is liable to be more or less deflected by the pilæ, which are not developed exactly with regard to the septa. In some cases the nodes occur on the septa; in others between them, and there are about three nodes to four septa. In a young specimen which probably belongs to this species, there is a suggestion of a very small, pointed dorsal lobe, somewhat as in the genus *Endolobus*. The siphuncle appears to be central or somewhat below the center.

I know of no American nautiloid which this species so much resembles as that which Hyatt described as *Temnocheilus crassum*. The whorl section of *perelegans* is more transverse and somewhat differently shaped, with distinct umbilical shoulders. The pilæ have nodes at both ends instead of near the ventral surface only, and at maturity they disappear, leaving only the two rows of nodes.

Horizon and locality.—Wewoka formation; Wewoka quadrangle, Coalgate quadrangle, Okla.

Metacoceras sculptile sp. nov.

Shell rather large, attaining a diameter of 67 mm., discoidal, with large umbilici, 31 mm. across at the diameter named.

Whorl section modified hexagonal, consisting of a relatively narrow ventral surface, two broad lateral surfaces, two umbilical zones and an impressed zone, all narrow. The ventrolateral and umbilical angles are distinct and only slightly rounded. The ventral surface is marked by two shallow sulci situated close to the margins, on either side of which the shell rises slightly into a gently convex median portion and gently elevated ventrolateral angles. The sides are flattened and slope distinctly outward from above to the umbilical shoulder. There, with an abrupt subangular change of direction, they are withdrawn inward and somewhat downward to a rather deeply concave impressed zone. Greatest height of the final volution 31 mm.; greatest width (at the umbilical shoulder) 25 mm.; width of ventral surface 15 mm.; width of lateral surface 24 mm.; width of umbilical zone 8.5 mm.; width of impressed zone 9.5 mm.

The sculpture seems to consist of fine, even striæ, which follow the lines of growth, leaving between them sharp, strong, angular liræ. This sculpture, however, is more or less concealed in our specimens by a thin, even, super-

ficial deposit, whether intrinsic or extrinsic I am unable to determine. This makes the surface look either smooth or, as the sculpture shows through, marked by obscure lines of increase. The liræ, which seem to strengthen and coarsen as they cross the ventrolateral shoulders, form a deep sinus on the venter. On the sides the direction is sigmoidal, convex above and concave below; similarly on the umbilical zone, save that the concave portion, which is below, is very slightly developed. When mature, the ventrolateral shoulders are marked by small, rather indistinct nodes.

Suture not known.

This species is of the type of *M. walcotti* and *M. hayi*. From both species it seems to differ in having the height proportionately less in comparison with the width; in having the sides contract toward the venter; in having the umbilical zones more nearly horizontal and the umbilical shoulders perhaps a little more angular. The nodes along the ventrolateral angles appear to be smaller and less distinct than in *M. hayi*, while the sculptured surface of *M. sculptile* is not recorded for either species.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Okla.

Cyrtoceras peculiare sp. nov.

Shell rather small, expanding with extreme rapidity. Apical angle about 60°. Axis nearly, if not quite, straight. The rate of expansion is so great that unless the shell grew to a very large size, the curvature of the axis would hardly be preceptible. The sides, therefore, appear to be nearly straight, but that on which the expansion is least rapid may probably be regarded as the dorsal and the other as the ventral side. The siphuncle then is strongly dorsad. The cross-section would be broadly oval, contracting toward the dorsal side, which is somewhat flattened. Only five chambers are preserved, the oldest being about three times as high as the others. The prolongation of the chambers is so rapid on the ventral side that in the internal mold they make step-like projections. The sutures are nearly direct, but are more or less distinctly sinuated, with gentle lobes on the dorsal, ventral and lateral surfaces, and equally faint saddles between.

The extremely rapid expansion of this species distinguishes it from the few Carboniferous representatives of the genus known in North America. It is, however, very doubtful whether this is a true representative of *Cyrtoceras*, a question which can be raised with equal propriety regarding the other American Carboniferous species referred to the genus.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Okla.

Gastrioceras venatum sp. nov.

Shell small, attaining a diameter of 18 mm., compressed globose. Umbilici rather large and open. Whorl section lunate, somewhat tumid at the sides with an ill-defined umbilical shoulder.

Sculpture consisting of angular plicæ or plications at the sides with relatively broad, rounded interspaces. The plicæ are short and divide irregularly into three or four branches of inferior size and prominence. Similar small plications are developed simultaneously in the sulci between the plicæ, all of which become crowded and finer, so that the venter is crossed by regularly arranged, moderately coarse and strong striæ which form a rather broad, deep sinus as they cross to the other side.

The suture is rather simple. The siphonal saddle is small and indented on top. The remaining lobes and saddles are rounded. The first lateral saddle is rather broad and symmetrical; the second, still broader and very unsymmetrical, the outer side being straighter and more extended than the inner. The two lobes are symmetrical. The first is very small, narrower than the siphonal saddle. The second is fully twice as large as the first and somewhat more spreading.

This species resembles the few Gastriocerata described from the Carboniferous of America which have plicated sides, but the plications in this case are finer and branching in a rather unusual manner. The suture is also distinctive in that the lobes are rounded instead of angular. In some respects the characters shown by this species suggest that it is an immature stage, but some fifteen specimens have been examined, all of which are of small and more or less uniform size.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Coalgate quadrangle, Okla.

Gastrioceras hyattianum sp. nov.

Shell subspherical with relatively wide umbilici when young; compressed globose with relatively narrow umbilici when mature; attaining a rather large size, the largest example having a diameter in the plane of revolution of 65 mm. and being about 37 mm. thick at the widest part of the final volution. Umbilical shoulder angular and more or less carinated at all stages, except perhaps when very immature. Cross-section broadly lunate in the young and narrowly lunate in the mature condition. In the latter, the curve of the venter and sides (which are not differentiated) is parabolic, gradually expanding toward the umbilicus and much more strongly curved above than at the sides. In this condition the whorls are deeply embracing. Specimens of nearly the same size seem to vary considerably in thickness, some being more discoidal, others more globose. The chamber of habitation is long, one volution or possibly more.

The surface when very young is probably cancellated with fine transverse liræ and fine revolving ones. In an early mature condition, the strength of the liration seems to have diminished considerably. The transverse liræ are finer but persistent, while the revolving liræ become restricted to the umbilical surface and the sides of the ventrolateral surface, the major portion of the venter showing only transverse markings. These have a more or less sinuous course with a gentle saddle in the center and obscure lobes toward the sides.

When mature, the shell seems to have been perfectly smooth, without liræ of either sort, except possibly a few revolving ones on the umbilical shoulder. My specimens do not show this sculpture, except here and there, and the foregoing statements are based on scattered observations and not on any one specimen, still less on a series of specimens showing consecutive changes.

The suture (observed on a shell in an early mature stage) shows a high, narrow ventral saddle, indented on top, and two rounded lateral saddles, the first of which is relatively narrow and symmetrical and the other broad and unsymmetrical. Both are considerably higher than the ventral saddle. The two lobes are tongue-shaped, the inner one being narrow and the outer broad and unsymmetrical. A third, broad, tongue-shaped lobe, smaller than the others, is found on the umbilical zone.

This species closely resembles *Gastrioceras occidentale*, the only positive difference of any moment suggested by the description and figures being that the umbilical shoulder of the latter is obscurely crenulated or subnodose. As neither the suture nor the sculpture are known, however, adequate grounds for comparison are wanting.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Coalgate quadrangle, Okla.

Gastrioceras angulatum sp. nov.

Shell of medium size, subglobose. The largest specimen has a diameter of 32 mm. Cross-section trapezoidal, much wider than high. Umbilical shoulders very angular. Umbilicus wide and deep. Ventral surface broadly rounded, more or less parallel to the impressed zone. Constrictions about five to a volution, gently curved across the venter with the convex side forward. A typical specimen has a diameter of 30 mm. with an umbilicus 16 mm. wide. The thickness at the widest part of the final volution is 25 mm. The height of the final volution is 7 mm., the width of the impressed zone 17.5 mm. A small specimen having a diameter of 15 mm. is composed of seven volutions.

The surface over the venter appears to be smooth when the shell is mature. The region of the umbilical shoulder, however, is marked by moderately coarse, revolving liræ, crossed by about equally coarse transverse liræ. This cancellated area appears to be narrow and to extend to or just beyond the umbilical shoulder, leaving the umbilical zone smooth. Doubtless in the younger stages, the whole surface was cancellated, though this fact is not shown by my specimens. In the later stages also, the transverse cancellating liræ appear to be absent, leaving only a few revolving ones on the umbilical shoulder.

The suture is not well shown by my specimens. There is a narrow, bifid siphonal saddle with sigmoidal sides. The first lobe is extraordinarily narrow, not so wide as the siphonal saddle and less than half as wide as the second lobe. Both the lobes are tongue shaped. The saddles are rounded, the first a little broader than the second, and they are considerably higher than the siphonal saddle. The umbilical shoulder passes through the outer side of the second saddle and doubtless a third tongue-shaped lobe is situated on the

umbilical zone. The internal sutures consist of three tongue-shaped lobes of very nearly equal size and shape, two rounded saddles, also nearly equal, and half of two others, one at either margin, each being interrupted by the limit of the depressed zone.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Coalgate quadrangle, Okla.

Dimorphoceras lenticulare sp. nov.

This species is known only from one or two fragments but the characters shown are sufficient for a fairly complete description.

The shape is discoidal, much thicker at the umbilicus than at the venter. The size indicated is about 40 mm. in diameter and about 13 mm. in thickness. As only the septate portion is known, complete specimens must have been considerably larger. The umbilicus was small and the shell highly involute. The shape of the whorl section is somewhat triangular, slightly higher than broad. The sides are gently convex, strongly and regularly contracting to the ventral surface, which is narrow and sharply rounded. Probably, there was a more or less distinct umbilical shoulder and a narrow umbilical zone.

There is a broad, rounded ventral saddle with a median notch. The lateral sutures consist of two parts, that toward the umbilicus having large turns and that toward the venter having small ones. The small folds, which comprise two lobes and a saddle, can be thought of as a large lobe coördinate with those toward the umbilicus, which has been divided by a median saddle. The three plications thus formed are nearly equal, but the first lobe and the saddle are rounded, while the second lobe is tongue-shaped. The saddle is a little narrower than the two lobes, and the second lobe projects a little farther backward than the first. The remainder of the suture consists of high angular plications, a saddle and a lobe, together with the major part of another saddle, all of which probably comes within the limits of the visible suture when fully exposed. These lobes and saddles are asymmetrical and have more or less sigmoidal sides. They are so arranged that the point of the lateral lobe is almost in contact with the outer side of the preceding lobe somewhat less than half-way up. The final saddle is broad, rounded and asymmetrical.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Coalgate quadrangle, Okla.

Dimorphoceras oklahomæ sp. nov.

Shell lenticular in shape, thick in the middle, thin at the edges. Diameter 50 mm., thickness 20 mm. Highly involute with small umbilici (about 5 mm.). The whorl section is more or less triangular, with gently convex, converging sides, and narrow, strongly rounded venter. Umbilical shoulder distinct; umbilical zone narrow.

Ventral saddle rather narrow, indented on top. The two small ventral lobes are pointed and tongue shaped, the first one short, the second long and narrow. The saddle between them is rounded. There is not much difference between

these four lobes and saddles in the matter of width. If anything, the ventral saddle and the small lateral saddle are a little wider than the two lobes. The large lateral saddle and lobe are about equal, moderately narrow, with somewhat sigmoidal sides. The suture seems to form part of another large, rounded asymmetrical saddle. Only part of the outer limb of this is retained on the only specimen found, but probably the remainder appeared on the confines of the visible suture not exposed in the type.

This species is most closely related to *D. lenticulare*, from which it has been discriminated because of the suture. The differences manifested in this feature can hardly be ascribed to difference in age, because the two type specimens must have been nearly of a size and presumably at a corresponding stage of development. The differences noted are the narrower ventral saddle, the pointed instead of rounded shape of the first small lobe, and the much elongated shape of the second. The outer sides of the first large lobe are also more approximate. *D. oklahomæ* differs from *D. texanum* in about the same characters as those pointed out for *D. lenticulare*, but is rather more closely related. This is shown, for instance, in the first small lobe, which is pointed in *oklahomæ* and *texanum*, but rounded in *lenticulare*.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Okla.

Goniolobоceras wellеri var. gracile var. nov.

This species attains a diameter of 53 mm. in a fragment entirely septate. The type specimen, however, has a diameter of 43 mm., with a thickness through the center of 14 mm. The umbilici are small, only 3 mm. wide, and the whorls highly involute. The sides are gently convex, contracting to a very narrow venter marked by a revolving channel guarded by two thin, angular ridges. In the early stages the shell is less compressed and the venter less distinctly channeled. When still younger, the venter was probably rounded, but the two carinæ with their inclosed groove are largely a development of the test and do not show clearly on the internal mold. The surface appears to be marked by obscure, incremental liræ, the direction of which indicates a deep, broad, hyponomic sinus.

The suture consists of two lobes and two saddles on each side, together with a high, broad, siphonal saddle. This is rounded, but with a notch (?) on the median line. The latter feature is not clear. The suture lines bend sharply backward near the middle, but in most specimens they appear to be disconnected. In one, however, they appear to connect into a small V-shaped reentrant angle. The second saddle is broad and unsymmetrical. The first saddle and the two adjacent lobes are very nearly equal, the second lobe being slightly broader. They are subangular, but not acutely pointed. The sutures are closely arranged, the inner sides of the first saddles being almost in contact.

This form is closely related to *G. welleri*, but differs in some particulars. J. P. Smith figures two mature examples of *G. welleri*, and it is perhaps desirable to distinguish between the type and the auxiliary specimen. The type specimen of the variety *gracile* is a little more compressed than the specimens of *G. welleri*, but I am not sure that the difference would be constant. The venter also seems to be narrower and to show the channeled condition at a stage when the type of *G. welleri* was rounded. The sutures are more closely arranged than in Smith's second specimen, but not more so than in his type. This feature is better shown in the former, from which the detail was drawn, than in the latter. The sides of the lobes and saddles are more sigmoidal as given by Smith. They are very nearly a constant distance apart, whereas in the Wewoka form, they are almost in contact at one point as described above, and the first lobe is much narrower. These differences are not so marked in the case of the type specimen, but there the point of the second lobe is nearly in contact with the inner side of the lobe immediately preceding, an arrangment quite different from the variety *gracile*. Furthermore, Smith definitely states that the ventral saddle in his form is not notched, but has a tongue-shaped forward extension, whereas the extension in my shell is as certainly backward.

These differences appear to be rather constant for the material examined, and it seems unwarranted to consider the Wewoka form as quite identical with the other.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Coalgate quadrangle, Okla.

Crustacea

Griffithides parvulus sp. nov.

Carapace small, elliptical, length about 2.5 times the width, nearly equally divided between cephalon, thorax and pygidium. The head, however, even without the genal angles, is longer than the pygidium.

Cephalon semi-elliptical in shape, considerably wider than long (if the width is measured from the anterior extremity to the edge of the neck ring), rather tumid. Genal angles prolonged into spines of undetermined length. A broad, striated border passes around the arc of the cephalic shield, terminating posteriorly in the genal spines. The border is strongly arched or subangular transversely, so that the outer surface is directed obliquely downward and outward, and the inner surface obliquely downward and inward, thus causing it to be defined from the inner parts of the cephalon by a deep sulcus. The sulcus dies down to a depressed line as it passes around the front of the glabella, and at the same time the direction of the border be-

comes so changed that its surface is essentially vertical, and so that the anterior outline of the glabella is terminal, when the head is seen from above. Outline of the facial suture very sinuous. The sutures almost come together at the end of the glabella, diverging strongly as their course is traced backward. At the sulcus which defines the border, they assume an opposite direction, contracting gently for an equal distance. They make a strong arch around the palpebral lobes and from the neck furrow pass somewhat obliquely outward to the articulating margin. Glabella much wider toward the front than behind, occupying nearly the whole of the cranidium, so that there is little of the fixed cheek, except the rather small palpebral lobes. The neck furrow is strong and broad, passing almost directly across the cephalon to the two sulci defining the border. The neck ring is very broad, oblique, prominent, much wider than the sort of band with which it is continuous, which is produced on either side by the neck furrow. The posterior part of the glabella is subdivided into three knob-like lobes by two oblique furrows cutting off the corners, so to speak, and a cross furrow connecting these parallel to, and a little in front of, the neck furrow. These lobes are rounded, and the furrows between coalesce around them into an undefined depressed area. A partial and indistinct transverse furrow, a little in front, indicates a second annulation of the glabella. The glabella is tumid, the palpebral lobes and neck ring very prominent. The large, elliptical, many-faceted eye is strongly oblique and the free cheek just external to the eye also slopes strongly downward toward the border. A small subangular ridge passes around the outer margin of the eye.

The somatic segments are 9 in number, with a highly arched axial lobe which comprises about one third of the entire width. The pleural lobes are much depressed and defined from the axial portion by sharp sulci. They are nearly planate over the median portion, but bend strongly and abruptly downward about half way to the extremity. The pleural portion of each segment is subdivided by a furrow which reaches almost to the axis.

The pygidium is semi-elliptical in outline, broadly rounded posteriorly and with a broad, smooth, oblique and depressed border which narrows somewhat anteriorly. The axis is strongly and sharply elevated and defined by well-marked grooves. It is flattened on top and nearly quadrate in section. The lateral lobes are moderately inflated, the convexity being irregular, so as to produce an angulation down the center of each, appearing on the segments on either side as a row of prominences or nodes. The segmentation of the pygidium is strong, produced by deep, sharp grooves which do not extend onto the border nor onto the sides of the pygidium. They produce about 12 axial rings and about 7 lateral ones.

The surface is marked by granules or small nodes which appear on the more prominent parts of the surface, on the basal portion of the glabella, on the crest of the neck ring, along the little ridge under the eyes, and in rows across the segments of the axis of both thorax and pygidium. The pleural segments are either without these nodes or have them fewer, smaller and less conspicuous.

If we except *Griffithides sangamonensis*, which I believe to be a *Phillipsia*, only two species of *Griffithides* are known in our American Pennsylvanian, *G. ornatus* and *G. scitulus*, and of these only *G. ornatus* appears to be marked with nodes like the present form. In many respects *G. parvulus* is very similar to *G. ornatus*, but aside from being very much smaller, it presents important and striking differences in the configuration of the basal portion of the glabella.

Horizon and locality: Wewoka formation; Wewoka quadrangle, Okla.