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THE FAUNA OF THE CANEY SHALE OF OKLAHOMA

BY

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THE FAUNA OF THE CANEY SHALE OF OKLAHOMA.

By George H. Girty.

INTRODUCTION.

Owing partly to a deficiency of evidence and partly to the ambiguous or even conflicting character of what we have, the problems presented by the Caney shale are peculiarly baffling. They involve two distinct areas in Oklahoma, and in their relations to other regions ramify extensively.

The Caney shale occurs in numerous exposures through the Arbuckle and Ouachita mountains, in the central parts of the Choctaw and Chickasaw nations, respectively. It consists of black and blue argillites with local sandy strata in the upper part, and has a maximum thickness of more than 1,000 feet. While most of the Caney is a black shale, the upper portion comprises beds of a lighter color which may have a different fauna. This paper deals only with the fauna of the black shales.

The stratigraphic relations of the Caney are difficult to state in general terms, for it is both underlain and overlain by different formations in different areas. Although so close geographically that one can be seen from the other, the Arbuckle and Ouachita mountains present sections which are in some respects strikingly different. In the Arbuckle region the Caney shale rests usually upon the Woodford chert, but over part of the area the Sycamore limestone intervenes between the Woodford and the Caney, thickest in the west and dying out entirely in the east. It is correlated with an undifferentiated lower division of the Caney in other areas. Beneath the Woodford occurs the Hunton limestone of Silurian age, the contact between the two formations being an unconformable one. The Woodford contains varying amounts of black shale and where the Sycamore limestone does not intervene appears to graduate into the overlying Caney.

In the Ouachita area the Caney rests upon the Jackfork sandstone, which in turn rests upon the Standley shale. The Standley shale is underlain unconformably by the Talihina chert of Ordovician age. The Standley and Jackfork, which together have a thickness of no less than 10,000 feet, are found beneath the Caney at all points in the Ouachita Mountain region, except in a single area in the southern part of the McAlester quadrangle; in that area the Standley and Jackfork of the regular Ouachita section are absent and also the Woodford chert and Sycamore limestone of the Arbuckle area, and the Caney appears to rest directly upon a chert of Silurian age correlated with the Hunton limestone, which is found at no other point in the Ouachita region.

It thus appears that the Jackfork sandstone and Standley shale of the Ouachita region are not found in the Arbuckle region and that the Woodford chert and Sycamore limestone of the Arbuckle region are not found in the Ouachita region. That the Woodford and Sycamore are absent from the Ouachita region is not cause for surprise, for they are relatively thin and are not persistent even in the Arbuckle region, but that two formations like the Standley and Jackfork, aggregating 10,000 feet in thickness, should occur in one section and be entirely absent from another only a few miles distant seems almost impossible. This is, however, only one of several anomalies.

If we should attempt to ascertain the position in the Arbuckle section of the Standley and Jackfork formations it would be natural to think that the unconformity below the Standley corresponds to the unconformity below the Woodford. The Woodford and Sycamore might be regarded as local or regional modifications of Caney deposition, and, that formation being found in both areas, the Standley and Jackfork would afford a partial measurement of the unconformity in the Arbuckle section by reason of their absence there. This, by all means the most promising explanation of the occurrence of the Standley and Jackfork, is sharply negatived by what appears to be the geologic age of the beds.

In the Tishomingo folio the Woodford chert is referred to the Devonian, the fossil evidence, which was obtained from the lower part of the formation, being said to consist of a small *Lingula*, some species of conodonts, and fossil wood of the genus *Dadoxylon*. This evidence is certainly inconclusive as thus stated, since conodonts are abundant in certain black shales of the "Coal Measures," since *Dadoxylon* also occurs in the "Coal Measures" as well as in the Devonian, and since few paleontologists would attach much importance to a small *Lingula*, especially unassociated with a more characteristic fauna. The *Dadoxylon* proves to be *D. newberryi* of the Devonian black shale of Ohio, and the lower Woodford which furnished the specimen referred to must be regarded as probably of Devonian age. However, as there are few species of invertebrates upon which, if occurring in similar circumstances, one would place absolute reliance, it does not seem to me that the Devonian age of the lower Woodford is beyond the reach of future revision.

It is rare to find exposures of the basal portion of the Caney shale. At this horizon in the eastern part of the Ouachita Mountain region, however, lines of large bowlders containing Ordovician fossils were observed in 1899, but exposures of the formation sufficient to determine the relations of these limestone bowlders to the shales were not seen by parties engaged in areal surveys until the season of 1904. The bowlders were originally supposed to represent solid ledges intervening between the Caney and Jackfork, so that the latter formation, together with the underlying Standley shale, would of necessity be of Ordovician age or older. In later surveys it was determined that the bowlders in question did not belong to continuous ledges but to a peculiar basal conglomerate. About the same time plant remains, which seemed to be of Carboniferous age, were obtained from a horizon well down in the Standley. Thus the position in the Arbuckle section of the Standley and Jackfork appears to be above the lower Woodford and below the Caney.

But even if it were possible, as at present it is not, to carry all of the beds of the Arbuckle section, down to the base of the Woodford, over into a position immediately above the Jackfork sandstone in the Ouachita region, an apparent conflict of evidence would still confront us.

A number of years ago I determined the age of the Caney shale as upper Mississippian,[a] but the appearance of evidence which made it reasonably probable that it was underlain by some 10,000 feet of Carboniferous sediments seemed to justify a doubt as to the correctness of the first determination, and in 1905[b] I suggested that the geologic age might in fact be Pennsylvanian.

It seems very unlikely that the Caney is really upper Mississippian if it is underlain by so great a thickness of strata also of upper Mississippian age, and it is, therefore, necessary to examine carefully all aspects of what appears to be almost an impasse. The situation would be relieved if the Caney of the Arbuckle region were of Mississippian age and distinct from the Caney of the Ouachita, which from its position above the Standley and Jackfork may have to be considered of late Mississippian if not Pottsville age. The lithologic evidence, the stratigraphic evidence, and the paleontologic evidence all unite, however, in identifying them as essentially the same series of beds. If it could be shown that the stratigraphic relations of the Standley and Jackfork with regard to the Caney

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[a] Atoka folio (No. 79), Coalgate folio (No. 74), and Tishomingo folio (No. 98): Geol. Atlas U. S., U. S. Geol. Survey.

[b] Proc. Washington Acad. Sci., vol. 7, 1905, p. 13.

shale of the Ouachita region are, in appearance or in fact, the result of structural forces, and that these formations really correlate with Pennsylvanian sandstones and shales which overlie the Caney in the Arbuckle region, two difficulties would be removed at once, since we should not have a Mississippian fauna overlying a Pennsylvanian (?) flora, and we should not be confronted with the anomalous fact of the absence of the Standley and Jackfork in the Arbuckle region. But other difficulties would doubtless be thus created, and, in fact, the stratigraphic evidence seems to be convincing and to prohibit the hypothesis that the Caney does not in fact overlie the Jackfork, but underlies the Standley.

The age of the Standley is not established beyond all peradventure, for the plant remains thus far obtained are scanty and fragmentary. Indeed, David White's interpretation of the evidence does not assign the age definitely. His statement is somewhat as follows:

> All the material, except one specimen of *Asterocalamites scrobiculatus* and the single minute fern pinnule, is more or less macerated and obscure, the collection consisting chiefly of drift-rounded or comminuted and more or less macerated bits of stems, roots, and bark, of no value except as showing that they fall within the epoch of vascular or woody plants (post-Silurian). The material is not of a nature or state of preservation to justify anything like a close correlation. The plant beds are Carboniferous. It is probable that they belong either in the upper part of the Mississippian or in the lower Pottsville, but this point requires additional paleontologic data for its determination.

Although, as seen from the foregoing quotation, the plant evidence indicates that the Standley is as old as the upper Mississippian, or as young as the Pottsville, the one condition is well nigh as bad as the other, for with the Standley as upper Mississippian, while we should not be confronted with an absolute contradiction of the faunal evidence obtained in the Caney, what we know of the lithologic character and the thickness of the upper Mississippian in other areas would still make it difficult to account for 10,000 feet of sediments of that age in the Ouachita region. No really definite statement as to the age of the plants seems to have been justified, however, save that they are Carboniferous, and even this is qualified as apparently less of a certainty by the preceding statement to the effect that they are surely post-Silurian.

The faunal evidence furnished by the Caney is much more extensive than that of the fossil plants referred to above. The Caney fauna has a facies widely different from that of the typical upper Mississippian faunas, and it would be difficult to determine its position in the time scale were it not that it is closely related to certain faunas in Arkansas which contain more of the typical upper Mississippian species, and which have long been regarded as belonging to that period. When I originally determined the Caney as neo-Mississippian, I did so because its fauna was so closely allied with that of the Moorefield shale of Arkansas. If, upon returning to the subject with a presentation of one side of the evidence upon which this conclusion was based, it were possible to say that the preliminary opinion had been erroneous, it would afford me real satisfaction as opening a way out of the present difficulties. But a more detailed study of the one fauna and a hasty review of the other have only added to the weight of the evidence. A large number, and those in many cases the most striking and typical of the Caney species, occur also in the Moorefield shale.

The table below gives the fauna of the Caney shale as it is at present known.

Distribution of the Caney fauna.[a]

[Asterisk indicates identical or nearly identical species occurring in the Moorefield shale, the Batesville sandstone, and the Fayetteville shale of Arkansas.]

	2047.	2057.	2075.	2076.	2077.	2078.	2079.	2080.	2081.	2082.	2083.	2084.	2085.	2086.	2087.	2088.
Lingula paracletus					×											
*Lingulidiscina newberryi var. caneyana					×											
*Lingulidiscina newberryi var. ovata			×	×									×			
*Lingulidiscina batesvillensis				×												
Chonetes planumbonus var. choctawensis					×								×			
*Productella hirsutiformis					×									×		
*Productus pileiformis							×									
*Liorhynchus aff. mesicostale					×											
*Liorhynchus aff. laura			×										×			
*Spirifer sp					×											
*Martinia sp													×			
*Composita ? sp.					×											
Deltopecten ? caneyanus					×								×			
*Caneyella wapanuckensis		×	×			×	×			×						
*Caneyella vaughani						×		×				×	×		?	
*Caneyella nasuta	×															
*Caneyella percostata						×				?		×				
Caneyella richardsoni						×			×		×					
Parallelodon multiliratus													×			
Conocardium sp					×											
Laevidentalium venustum											×					
Pleurotomaria ? sp.										×						
Naticopsis sp.										×						
Macrocheilus ? sp							×			×						
Orthoceras wapanuckense							?			×						
Orthoceras caneyanum			×			×	×	×								
Orthoceras crebriliratum			?			×					×					
*Orthoceras choctawense							?									
Orthoceras indianum						×										
Orthoceras sp		×														
Cycloceras ballianum											×					
Actinoceras vaughanianum								×		?						
Cyrtorhizoceras ? hyattianum										×						
Coelonautilus gratiosus										×						
Bactrites ? quadrilineatus											×					
Bactrites ? smithianus					?				×	×	×					
Gastrioceras richardsonianum		×	×	×	×		×			×						
*Gastrioceras caneyanum	×					×	×	?	?							
*Goniatites choctawensis	×					×			×		×	?				×
*Adelphoceras meslerianum						×					×					
*Eumorphoceras bisulcatum		×	×				×			×		×				
Trizonoceras lepidum						×	×			×						

[a] The numbers heading the columns refer to localities similarly designated in the locality register on pp. 73-75.

Distribution of the Caney fauna—Continued.

	2089.	2090.	2091.	3948.	3981.	3982	3983.	3984.	3985.	3986.	3987.	3988.	5113.	5114.	5944.
Lingula paracletus		×													
*Lingula albapinensis	×									×		×			×
*Lingulidiscina newberryi var. caneyana	×	×					×					×			
*Lingulidiscina newberryi var. ovata										×					
*Productella hirsutiformis					×										
*Martinia sp	×														
*Composita ? sp		×													
*Caneyella wapanuckensis			×	×											
*Caneyella vaughani													?		
*Caneyella nasuta							×								
Parallelodon multiliratus	×														
Idiotheca rugosa														×	
Laevidentalium venustum			×	×											
Macrocheilus ? micula			×												
Orthoceras wapanuckense				?			?								
Orthoceras caneyanum								?							
Orthoceras crebriliratum			×												
*Orthoceras choctawense			×												
Gastrioceras richardsonianum			×	×		×			×				?		
*Gastrioceras caneyanum								×					?		
*Goniatites choctawensis								×					?		
Goniatites newsomi								×							
Goniatites sp. *a*											×				
Goniatites sp. *b*															×
*Adelphoceras meslerianum								×							
*Eumorphoceras bisulcatum			×	×									×		
Trizonoceras typicale				×											
Trizonoceras lepidum			×	×											
Entomis unicornis					×										
Cytherella aff. benniei					×										

The ordinary inference from these facts, one which I should draw without hesitation were it not for the bearing of the plant evidence found in the Standley, is that the Caney and the Moorefield-Fayetteville beds were contemporaneous in a geologic sense.[a] But this, it may be urged, does not necessarily entail the Mississippian age of the Caney without carrying the inquiry one stage further. Careful consideration has been given the hypothesis that the Moorefield-Fayetteville beds may be not Mississippian but Pottsville in age. While some circumstances lend a color of probability to such an hypothesis, the negative evidence seems at present to warrant its rejection.

If, then, the Caney correlates with the Moorefield, if the Moorefield is of Mississippian age, if the Caney rests on the Jackfork sandstone, and if the evidence furnished by the Standley flora halts between upper Mississippian and Pottsville, the conclusion that the Standley is upper Mississippian and that the sedimentation of that period was peculiar and excessive in the Ouachita region seems to involve the fewest inconsistencies. This conclusion is tentative and unsatisfactory, but seems to accord best with the evidence known to me. Future discoveries may prove it wrong.

If the lower Woodford is really of Devonian age the position of the Standley and Jackfork in the Arbuckle section must evidently be above the lower Woodford and below the Caney, in spite of the

[a] The White Pine shale of Nevada, which is also a black shale formation, likewise contains a fauna similar in many respects to that of the Caney.

fact that the Woodford and Caney appear from lithologic and stratigraphic evidence to present continuous sedimentation. The typical Woodford has thus far furnished very little in the way of organic remains, but such little as we possess does not tend to ally it with the Caney.

If the Standley flora when better known should prove unmistakably of Pottsville age a satisfactory explanation will, it now seems, be impossible. Either one line of evidence or the other, the plants or the invertebrates, must be misleading. Several hypotheses would then be open for consideration. Assuming only that the invertebrate evidence is at fault, we must conclude that this fauna survived for a very long time with but little change in its composition. One contingent hypothesis would be that the basal beds of the Caney in the Arbuckle region were essentially the same as the basal beds of the Moorefield shale of Arkansas, and that while extensive and varied sedimentation conjoined with various faunal changes were taking place in other areas—northern Arkansas and the Ouachita region being most in point—in the Arbuckle region the sedimentation was relatively limited, uniform, and without marked modification of organic life. On this hypothesis the Standley and Jackfork would be represented by sediments in the Arbuckle region (part of the Caney shale). An alternative hypothesis would be that there was an interruption in Caney sedimentation in the Arbuckle region during which the Standley and Jackfork were laid down in the Ouachita region, only the lower part of the Caney of the Arbuckle region being equivalent to the Moorefield shale, and only the upper portion being equivalent to the Caney of the Ouachita region. This would involve an unconformity in the midst of the Arbuckle Caney during which 10,000 feet of sediments were being laid down in the Ouachita region without any lithologic or stratigraphic evidence of interruption in the sedimentation or any appreciable break in the faunas. Neither hypothesis seems very satisfactory on general principles, and, so far as I can see, the evidence favors one little more than the other. A third hypothesis would be that the Caney of the Arbuckle region is wholly of Mississippian age and in position really inferior to the Standley but unrepresented in the Ouachita region; while a fourth would be that the Arbuckle Caney and the Ouachita Caney are the same bed and of Pottsville age, while the Moorefield-Fayetteville beds are distinct and geologically much older.

Of these four propositions the last seems the most probable to me, because the faunas of the Caney in the Arbuckle and Ouachita regions appear to show closer alliance with one another than with the Moorefield fauna, striking as that certainly is. All four of these hypotheses are dependent, it will be observed, upon the theorem that the Caney fauna began in upper Mississippian time and continued without any marked change of facies for a protracted period, probably into the Pottsville. I know of no precedent for such an assumption and am strongly opposed to adopting it in the present case unless subsequent evidence renders it unavoidable and overthrows the provisional explanation which is here adopted.

The account of the Caney fauna which is to follow is based upon 31 collections, several instances in which practically the same point was visited by different parties not being counted separately. Geographically these represent seven different quadrangles, as follows: Antlers quadrangle, stations 2075, 3948, 3983, 3984, 3986, 3987, 3988; Ardmore quadrangle, stations 3981, 5944; Atoka quadrangle, stations 2076, 2077, 2082, 2089, 5114; McAlester quadrangle, stations 2078, 2079; Stonewall quadrangle, stations 2080, 2081; Tishomingo quadrangle, stations 2083, 2084, 2085, 2086, 2087, 2088, 2090, 2091, 5113 (?); Tuskahoma quadrangle, stations 2047, 2057, 3982, 3985. The collections from the Antlers, McAlester, and Tuskahoma quadrangles belong to the Ouachita section; those from the Ardmore, Atoka, Stonewall, and Tishomingo quadrangles belong to the Arbuckle section.

Stratigraphically these collections all had their origin in the Caney shale (the assignment of lots 2080 and 2081 being upon faunal grounds) except lot 5114, which probably belongs to the Woodford. The stratigraphic relations of the exposures where fossils have been found in the Caney shale are often indeterminate by reason of faulting and the lack of continuous exposures. In most cases where it was possible to determine the stratigraphic relations of collections they proved to have come from the middle or lower part of the series. The single collection (3984) which seems probably to have been derived from the upper part proves to have the same fauna as those below.

In this connection it is necessary to mention lot 3981, which comprises the few fossils cited from the "Upper Woodford" in the Tishomingo folio. By an unfortunate misunderstanding the limits of the Caney and Woodford were not taken at the same points in the section by the geologist and paleontologist working in this quadrangle, with the result that the Caney is mapped and described as limited below by the top of the cherts; while Ulrich, who reported upon the Woodford fossils, included in that formation under the title "Upper Woodford" a more or less extensive amount of the black shales above the chert series which really belong in the Caney, as elsewhere defined and as employed in the present report.

As based upon the fossils from station 3981, the "Upper Woodford" (that is, the lower part of the Caney shale) was assigned to the Kinderhook period. The only recognizable fossils are said to be two concentrically plicated species of *Productella*, one of which seemed referable to *Productella concentrica*. The *Productella* is wrongly identified as *P. concentrica*, which is a common fossil of the Chouteau limestone, and proves to be *P. hirsutiformis*, a characteristic brachiopod of the Caney shale and one characteristic also of the Moorefield shale of Arkansas. It is practically certain, therefore, that the age of this part of the Caney is not Kinderhook but considerably younger. The fossil evidence from the Woodford is still very incomplete, but so far as known there is no faunal or floral connection with the Caney.

The fauna of the Caney shale as at present known comprises 49 species of invertebrates, but the present paper by no means presents an account of all the organic life of which this formation has furnished evidence.

Prominent among the classes of organisms which are omitted are the plants, of which there are sometimes abundant though ill-preserved vestiges. These oftenest take the shape of impressions or replacements of wood or stems, and they frequently occur in immediate association with the goniatites and other cephalopods. Another neglected type is the fishes, represented not only by teeth but by what appear to be fragments of bone. In this connection may be mentioned agglomerations of organic fragments, possibly of coprolitic origin, which occur as a rule in small concretions. There are also singular organic remains, quite fragmentary, whose biologic relations I would not venture to designate. Even among the recognizable Invertebrata a variety of forms, chiefly pelecypods, have been left without especial notice, because they are so imperfectly preserved that even a generic reference would be largely guesswork. Among these the following very provisional identifications may be mentioned: From station 2077 *Yoldia?* sp., *Schizodus?* sp.; from station 2079 *Deltopecten?* sp.; from station 2082 *Aviculipecten?* sp. and plant remains; from station 2084 *Microdon?* sp.; from station 2089 *Nucula?* sp., *Macrodon?* sp. Miscellaneous indeterminata have also been found at stations 2075, 2077, 2079, 2082, 2083, and 5114.

As already noted, the Caney fauna is a peculiar one, the dominating type, not only in differentiation of species but in abundance of individuals, being the cephalopods, a group which in most faunal associations of Carboniferous age is inconspicuous. The brachiopods are poorly represented compared with the usual faunas of this period, and in their occurrence are rather infrequently associated with the cephalopods. Where they occur at all, however, they are sometimes fairly abundant if restricted to a relatively few species. Lingulas, discinoids, one or two species of *Liorhynchus*, and *Productella hirsutiformis* are the dominant brachiopod forms—an association so primitive in its facies that when first discovered in Arkansas in a somewhat modified form Prof. H. S. Williams was led to notice it under the title "On the recurrence of Devonian fossils in strata of Carboniferous age." [a]

While I have spoken of the Caney fauna as a unit and regard it as such, there thus appear to be two different facies of a sort contained in it. A typical example of one of these was collected by G. B. Richardson and myself near the hamlet of Wapanucka in a position but little above the Woodford chert. It comprises brachiopods and some pelecypods, most of the latter, unfortunately, indeterminable, and has not been found in its entirety at other points. The other facies consists characteristically of goniatites and some other cephalopods, with one or more species of the pelecypod genus *Caneyella* usually accompanying them. Other types are rare. The goniatite fauna comes in at Wapanucka near that containing the brachiopods, and at a slightly higher horizon.

Fossils are of sporadic occurrence in the Caney shale, and in many places the stratigraphic relations of its outcrops can not be definitely determined. It seems to be true, so far as now known, that this same relation is generally prevalent and that the brachiopod facies usually occurs in the lower part of the formation. There is no well-marked faunal break, however, between the collections in which the brachiopods predominate and those composed chiefly of cephalopods, and it seems almost certain that they represent two different facies of the same fauna rather than two different faunas. This inference seems justified not only by the absence of any break in the Caney fauna, but by the apparently uninterrupted character of Caney sedimentation, and by the fact that the two facies, which in the Caney are to a certain extent independent, occur in the Moorefield shale of Arkansas. A few of the Caney goniatites also seem to occur in the Batesville sandstone and in the Fayetteville shale, and on this account the evidence would seem to indicate, with the qualifications set down above, that the Caney shale correlates with these formations as well as with the Moorefield.

The faunal evidence known to me not only warrants the belief that the Caney fauna is best regarded as a unit, but seems to justify the correlation of the Caney shale of the Arbuckle region and the Caney shale of the Ouachita region as essentially the same series of beds.

Aside from the geologists who aided in securing the material upon which this report is based and whose names are given in the locality register in connection with the collections with which they were severally concerned, especial acknowledgments are due to J. A. Taff for valuable suggestions and for the revision of such portions of this account as deal more directly with field relations.

[a] Am. Jour. Sci., 3d ser., vol. 49, 1895, pp. 94–101.

DESCRIPTIONS OF SPECIES.

BRACHIOPODA.

Genus LINGULA Brugière.

LINGULA PARACLETUS Hall and Clarke.

Plate I, figures 1–5.

1892. *Lingula paracletus.* Hall and Clarke, Geol. Surv. New York, Pal., vol. 8, pt. 1, p. 172; pp. 10, 12, fig. 8.
Cuyahoga shale: Chardon, Ohio.

1895. *Lingula paracletus.* Hall, New York State Museum, 48th Ann. Rept., 1894, vol. 2, p. 326, fig. 1.
Cuyahoga shale: Chardon, Ohio.

1895. *Lingula paracletus.* Hall, New York State Geol., 14th Rept., 1894, p. 326, fig. 1.
Cuyahoga shale: Chardon, Ohio.

The shell from the Caney shale which I have referred to this species attains a rather large size and has an ovate shape. The length varies from one and one-half to one and one-third times the greatest width, which occurs about one-third the length from the anterior margin. The shell contracts very gradually above, with a curved outline, and the anterior end is broadly rounded. The shape varies considerably in different specimens, both in the proportional width and in the outline of the posterior end. Some of the variation can safely be ascribed to compression and some to difference in age; since the smaller, and presumably younger, examples as a rule appear to be more slender than the mature ones. The shape of the posterior end and the proportional width depend in a measure upon the identity of the valve as a dorsal or ventral, for specimens retaining both valves in conjunction show that the posterior extremity of the dorsal valve is rather obtusely or abruptly terminated, while the ventral, more pointed in shape, projects considerably beyond. Nevertheless, it is frequently impossible to say with any assurance whether a given specimen is a dorsal or a ventral shell. In the ventral valve the beak is terminal, but in the dorsal it is situated a short distance in front of the posterior edge, which seems to be folded strongly inward.

The convexity, especially of the dorsal valve, is considerable, and when flattened, as it occurs in the Caney shale, the shell is often fractured.

The external surface is marked by numerous irregularities of growth and by extremely fine concentric liræ.

On its interior the ventral valve has a large, deep pedicle groove, from which proceed the strongly diverging vascular sinuses. The latter, though sharply defined at first, can be traced only a short distance. In the median portion there are two thin gently diverging septa, which begin just below the pedicle groove and extend forward about one-third the length of the shell. At their anterior ends are other impressions, too indistinct to be described, which are in part probably those of a pair of median laterals. The apical portion of the shell on either side of the pedicle groove is transversely striated. The margin of contact is broad. In the dorsal valve no area corresponding to that of the ventral has been observed. This valve apparently terminates in a narrow reflexed margin (the edge of the shell posterior to the beak), upon which no area at all, or at most an extremely narrow area, has been developed. The muscular impressions in this valve are also too faint to be preserved; at least none have been observed.

In the Caney shale this species attains a length of 16 mm. and more, but considerable variation is found to exist in material from different localities. The specimens obtained by G. B. Richardson and myself from station 2077 are nearly all large. Those collected by J. A. Taff at almost the same locality are small, averaging about 9 mm. in length. Of about this size also is the collection obtained from station 2090. The small variety agrees in all essentials with the more robust form, and no good purpose, it seems, would be served by attempting to distinguish them.

The internal characters above noted are not altogether those of the typical form of *L. paracletus*, and to some extent they are suggestive of *Barroisella*. The high cardinal area of the pedicle valve, the two septa, as I have denominated them, which may be the elevated margins of a low median ridge, and other structures are in point. I think that too little is known of the present form to determine whether it is really a representative of *Barroisella*, but though the external characters are those of *Lingula paracletus* this may well prove to be the case.

This form resembles a number of species from our Carboniferous rocks, but appears to be most closely allied to the Waverly shell to which Hall and Clarke gave the name *Lingula paracletus*. Basing a comparison with *L. paracletus* entirely upon their figure and description, I find a close agreement in almost every particular. It is in the matter of internal markings alone that any essential differences can be pointed out, and it is only upon consideration of their close agreement otherwise, and upon the belief that the differences of internal character may be due to preservation under different conditions, that an identification of this with the Ohio species is recorded.

The smaller examples of *L. paracletus* are similar to *L. melie*,[a] another Waverly species, but they are proportionately broader, and instead of contracting slightly toward the front, as do most specimens of *L. melie*, enlarge, or at least maintain their greatest width, to a point anterior to the habit in Hall's species.

The Caney shell has the same general shape which Herrick shows in his figures of *L. meeki*,[b] but it is a proportionately narrower form, with a broader posterior outline, and it attains a larger size than is known in that Waverly species.

Another related form is that to which Miller and Gurley gave the name *Lingula indianensis*.[c] I have no specimens with which to make comparison, and can only point out that *L. paracletus* is a shorter and broader form, in which the convexity is apparently somewhat greater and in which the flattened margins cited as characteristic of the Keokuk species are lacking.

The smaller form of *L. paracletus* also resembles certain Devonian types, as for example, *L. ligea*[d] and *L. spatulata*,[e] but it is less elongate than either of the species mentioned and much smaller than *L. spatulata*.

Horizon and locality.—Caney shale, Atoka quadrangle (station 2077), Tishomingo quadrangle (station 2090).

LINGULA ALBAPINENSIS Walcott.

Plate I, figures 6, 6a, 7, and 8 (?).

1884. *Lingula Albapinensis*. Walcott, U. S. Geol. Survey, Mon. 8, p. 108, pl. 2, fig. 1.

Upper Devonian: White Pine district, Nevada.

This species is rather plentiful at station 3986 and occurs, though less abundantly, at other points. It is always of small size, rarely exceeding 7 mm. in length. The shape is narrow, elliptical, the widest portion being posterior to the middle. The surface is marked by very fine, regular, concentric striæ.

This species differs from that referred to *Lingula paracletus* in its smaller size and different shape, and though occurring in the same beds it has not been found associated with the latter except in one doubtful instance. From such evidence as I have seen this appears to be not a youthful stage of *L. paracletus*, but an independent form. In the characters which can now be ascertained it is very similar to

[a] New York State Cab. Nat. Hist., 16th Rept., 1863, p. 24.
[b] Bull. Sci. Lab. Denison Univ., vol. 4, 1888, p. 18, pl. 10, fig. 31.
[c] Bull. Illinois State Mus. Nat. Hist., No. 3, 1894, p. 69, pl. 7, fig. 1.
[d] New York State Cab. Nat. Hist., 13th Rept., 1860, p. 76.
[e] Geol. Surv. New York, Rept. 3d dist., 1842, p. 168, fig. 3.

if not identical with the species from the White Pine shale of Nevada which Walcott described as *L. albapinensis.*

Lingula albapinensis considerably resembles in miniature *L. melie*, which occurs abundantly in northern Ohio in the Sunbury ("Berea") shale of the Waverly group. The resemblance is really closer than Hall's figures would lead one to suspect, as many specimens of *L. melie*, perhaps the larger number, differ from one of the figures in narrowing toward the front, and from the other in being less acutely pointed behind. I can not, however, regard *L. albapinensis* and *L. melie* as being the same.

L. spatulata Hall from the Genesee shale is also similar and invites comparison because it likewise is a diminutive species. Hall's figures, however, show a more slender variety and one whose shape is spatulate, as distinguished from more truly elliptical.

Horizon and locality.—Caney shale, Atoka quadrangle (station 2089), Antlers quadrangle (stations 3986, 3988), and Ardmore quadrangle (station 5944).

Genus LINGULIDISCINA Whitfield.

This term is here provisionally employed in a sense not hitherto used, namely, for the group of shells now usually referred to *Orbiculoidea. Orbiculoidea*, as the term has been applied, at least by American writers, owes its interpretation to Hall and Clarke, from whose valuable monograph the following quotation is derived:

> The genus *Orbiculoidea* of D'Orbigny was first defined and exemplified in the Prodrome de Paléontologie, vol. i, p. 44, the date of this work being 1850 not 1849. Dall is in error in stating that *Orbicula Morrisi*, Davidson, is the first species mentioned under the diagnosis quoted. D'Orbigny here gives three species in the following order: *O. Forbesi*, Davidson, *O. Morrisi*, Davidson, *O. Davidsoni*, D'Orbigny. As no species is specially designated as the type of the genus we are compelled to assume these three as types in their order and upon their merits. It is shown on page 136 that the first of these, *O. Forbesi*, Davidson, is unquestionably congeneric with *Schizotreta elliptica*, Kutorga, Kutorga's genus having been established in 1848. As this species, therefore, can not be used as the type of *Orbiculoidea*, we must assume the second species as the typical representative of the genus, and upon this is based the distinction throughout the foregoing pages in the use of this term *Orbiculoidea* by D'Orbigny and by Davidson. At the place cited in the "Prodrome" the date "1847" stands after the name of the genus. The explanation of its use appears upon page lix of the Introduction, and the date of publication of the work renders its adoption untenable.[a]

The method here employed of determining the generic content of *Orbiculoidea* appears to be that, so called, of residues, a system open to serious objection, and much more frequently found in use among botanists than zoologists. I believe that the rule among the latter,

[a] Geol. Survey New York, Pal., vol. 8, pt. 1, 1892, p. 160.

that unless a genotype is selected by the author the first-named species shall be employed, is far preferable, and I propose to apply it in this case. In adopting this course I have the fewer doubts, in that D'Orbigny did not arrange his species of *Orbiculoidea* alphabetically. Upon this interpretation, *O. forbesi* must stand as the type of the genus, which, inasmuch as Hall and Clarke state that that species is the same as *Schizotreta elliptica*, becomes a synonym of *Schizotreta*.

I have not been able to examine specimens of *Lingula exilis*, the species which Whitfield assumes for the type of his genus *Lingulidiscina*, but so far as his description and figures depict the fundamental characters, I can not see that *Lingulidiscina* is aught else than an *Orbiculoidea* (using the term at its current value), in which the apex is very eccentric. It requires no great experience among this group of discinoids to show the entire futility of attempting to use the position of this feature as a generic character. On this account I have substituted *Lingulidiscina* for *Orbiculoidea* in its commonly accepted usage. Since it may prove, however, that *L. exilis* really possesses characters which are not enumerated by Whitfield, and which force a discrimination from the *Orbiculoidea* group, *Lingulidiscina* is here used for the latter only provisionally.

Some suspicion that this will be found to be the case is aroused by the fact that Schuchert places *Oehlertella* as a synonym of *Lingulidiscina*. If the structural differences pointed out by Hall and Clarke are not accidental, I should recognize that genus as distinct, whether from typical *Lingulidiscina* or the present group, but one may infer from Schuchert's course that he believes the characters are accidental, rather than that he considers them inadequate for taxonomic purposes. If he is correct in this I should follow him in making *Oehlertella* a synonym for *Lingulidiscina*. *Orbiculoidea newberryi*, which he places with *Lingulidiscina*, is certainly a member of the *Orbiculoidea* group.

LINGULIDISCINA NEWBERRYI var. CANEYANA n. var.

Plate I, figures 13–17.

This species is extremely abundant at station 2077 and is found also, more sparingly, at several other points. It occurs in a shale of dark color and sandy texture, and specimens are generally both macerated and compressed. It is difficult, therefore, to determine some of the specific characters. Holding in mind this qualification, I have drawn up the following description.

The outline was essentially circular, with the apex of the dorsal valve near the posterior margin, perhaps two-thirds of a radius from the center. The dorsal convexity was probably rather low.

The ventral valve was nearly flat, the pedicle slit being narrow, only slightly depressed, and not so conspicuous as in some species.

In length it is perhaps one-half a radius, and it extends from near the circumference to near the center.

The surface of both valves is marked by rather thin, regular, and equidistant liræ and by numerous inconspicuous rounded ones intermediate with them.

This species rarely attains a diameter in the Caney shale exceeding 10 mm., and the majority of specimens measure only 8 or 9 mm.

Among described species this form probably most closely resembles *L. newberryi*. A comparison with the typical specimens of *L. newberryi*, which I have been able to examine through the courtesy of the American Museum of Natural History, indicates certain differences which, if as constant as now seems to be the case, would make a reference to the same species inadvisable. The Waverly form attains a much greater size than that from the Caney shale, and the dorsal valve is more elevated, though this character can not be satisfactorily determined in the flattened Caney specimens. The apex of this valve also seems to be persistently, if slightly, less marginal, and the ventral fissure larger and surrounded by a more extensive depressed area.

In some respects this form much suggests *L. herzeri*, but the apex of the dorsal valve is distinctly more marginal than in that species and the inner extremity of the pedicle slit correspondingly less central. The more marginal apex and lower convexity distinguish this form from *L. batesvillensis* and from the Caney specimens which I have called *L. newberryi* var. *ovata*.

Horizon and locality.—Caney shale, Atoka quadrangle (stations 2077, 2089), Tishomingo quadrangle (station 2090), Antlers quadrangle (stations 3983, 3988).

LINGULIDISCINA NEWBERRYI var. OVATA n. var.

Plate I, figures 9–11.

A few specimens from the Caney shale are more or less conspicuous for having the transverse axis considerably shorter than the other, and the posterior extremity more or less distinctly narrower than the anterior, so that an oval shape results. But a small number of specimens so characterized have come to hand and they have been assembled as a group, believed to be distinct from *L. newberryi*, though probably varietally related to it.

One of these specimens is a dorsal valve from station 2076, where these shells occur in small round nodules and have suffered very little from compression. It has a length of 9.5 mm. and a maximum width of 8 mm. On this shell there is a well-marked posterior groove, which, however, is probably only an accidental feature.

The surface is crossed by a number of rather indistinct and regular concentric markings and by very many indistinct microscopic radial ones. These are probably due to the setæ on the inner side of the shell and their presence suggests that the surface now seen is an exfoliated one.

A second dorsal having this characteristic elongated and oval shape was obtained from station 3986. It retains part of the shell apparently in good preservation, showing very strong, rather regular, concentric liræ. A ventral valve from the same point has the characteristic oval shape. The pedicel slit is strongly impressed; it begins near the center and the scar can be traced almost, perhaps quite, to the circumference, being situated at the narrower end of the oval. The depressed area is of a somewhat quadrate outline.

In addition to the specimens primarily concerned in this identification I have referred here three dorsal valves from station 2075. They are small and more or less elongate in shape—perhaps more elliptical than ovate. The largest is less than 6 mm. in length. In the position of the apex and other characters, except size, these examples agree with *L. newberryi* var. *ovata.*

This form is distinguished from that described as *L. newberryi* var. *caneyana* by reason of its shape, the less marginal position of the apex of the dorsal valve, and the large introverted area surrounding the pedicle slit of the ventral valve. It suggests the Keokuk species *L. varsoviensis*, which likewise has an elongated shape, but *L. varsoviensis* is elliptical instead of oval and the pedicle slit is not surrounded by a large depressed area. The shape of the dorsal valve of *L. varsoviensis* is not known, but, in view of the differences already pointed out, taken in connection with the very different faunal association, I would deem it unwise for the present to assume that they are the same species.

It is somewhat doubtful whether this form should be distinguished from Winchell's *L. saffordi.* The dorsal valves referred here differ in having the apex less eccentric, and the liræ conspicuously unequal. The ventral valve is similar in both. These comparisons are based upon authentic if not typical material of *L. saffordi*, and while they leave a reasonable doubt as to the identity of the two forms, better and more complete material of both may show that they are really the same.

Meek [a] has figured a ventral valve from the "Coal Measures" of Nebraska which much resembles the present species.

Horizon and locality.—Caney shale, Antlers quadrangle (stations 2075, 3986), Atoka quadrangle (station 2076), Tishomingo quadrangle (station 2085).

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[a] Meek, U. S. Geol. Survey Nebraska, etc., Final Rept. pl. 4, fig. 3.

Lingulidiscina batesvillensis Weller.

Plate I, figures 12, 12a.

1897. *Orbiculoidea batesvillensis.* Weller, New York Acad. Sci., Trans., vol. 16, p. 255, pl. 18, figs. 4, 5. (Date of volume 1898.)
Batesville sandstone: Batesville, Ark.

This identification is based primarily upon a dorsal valve from station 2076, which occurs in a small round concretion and has suffered very little from compression. It was associated with a specimen referred to *L. newberryi* var. *ovata*, but it is considerably larger, and differs in certain other particulars. The shape is almost but not quite circular, the longitudinal axis measuring 17 mm. and the transverse axis probably about 15.5 mm. The convexity, determined as closely as possible, is 3 mm. The apex is about 5 mm. from the posterior margin and 13 mm. from the anterior, the measurements being made along the convexity of the valve.

The surface is crossed by a number of rather indistinct and irregular concentric markings and by a large number of very indistinct and fine radial striæ. Similar radial markings are found also on the associated specimen of *L. newberryi* var. *ovata.* They are probably due to setæ on the inside of the shell, and their presence suggests that what we have exposed to view is an exfoliated surface.

This specimen is fairly well distinguished from the form referred to *L. newberryi* var. *caneyana* by the less marginal position of the dorsal apex, the difference being as a rule rather striking, nor is it believed that this difference is due to the fact that one of the forms occurs flattened in shale and the other retains its natural convexity. It is believed also that this is not a mature example of the same form of which an associated representative was referred to *L. newberryi* var. *ovata.* Though not quite circular this specimen clearly does not possess the conspicuously oval shape of the other species. On the whole, it seems to be most closely similar to *L. batesvillensis* of described species, though *L. herzeri* is also related. *L. batesvillensis* is described as subcircular or longitudinally elliptical, and this specimen closely resembles Weller's type specimen, as shown by his figures. The only difference which I am able to point out is that the apex is a trifle more centrally situated than in the type.

Weller states that *L. batesvillensis* is similar to *L. newberryi*, but is distinguished by being less circular and much larger. Weller's figure of *L. batesvillensis* is as much smaller than some of Hall's figures of *L. newberryi* as it is larger than others, and it is also less ovate or elliptical than some of Hall's figures. In fact, after carefully comparing the typical and other specimens of *L. newberryi* and Hall's figures with Weller's description and figures of *L. batesvillensis*, it has seemed impossible to distinguish them upon such data as are now available. If the study of specimens of *L. batesvillensis* does not reveal any more real differences than are now extant no other course will remain than to place Weller's species in the synonymy of *L. newberryi.* The apex of the Caney specimens, which was stated to be slightly more central than in *L. batesvillensis*, is also slightly more central than in most specimens of *L. newberryi.*

In its intrinsic characters the Caney shell is perhaps, if anything, more similar to *L. herzeri* than it is to *L. batesvillensis*, but I was influenced to the present identification by the long geographic separation and by the different and probably older faunal association of the Waverly species.

The proper ventral valve of the Caney shell is not definitely known, but I have provisionally referred to this species a few imperfect ventrals from station 2085. These are of fair size, the largest having a diameter of about 12 mm. The shape can not be definitely determined, but appears to have been circular. The sculpture, as in *L. newberryi* var. *caneyana*, consists of rather strong, thin, regularly disposed concentric liræ, separated by flat, relatively smooth intervals. These shells have not been referred to *L. newberryi* var. *caneyana* because the pedicle slit is longer and less eccentric, its inner end reaching nearly to the center of the valve and its outer nearly to the circumference, but it is not certain that they properly belong to *L. batesvillensis.*

Horizon and locality.—Caney shale, Atoka quadrangle (station 2076), Tishomingo quadrangle (station 2085).

Genus CHONETES Fischer.

CHONETES PLANUMBONUS var. CHOCTAWENSIS n. var.

Plate II, figures 1, 1a, 2, 2a, 3.

Among Mississippian *Chonetes* that from the Keokuk to which Meek and Worthen gave the name *planumbonus* stands out as a rather well-marked species. At the same time one can not but trace a relationship between it and the earlier *C. logani.* Its sculpture is peculiar, in that the ribs are more or less obsolete, and the radial subordinate to the concentric ornamentation.

In the lower portion of the Caney shale I find a form which is very similar to that from Illinois, the general resemblance being so close that it is only after some demur that the decision to employ for it a new varietal name has been reached.

It is of medium size, transverse, and rather flat. The width varies from one and one-half times to nearly twice the height. The greatest width is found at the hinge line, and the cardinal angles are sometimes slightly produced. The sides, which are usually more or less rectilinear, converge toward the front and merge into the gently rounded anterior margin. The convexity appears to be slight, though as all the fossils have been somewhat flattened in the shale in which they occur, it is difficult to arrive at the truth in this regard. There are five or six, or probably seven, cardinal spines or tubes on each side, the two nearest the beak, however, being rarely preserved. They are long, slender, sometimes curved, and decline but little from the perpendicular.

The surface is nearly smooth. In most specimens no trace of radial striæ can be detected, even with a glass. In others they can easily be seen with this aid, but they are always more or less obsolete. They are probably constantly present upon the inner surface of the valves. A more conspicuous feature is found in the concentric striæ or delicate wrinkles, which are usually the only ornamentation that the surface seems to have. These are, however, neither strong, equal, nor regular.

From typical *C. planumbonus* as it is found at Crawfordsville, Ind., the fossils from the Caney shale present a number of not very striking but fairly constant departures. They are a little larger, and decidedly more transverse, with extended instead of contracted cardinal angles. The convexity was apparently less, and is central, considering the whole shell, instead of being, as in the typical variety, near the margin, with the central portion left comparatively flat. The Caney form also exhibits to a distinctly more marked degree the characteristic tendency toward obsolescence of the radial striæ.

Our collections, however, contain some specimens from Ste. Genevieve County, Mo., in which the differences of sculpture are less marked, though those of configuration apparently remain. The surface of these specimens retains only occasional and obscure traces of radiating striæ, while more or less lamellose concentric wrinkles and striæ are plainly visible with a glass. In both this form and that from the Caney shale the radiating striæ seem to be a little better developed on the dorsal than on the ventral valve.

Horizon and locality.—Caney shale, Atoka quadrangle (station 2077).

Genus PRODUCTELLA Hall.

PRODUCTELLA HIRSUTIFORMIS Walcott.

Plate II, figures 4, 5, 6.

1884. *Productus hirsutiformis.* Walcott, U. S. Geol. Surv., Mon. 8, p. 133, pl. 2, fig. 10.
Upper Devonian: Eureka and White Pine districts, Nevada.

This form was originally described from a black shale horizon in the White Pine district, Nevada, and until rather recently it was not known to occur at any other place or horizon. The occurrence of the same species in Oklahoma in beds of a similar lithologic character is, therefore, a matter of some interest. The Caney representatives of *P. hirsutiformis* show the characters of the species so well and so faithfully that I can not admit much doubt as to the correctness of the identification. Comparison has been made with type and other material.

Some slight modification can be introduced into Walcott's description so far as to point out in the statement that the width is less than the length, that these terms can not be employed in the usual sense, for the shell is always transverse. In fact, the width is more than usually in excess, the shape being subquadrate and the convexity low. The author also states that a few slender curved spines are scattered irregularly over the surface. They are, indeed, few in comparison with *Productella hirsuta*, the species evidently in his mind, but they are really rather numerous and somewhat regularly distributed over the surface at intervals of 2 to 4 mm. Their size is what might be called average, or a little under the average. Perhaps a basal diameter of 0.5 mm. would represent the usual dimensions.

Attention is called in the original description to the fact that the spines are not provided with elongate bases, but spring more or less directly from the surface, a circumstance by which *Productella hirsutiformis* is distinguished from *P. hirsuta* and other similar forms. In addition to the spines the surface is crossed only by concentric striæ and by wrinkles, which are rather fine and in some cases rather strong. In others only the delicate concentric striæ are seen. Of costæ or radial markings there is no trace.

P. hirsutiformis is more a Devonian than a Carboniferous type, though in *P. pyxidata* of the Louisiana ("Lithographic") limestone we probably find a related species. It is at all events a type which is very rare, perhaps elsewhere unknown, at any horizon so high in the Mississippian as this without much question is.

As regards the generic position of *P. hirsutiformis*, I find that the ventral valve has a well-marked, though narrow, cardinal area, with transverse striations. On account of the possession of this structure it is thought probable that this form belongs to the group of *Productella*, though it is true that in the best example noted the delthyrium appears to have been open. Other generic characters bearing upon this point have not been ascertained. Several ventral valves (from Nevada) apear to bear a rather well-marked septum. This character does not appear in all the material, but if it really exists it is an interesting and anomalous one.

Horizon and locality.—Caney shale, Ardmore quadrangle (station 3981), Atoka quadrangle (station 2077), Tishomingo quadrangle (station 2086).

Genus PRODUCTUS Sowerby.

PRODUCTUS PILEIFORMIS McChesney.

Plate II, figure 7.

1860. *Productus pileiformis.* McChesney, Desc. New Species Pal. Foss., p. 40. (Date of imprint 1859.)
Kaskaskia division: Chester, Illinois.
1863. *Productus coræformis.* Swallow, St. Louis Acad. Sci., Trans., vol. 2, p. 94.
Archimedes limestone: Cooper County, Missouri.
1891. *Productus pileiformis.* Whitfield, New York Acad. Sci., Ann., vol. 5, p. 582, pl. 13, figs. 13, 14.
Maxville limestone: Ohio.
1895. *Productus pileiformis.* Whitfield, Geol. Survey Ohio., Rept., vol. 7, p. 470, pl. 9, figs. 13, 14. (Date of imprint 1893.)
Maxville limestone: Ohio.

Of this species our Caney collections have thus far furnished but a single specimen. It is a small dorsal valve of the usual type. The length is 8 mm. and the greatest width about 9 mm, the outline contracting somewhat at the hinge. The costæ are fine, about ten in 3 mm. There are a few concentric wrinkles, strongest upon the ears.

From the example under consideration it would be difficult to tell whether the Caney form resembled more the Mississippian *P. pileiformis* or the Pennsylvanian *P. cora.* The name adopted, therefore, should have a biologic rather than a stratigraphic significance.

Horizon and locality.—Caney shale, McAlester quadrangle (station 2079).

Genus LIORHYNCHUS Hall.

LIORHYNCHUS AFF. MESICOSTALE Hall.

Plate II, figures 11, 12.

1843. *Atrypa mesacostalis.* Hall, Geol. Surv. New York, Rept. Fourth Dist., Tables Organic Remains, No. 67, fig. 1.
Chemung group: Ithaca, Chemung, etc., New York.
1860. *Leiorhynchus mesacostalis.* Hall, New York State Cab. Nat. Hist., Thirteenth Rept., p. 86, fig. 1.
Chemung group: Steuben County and other parts of western New York.
1867. *Leiorhynchus mesacostalis.* Hall. Geol. Surv. New York, Pal., vol. 4, p. 362, pl. 67, figs. 18–25.
Chemung group: Numerous localities in central New York.
1887. *Rhynchonella mesacostalis.* Tschernyschew, Com. géol. [St. Petersburg], Mém., vol. 3, No. 3, p. 91, pl. 14, figs. 3, 4.
Devonian: West slope of the Ural Mountains, Russia.
1893. *Liorhynchus mesacostalis.* Hall and Clarke, Geol. Surv. New York, Pal., vol. 8, pt. 2, p. 194, pl. 59, figs. 11, 12.
Chemung group: Tompkins County, New York.
1896. *Leiorhynchus mesacostalis.* Kindle, Bull. American Pal., No. 6, p. 37.
Ithaca group: Ithaca, N. Y.

It is this species or one closely related to it which has been identified in the White Pine shale of Nevada and in the "Spring Creek" limestone of Arkansas as *Liorhynchus quadricostatum.* Hall himself, in fact, pointed out that *L. mesicostale*, *L. quadricostatum*, and also *L. multicosta* (=*L. laura*) tended to run into one species. Without having studied suites of specimens, and basing my remarks upon Hall's figures and descriptions, it would seem to me desirable that these forms, even though they intergrade and though the limiting varieties alone are readily distinguishable, be kept separate in some measure. The peculiar feature of *L. quadricostatum* seems to be that the mesial portion of the shell is occupied by four or five large plications, while the sides are covered by numerous much finer ones. In *L. mesicostale* the mesial portion bears four or five large plications, but the sides are smooth, while in *L. laura* the entire surface is covered with coarse plications, of which four or five occupy the fold and sinus; but in both *L. laura* and *L. quadricostatum* a strong tendency is manifested for the lateral plications to die out partially or entirely, thus grading into *L. mesicostale.*

It seems to be not the typical but the abnormal or intermediate types of *L. quadricostatum* which the shells from the "Spring Creek" and White Pine formations most resemble.

Shells possessing the characters of *L. mesicostale* and *L. laura* are rather abundant in the Caney shale at several points, but the type of *L. quadricostatum*, with fine lateral plications, has not been found there as yet. The Caney shale forms appear to intergrade with those which I have identified as *L.* aff. *laura.*

Liorhynchus is generally characterized by the tenuous nature of its rather large shell, and the specimens from the Caney shale have suffered a good deal in compression and distortion during fossilization.

Horizon and locality.—Caney shale, Atoka quadrangle (station 2077).

LIORHYNCHUS AFF. LAURA Billings.

Plate II, figs. 13, 14, 15.

1860. *Rhynchonella? Laura.* Billings, Canadian Jour., vol. 5, p. 273, figs. 26–28.
Hamilton shales: Bosanquet, Canada West.

1860. *Leiorhynchus multicosta.* Hall, New York State Cab. Nat. Hist., Thirteenth Rept., p. 85, figs. 14, 15 on p. 94.
Hamilton shales: Numerous localities in western New York.

1863. *Rhynchonella? Laura.* Billings, Canada Geol. Surv., 15th Rept. Prog., p. 384, fig. 418.
Hamilton formation.

1867. *Leiorhynchus multicosta.* Hall, Geol. Surv. New York, Pal., vol. 4, p. 358, pl. 56, figs. 26–40.
Hamilton group: At numerous localities to the western limits of the State.

1874. *Leiorhynchus Laura.* Billings, Canadian Nat., n. ser., vol. 7, p. 240.
1884. *Rhynchonella* (*Leiorhynchus*) *Laura.* Walcott, U. S. Geol. Survey, Mon. 8, p. 159.
Upper Devonian: The Gate, northwest of Eureka, Nev.
1886. *Rhynchonella multicosta.* Tschernyschew, K. Min. Gesell. zu St. Petersburg, Verh., bd. 22, p. 290, pl. 15, figs. 1–3.
Devonian: Donetz Basin, Russia.
1887. *Rhynchonella multicosta.* Tschernyschew, Com. géol. [St. Petersburg], Mém., vol. 3, No. 3, p. 82.
Devonian: Western slope of Ural Mountains, Russia.
1893. *Liorhynchus multicosta.* Hall and Clarke, Geol. Surv. New York, Pal., vol. 8, pt. 2, p. 194, pl. 59, figs. 8–10.
Hamilton group: Western New York.
1893. *Liorhynchus Laura.* Hall and Clarke, idem., p. 194, pl. 59, figs. 13–17.
Hamilton group: Widder, Ontario.

The shells included under this title are probably not distinguished by any sharp line from those referred to *L.* aff. *mesicostale.* In the latter case only the mesial portion of the shell is plicated, and that sometimes only obscurely, while in the present instance the plications run onto the sides or even cover the entire surface. If other differences exist, I am unable to name them, as the shape and configuration of these fragile shells have been destroyed by the distortion and compression which they have undergone.

Horizon and locality.—Caney shale, Antlers quadrangle (station 2075), Tishomingo quadrangle (station 2085).

Genus SPIRIFER Sowerby.

Spirifer sp.

Plate II, figure 8.

Of this interesting form our collections contain only one specimen; the figure shows most of the characters which can be determined.

The size is rather large, the hinge line is extended and submucronate, the contour contracting suddenly below. In the ventral valve, which is the only one known, the beak is moderately projecting, incurved, and the area is probably low. The sinus is well marked, broad, and moderately deep. There were probably eight to ten rather coarse lateral plications, and the sinus itself appears to have been plicated, indications of about two costæ being found near the apex. Of this, however, one can not be sure from the only specimen obtained.

The fine sculpture seems to consist of delicate, more or less regular, concentric striæ, without traces of any radiating ones.

Horizon and locality.—Caney shale, Atoka quadrangle (station 2077).

Genus MARTINIA McCoy.

Martinia sp.

Plate II, figure 9.

The fossils treated under this title come from two localities, but they are so crushed and fragmentary that no satisfactory conclusion can be reached regarding them.

The most complete material is doubtless that from station 2085. The form found at this point is rather small, the largest example having a width of about 20 mm. The dorsal valve is broader than long, but the ventral is probably as long as or a little longer than broad. The hinge is wide, the dorsal valve unusually squarish, the ventral subpentagonal. A faint narrow sinus seems to form a constant feature of each valve.

The surface appears to be smooth or marked only by concentric striæ of growth.

The configuration, and especially the structure, of the ventral beak indicates that this form, crushed as it is, is a spiriferoid rather than an athyroid, and the surface is that of the smooth rather than the spinose group of unplicated spirifers. The square-shouldered shape is that which is familiar in the group of *Ambocœlia*, but the present form probably does not belong to that genus.

Similar, and probably congeneric, even probably conspecific, are the few fragmentary specimens from station 2089, though their condition is inferior to that of the foregoing and though it is impossible to say anything final regarding them.

The relation of these little-known shells to other American martinias is somewhat uncertain. They resemble *M. contracta* more than *M. robusta*, but I should hesitate to identify them with the former or say definitely that they were distinct from the latter without more abundant and better material than that which I have been able to examine.

Horizon and locality.—Caney shale, Atoka quadrangle (station 2089), Tishomingo quadrangle (station 2085).

Genus COMPOSITA Brown.

Composita ? sp.

Plate II, figure 10.

The fossils included in the present group consist of a single fairly perfect specimen from station 2077 and a number of more or less fragmentary ones from station 2090. They attain a rather large size and have a generally elongate-oval shape, varying somewhat in the proportion of length to width. There is a low broad sinus and a smooth surface. If they really belong to the genus *Composita* they are different from any species known from the same horizon, but unhappily, I have been unable to ascertain either the configuration of the ventral beak or the internal structures of the dorsal valve, so that the generic relations lean to three very different groups.

So far as one can tell these shells have the general appearance of *Composita*, and they have been tentatively referred to that genus, but as the genus *Martinia* occurs also in these beds there is a reasonable possibility that they may prove to be martinias. At the same time it is probable that they belong to a different species from that found at stations 2085 and 2089.

It is possible too that this form belongs to a different genus altogether. The specimen represented by my figure occurs associated with *Liorhynchus* aff. *mesicostale*, and the smooth and the plicated shells have, so far as can be told, the same general shape and configuration. Furthermore, *L.* aff. *mesicostale* manifests a tendency for even the mesial plications to become obsolete, while the figured specimen of *Composita?* sp. shows obscurely what one so disposed might regard as traces of obsolete irregular plications, although I do not hold this view. There is a possibility, therefore, that the shells under consideration may prove, in part at least, to be an abnormal group of the genus *Liorhynchus*. A fact contradicting such a supposition, however, is that while *Liorhynchus* is characteristically a thin fragile shell and our specimens of *L.* aff. *mesicostale* are mostly casts, the specimens of *Composita ?* sp. are testiferous and, though fragmentary, thick and solid.

Horizon and locality.—Caney shale, Atoka quadrangle (station 2077), Tishomingo quadrangle (station 2090).

PELECYPODA.

Genus DELTOPECTEN Etheridge.

1892. *Deltopecten.* Etheridge, fil., Geol. Pal. Queensland, p. 269.
1904. *Limipecten.* Girty, U. S. Nat. Mus., Proc., vol. 27, p. 721.
1906. *Deltopecten.* Etheridge, jr., Mem. Geol. Surv. New South Wales, Pal. No. 5: Mon. Carb. and Permo-Carb. Inv. New South Wales, Pelecypoda, vol. 2, pt. 1, p. 22.

In 1904 I introduced the name *Limipecten* for a type of pelecypod structure which was thought to combine the characters of the two living genera *Lima* and *Pecten.* Though the typical specimens belonged to an undescribed species from Texas, the genus was believed to be well represented in the Carboniferous rocks of North America and to include among other species the well-known Pennsylvanian form *Aviculipecten occidentalis.* The chief structural feature of

Limipecten was the possession of a broad, slanting, or beveled cardinal plate in both valves, centrally depressed into a triangular cartilage pit. Externally the two valves were very unlike, the left being strongly convex and marked by prominent radiating ribs, while the right was nearly flat, with sculpture almost obsolete and of a different character from that of the opposite valve. The right valve also had a deep byssal sinus under the anterior ear.

When *Limipecten* was described Etheridge's genus was not known to me. Based upon some types from the Carboniferous of New South Wales, *Deltopecten* seems to have escaped recognition in those text-books and general works which furnish one's chief resource for ascertaining the diversification of animal types over the earth, so that until recent reading in foreign literature brought it to my notice I was not aware that such a genus had been described. I am well satisfied that *Limipecten* is a distinct type from *Aviculipecten*, but it seems to me that the American shells which I included under *Limipecten* have all the characters of the Australian ones which represent *Deltopecten*. Accordingly, *Limipecten* must give place to *Deltopecten* in every case.

Whether the form from the Caney shale described beyond is a representative of *Limipecten* (=*Deltopecten*) has not yet been completely settled. The characteristic structure is not shown by my specimens, but the sculpture and the relative configuration of the two valves are those of *Deltopecten*.

In deciding whether *Deltopecten* is quite distinct from *Aviculipecten* the character of typical *Aviculipecten* must first be determined. My own effort to do this resulted in a memorandum published in the American Geologist (vol. 33, p. 291), which drew forth a comment from Mr. Wheelton Hind and a reply to the same from me. Referring to this short-lived controversy, Mr. Etheridge states that it makes little difference which species is regarded as the type of *Aviculipecten*, seeing that McCoy gave a diagram and full description of the genus. The point is perhaps of not prime importance, but to me it seems that the determination of the typical species of *Aviculipecten* is not of so little moment as it appears to Mr. Etheridge, for, after all, the genus depends for its validity and its relation to other genera not upon the diagram and description, which may possibly be misleading or incorrect, but upon the characters of the typical species.

DELTOPECTEN? CANEYANUS n. sp.

Plate III, figures 1, 2, 3.

Shell of medium size, slightly oblique, inclined backward. Proportion of length to width variable; probably in some specimens the two dimensions are almost equal, but in others the length is considerably in excess of the width. Hinge about half as long as the greatest width, which occurs in the lower half of the shell. Ears of moderate size, the posterior somewhat the larger. In the left valve their outlines are gently concave, the width increasing just below. They are defined not only by sinuses in the outline, but by being depressed and by having sculpture different from that of the body of the shell.

The sculpture of the left valve consists of very slender radii separated by flat intervals about three times their own width, but sometimes only twice or even once. The radiating liræ are subequal, sometimes slightly alternating, and they increase by implantation. About five occur in the space of 5 mm. They are absent upon the ears. The surface is also crossed by rather strong, fine, regular, concentric liræ, which have a more or less cancellating effect with the radial ones, though they are much finer. The concentric liræ are strong upon the ears.

The right valve is like the left in configuration, but is flatter and has a deeper sinus under the anterior ear. The surface is nearly smooth, but fine radii, though obsolete over the upper portion of the shell, are developed toward the front and sides. They are rather broad and are separated by narrow striæ, the reverse of the other valve.

The literature has been gone over pretty carefully in an effort to find a species with which this can be identified, but to no purpose. The fine equal radii are one of the features distinguishing this form from most of those which have been described, and their absence from the wings also serves to characterize it.

I have little doubt that *Deltopecten? caneyanus* belongs to the group for which I propose the name *Limipecten*. At least it has all the superficial characters. *Limipecten* I now believe to be identical with the Australian genus *Deltopecten*, which was described a long time back, but appears generally to have failed of acceptance, and even to have been frequently omitted from general works. It was consequently overlooked when I was engaged upon *Limipecten*.

Horizon and locality.—Caney shale, Atoka quadrangle (station 2077), Tishomingo quadrangle (station 2085).

Genus CANEYELLA n. gen.

The shells included under this title are abundant in and characteristic of the Caney fauna. Although the extremes must appear rather widely separated, they possess such characters in common and exhibit such tendency to intergrade as to indicate pretty clearly that all are manifestations of but a single generic type.

The general expression is aviculoid. The two valves apparently are alike in configuration and sculpture. The axis is oblique, much more oblique in some species than in others, however. Also great variability is exhibited in the proportions of length and width, some types being very elongate and others relatively transverse. The beaks are strongly anterior, but never quite terminal. The posterior portion is alate, but the hinge is not extended. The portion anterior to the beaks is sometimes like a narrow band, sometimes more extended and nasute, but always so arched and emarginate as to leave between the two valves a large and very conspicuous byssal opening. The shell is thin and fragile, probably somewhat thickened along the hinge line, but so far as I have observed the hinge is edentulous. The muscular imprints have not been observed.

In point of sculpture also great variation is shown. All the species known are concentrically corrugated, but in some the folds are a less conspicuous feature than in others. One group is also marked by radial costæ, which are either few and coarse or numerous and fine. They are developed particularly along the mesial portion of the shell, and through manifesting a decided tendency to become evanescent, even in the species where they are best developed, they frequently occur along the center, while the sides are without them. The costæ, however, are not substituted for the concentric undulations, but rather are an additional development, corrugations more or less strong traversing even the costate species.

So varied is the first impression produced by different species of this group that rather widely different genera are suggested by them, a number of which have been tentatively considered in the hope of locating these Caney forms without creating either an anomaly or a new genus.

I suspect that to the same genus belong several species from the Batesville sandstone which Weller has assigned to *Pteronites*. The configuration of the anterior auricle of the Caney forms is quite unlike that of *Pteronites*, and it is somewhat doubtful whether the latter was gaping in front, in shape of a large byssal aperture. The hinge line of *Caneyella* is not extended behind, as in *Pteronites*, while the latter genus is not marked by concentric undulations and especially by radial costæ. In point of fact the only Caney shale species which does not differ widely in appearance from typical *Pteronites* is *C. nasuta*, which is the form that rather suggests to me Weller's *Pteronites*.

Hall appears to have included under *Lunulicardium* two rather distinct types of shells, one of which, if not generically the same as *Caneyella*, at least presents some points of strong resemblance. It is this group which J. M. Clarke has recently removed from *Lunulicardium* and referred, provisionally, be it said, to *Posidonia*.[a] The

[a] New York State Mus., Memoir No. 6, Naples fauna, pt. 2, 1903, pp. 264 et seq.

Devonian species differ from those of the Caney shale, in some cases, in the more auriculate character of the anterior projection as well as in the more central position of the beaks. One of the characters upon which *Posidoniella* was discriminated from *Posidonia* is the nearly terminal, instead of subcentral, position of the umbones, and in this particular the Caney shells much more strongly suggest *Posidoniella* than either typical *Posidonomya* or our aforementioned Devonian posidonias. In fact, one group of them, especially *Caneyella wapanuckensis*, has in some ways so much the general expression of *Posidoniella* that I have for some time had the shells under consideration assigned to that genus. Even *C. wapanuckensis* possesses one feature—the large byssal aperture—which is wanting in *Posidoniella*, while caneyellas of the costate group are quite anomalous for De Koninck's genus. I can not, therefore, upon second consideration regard it as appropriate to refer the Caney shells to *Posidoniella*.

If the noncostate, concentrically corrugated forms resemble *Posidonia*, *Posidonomya*, etc., the forms at the other end of the series, represented by *C. percostata*, *C. richardsoni*, and *C. nasuta*, suggest quite different generic relations. *Actinopteria* and *Pterinopecten* have suggested themselves to me. *Pterinopecten* can be immediately dismissed, because of the very unequal configuration, convexity, and sculpture of the two valves. *Actinopteria* also is said to be inequivalve, and it shows some other features with which the present species are incongruous. I refer to the lobelike character of the anterior auricle and to the acuminate prolongation of the posterior wing, a difference which may be trivial but which I believe is not without its significance. Then, too, the two nonplicated species of the present group would appear as much out of place in *Actinopteria* as the two plicated ones would in *Posidoniella*.

Caneyella richardsoni is selected as the type of the genus.

CANEYELLA WAPANUCKENSIS n. sp.

Plate III, figures 6, 7, 8, 9, 10, 11.

Shell small, usually under 10 mm. in length, generally ovate, nearly or quite equivalve. Proportions of length and width rather variable, some specimens being relatively narrow and others broad. Beaks nearly terminal. Umbonal ridge directed to the hinge line at an angle somewhat varyingly acute; situated close to the anterior border; narrow and high at first, low and broader below. Cardinal line short and straight, merging into the posterior outline, which is frequently strongly bowed above. Posterior outline, convex, sharply curved below, and merging with the anterior outline, which is nearly straight. It is seldom possible to get a true outline of specimens near the beak, but the anterior rim seems to be gently emarginate above and the shell somewhat elevated, forming a rather elongate opening between the two valves and just below the beak. The convexity is moderate to high, falling away abruptly on the narrow anterior side and somewhat more gently in the other direction, often showing a more or less flattened band along the posterior margin.

The surface is nearly smooth, marked only by a varying number of low concentric undulations.

The most closely similar species of those known to me are *Posidonomya fracta* and *P. fragosa.* The species from the White Pine shale of Nevada, however, is pretty regularly marked by more or less faint radiating costæ, a feature which at once distinguishes it from the present form, unless, indeed, the latter be supposed to be founded upon an immature stage, an hypothesis which its small size in a measure sanctions. More striking, however, is the resemblance with the "Coal Measures" form which Meek described from Ohio as *P. fracta*, especially with the smaller, more elongate specimen represented by his figures, which he designates as the type. Perhaps the most notable difference that can be adduced from his figures is the strong undulations of the Ohio form. In view of this difference, of the larger size, of the wide geographic separation, and of the different faunal asociations, it seems hardly advisable to refer the present form to Meek's species, especially without comparison with authentic or charateristic specimens.

Caneyella wapanuckensis is extremely common at several localities in the Caney shale, and everywhere maintains its small size. In spite of numbers it is very difficult to secure good specimens, owing, doubtless, to its fragile constitution. In the soft shales these shells are macerated, compressed, and distorted so as to become almost hopeless for scientific study. In the calcareous concretions they are often broken, and even the more perfect ones are somewhat incomplete about the edges.

Horizon and locality.—Caney shale, Tuskahoma quadrangle (station 2057), Antlers quadrangle (stations 2075, 3948), Atoka quadrangle (station 2082), McAlester quadrangle (stations 2078, 2079), Tishomingo quadrangle (station 2091).

Caneyella vaughani n. sp.

Plate IV, figures 7, 8, 9, 10.

While fairly common in the Caney shale, this species is far from being as abundant as *C. wapanuckensis*, and it is, furthermore, extremely difficult to secure anything but imperfect specimens.

C. vaughani is much larger than any of the other Caneyellas, certainly attaining a length of 25 mm. and probably in some cases of over 50 mm. It is a rather broad form, strongly oblique, and marked by relatively strong concentric undulations. The hinge line is shorter than the width below. The posterior wing is rather broad, the oblique lateral outline making an obtuse angle with the hinge. On the anterior side the hinge line is much shorter, the margin rounding in strongly and leaving the beak more nearly terminal. In some specimens at least a small area just below the hinge line is elevated or vaulted, causing an opening to be left between the two valves and producing a slight emargination in the outline.

The foregoing description is based upon one or two specimens, or rather upon parts of one or two specimens, but will probably be found in the main true of the whole.

The mature condition appears to be quite distinct from *C. wapanuckensis*, but small specimens are much more similar. The greater breadth of the present form and the stronger and more regular undulations afford more or less available means of distinguishing even quite young individuals. Nevertheless, as many specimens are imperfect, it is often not possible to reach a satisfactory conclusion with regard to their specific relations.

Associated with typical *C. vaughani* is a small, narrow variety, the proper disposition of which has given me some concern. In some specimens the concentric undulations are fairly strong, but in others they are faint. Though many of these examples are considerably larger than what I regard as typical *C. wapanuckensis*, the smaller ones, especially those which are nearly smooth, draw very close to if they do not merge with that species. I do not at present regard *C. wapanuckensis*, however, as merely composed of young examples of *C. vaughani* or as representing only an unimportant variety.

Certain small, presumably young, specimens instead of showing concentric rounded undulations are more sharply though not more deeply plicate, and have the angular ridges as if somewhat lamellose. This may prove a specific or varietal feature, but at present I prefer to regard it merely as subordinate, due partly to immaturity, and to include the shells themselves under *C. vaughani*, which they resemble, it is clear, much more than *C. wapanuckensis*.

This species is named after Mr. T. Wayland Vaughan, who brought in the first specimens which I had the opportunity of studying.

Horizon and locality.—Caney shale, McAlester quadrangle (station 2078), Stonewall quadrangle (station 2080), Tishomingo quadrangle (stations 2083, 2084, 2087?, 5113?).

Caneyella nasuta n. sp.

Plate III, figures 12, 12a, 13, 14.

Shell rather small, very oblique, with a well-marked anterior lobe. Beak fairly prominent, about one-third the hinge length back from the anterior extremity. Hinge line somewhat shorter than the maximum width. The posterior outline meets the hinge at a strongly obtuse angle, probably merging with it, and after extending strongly backward in a nearly straight line it bends around in a sweeping curve and is more or less rectilinear up to its junction with the cardinal line in front. The anterior extremity is slightly rounded. The umbonal ridge is rather prominent, emphasized on its anterior side by a strong sinus, which meets the anterior outline a little in front of its median point, causing a slight deflection. The shell rises again, however, into the anterior lobe, which is convex, leaving, with the cognate valve, a rather large opening for the byssus.

Surface marked by rather fine, indistinct, regular, concentric undulations and by larger ones at somewhat distant intervals. There are also rather fine radiating costæ, more extensively developed upon some examples than upon others. They occur chiefly down the mesial portion of the shell.

In one respect *Caneyella nasuta* is a rather aberrant member of the interesting group of forms for which this genus has been established—that is, in the prolonged, nasute character of the anterior auricle, a feature in which it strongly contrasts with *C. wapanuckensis* and *C. richardsoni*, though in some measure approached by *C. vaughani*. Aside from this, however, the affinities of the present species seem to lie distinctly on the side of *C. richardsoni*.

Horizon and locality.—Caney shale, Tuskahoma quadrangle (station 2047), Antlers quadrangle (station 3983).

Caneyella percostata n. sp.

Plate IV, figures 2, 2a, 3, 4, 5, 6.

Shell of medium size, obliquely subovate, varying in relative breadth in different specimens. Beak nearly terminal, anterior projection narrow and arched, so that the two valves leave between them an elongate byssal aperture. Cardinal line rather long, merging with the posterior outline. Anterior outline in general rather straight above, more strongly curved below, joining the posterior outline without break across the strongly rounded base. Anterior-superior angle acute and sharp. Posterior-superior angle obtuse and rounded.

Surface marked by a few coarse, often sharply angular ribs, which obliquely cross the mesial portion of the shell from the umbo to the base. There are in addition concentric undulations, often moderately strong and regular, especially over the upper or umbonal portion; sometimes fainter and more irregular.

In its general plan this species may be compared with *Posidonomya fragosa* from the White Pine shale of Nevada, but the figured specimens show numerous differences from that species. *C. percostata* has a longer hinge line and a broader shape. The ribs are fewer, coarser, stronger, and more angular. Although this is true of the specimens selected for illustration, the shells vary so greatly in themselves and in many cases are so imperfect that these differences are at times much less marked.

C. percostata is also related in a general way to *C. richardsoni.* The shape does not greatly differ; the chief distinction rests in the plications, those of the present species being much coarser and less numerous. Nevertheless, both forms vary freely. As elsewhere remarked *C. richardsoni* manifests a distinct tendency to obsolescence of the lateral ribs. A specimen of that species with the ribs more than usually coarse and restricted to the mesial portion would approach very closely to a specimen of the present species in which the plications were more than usually fine. Both cases are found in the specimens examined; and as, owing to their imperfect condition, it is impossible to take all characters into account, it happens that in given instances one can not refer an aberrant example with any confidence to one species rather than another. For my own part I have been somewhat guided by the character of the dominant form when, as proved usually to be the case, only one species was present in its typical expression.

Horizon and locality.—Caney shale, McAlester quadrangle (station 2078), Atoka quadrangle (station 2082?), Tishomingo quadrangle (station 2084).

CANEYELLA RICHARDSONI n. sp.

Plate IV, figures 1, 1a.

Shell of medium size, strongly oblique and transverse. Umbones prominent. Hinge line long, somewhat shorter than the width. Posterior outline nearly straight above, meeting the hinge at an obtuse angle, becoming more and more strongly bowed below until it assumes an upward direction, when it again becomes nearly straight; slightly sinuous toward the hinge in connection with the byssal sinus.

Surface marked by numerous rather fine ribs, which divide, and thus tend to form groups of two or three. Ribs more or less finer and fainter toward the sides and tending to become obsolete all over, so that occasionally a small specimen shows only a few obscure ones over the mesial portion; frequently quite flexuous. There are also numerous concentric striæ of varying strength, less marked than the costæ, with which they produce a somewhat cancellated effect.

In being provided with costæ this species shows its relationship to *C. percostata*, but is distinguished by the fact that the ribs are finer and more numerous. *C. richardsoni* belongs also to the group of which the form described by Meek as *Posidonomya fragosa* is an example, and some specimens in which the costæ are nearly obsolete, except for a few down the middle, suggest the western form quite strongly. The typical variety, however, can hardly be confused, and even shells with obsolete costæ differ in shape rather widely from *Posidonomya fragosa*.

Horizon and locality.—Caney shale, McAlester quadrangle (station 2078), Stonewall quadrangle (station 2081), Tishomingo quadrangle (station 2083).

Genus PARALLELODON Meek.

Parallelodon multiliratus n. sp.

Plate III, figures 4, 4a, 5.

Shell of medium size, transverse. Posterior extremity truncate in the usual manner. Inferior outline rather strongly convex, curving upward somewhat suddenly in front and apparently somewhat retracted as it meets the hinge line. Beak moderately prominent and situated a short distance back from the anterior margin. Umbonal ridge well up toward the hinge line.

Surface marked by very fine radiating liræ, which are coarsest near the cardinal line on the posterior side and gradually become finer and fainter toward the front until most of the umbonal region and all the anterior half of the shell appear to be smooth. There are in addition very fine, faint, concentric liræ.

In the fineness of its radii this species seems to stand alone among the American representatives of the genus, and I find it hardly necessary to point out other differences between the present species and such others as are sufficiently known to allow of careful comparison. Some undescribed forms from the Chester have equally fine radii and may prove to be the same, though they are more highly convex.

Horizon and locality.—Caney shale, Atoka quadrangle (station 2089), Tishomingo quadrangle (station 2085).

Genus CONOCARDIUM Bronn.

Conocardium sp.

Aside from the peculiar shells for which the genus *Caneyella* has been established, but few species of pelecypods are accounted for in this report. A number of types are in fact contained in our collection, but they are too imperfectly known even to appear in the body of this account of the Caney fauna as indeterminata. Although represented by but two individuals, and rather fragmentary ones, the present form is of sufficient interest, and can be described in sufficient detail, to merit separate recognition.

The shape was triangular, the truncated tubular anterior portion being missing. The anterior and cardinal margins are nearly straight and of nearly equal length, about 13 mm. in one specimen. The inferior-posterior margin is gently convex, and in the same specimen about 20 mm. long. The inferior-anterior and the superior-posterior angles, therefore, are acute, and the anterior-superior angle is obtuse.

The surface is marked by a considerable number of fine, sharp liræ, separated by rounded striæ considerably wider than the liræ. Frequently smaller liræ arise by intercalation between the larger ones. There are about twelve of the large liræ in a distance of 5 mm., and from two or three to eight or nine small ones additional. The latter, however, may have attained such a size that they are not conspicuously alternating.

Horizon and locality.—Caney shale, Atoka quadrangle (station 2077).

PTEROPODA.

Genus IDIOTHECA n. gen.

Shell rather small, short-conical, oblique, laterally compressed. Anterior end (if that nearest to the apex may be provisionally thus designated) narrower than the posterior, and marked by a sinus or groove. Posterior end strongly rounded. Sculpture consisting of transverse wrinkles, which are strongest across the anterior end and almost obsolete across the posterior, where also they are deflected downward.

Shell substance phosphatic or chitinous (?).

I am quite at a loss regarding the affinities of this interesting form. After canvassing several different groups it seems to me probable that it belongs to the Conulariidæ, the shell substance, so far as preserved, suggesting *Conularia* itself. It may possibly be an aptychus of one of the *Goniatites*, which occur so abundantly at a little higher horizon, or it may be a gasteropod related to the much older genus *Stenotheca*. That it is a laterally compressed discinoid I regard as a hardly possible hypothesis.

IDIOTHECA RUGOSA n. sp.

Plate V, figures 6, 6a, 6b, 6c.

Shell rather small, rapidly expanding, obliquely conical, strongly compressed. Height about three-fourths of the greatest length. Apex about three times as far from one edge as from the other. For convenience the end nearest the apex may be called the anterior, although it is at present not possible to homologize the parts with any known shell. The width of the aperture is much less than the length, but it is difficult to express the ratio numerically, since the shape is irregular, the anterior end being narrower than the posterior. There is besides an impressed zone or sinus traversing each side from the apex to the aperture a little posterior to the middle. The posterior end is broadly rounded. The narrower anterior end appears to be concave, the concave portions joining the sides in acutely angular edges.

The surface is marked by fine transverse corrugations, which are strong over the anterior half of the shell and increasingly faint toward the posterior, where they are almost or quite obsolete. Their direction is not strictly transverse, as they bend rather strongly downward just before dying out near the posterior portion. This area, which, as already remarked, shows almost no trace of transverse wrinkles, is obscurely marked by very fine longitudinal striæ.

The anterior edge of the specimen is unfortunately not very perfect. The structure appears to be as described above, but this configuration may be due to accidental causes and to lateral compression, which upon this hypothesis would have more or less greatly diminished the width in proportion to the length and have crushed and dislocated the anterior end. While, therefore, it is possible that the section may have been more nearly circular and the anterior end rounded instead of reentrant, I am inclined to doubt this, the shape at present being quite symmetrical and showing no signs of compression over the posterior end, which must have been affected only less strongly than the front.

The only specimen found is covered in part with a dark chitinous (?) or carbonaceous (?) layer, the remainder being white and polished, as if phosphatic. While there may have been whitish phosphatic matter forming a part of the shell, the appearance noted is probably due to the specimen's being almost an internal mold in a very siliceous rock, essentially a chert.

Horizon and locality.—Woodford chert (?), Atoka quadrangle (station 5114).

SCAPHOPODA.

Genus LÆVIDENTALIUM Cossmann.

LÆVIDENTALIUM VENUSTUM Meek and Worthen.

Plate V, figures 5, 5a.

1861. *Dentalium venustum.* Meek and Worthen, Acad. Nat. Sci. Phila., Proc., p. 145.
St. Louis limestone: Waterloo, Monroe County, Ill.

1866. *Dentalium venustum.* Meek and Worthen, Geol. Surv. Illinois, Rept., vol. 2, p. 284, pl. 19, fig. 8.
St. Louis group: Waterloo, Monroe County, Ill.

1903. *Plagioglypta venusta.* Girty, U. S. Geol. Survey, Prof. Paper, No. 16, p. 453.

The species subsumed under this title comprises straight, slender, very gradually expanding, subcylindrical shells having a circular section. The surface is without sculpture, the best preserved showing only almost imperceptible growth lines. A characteristic specimen has a length of 14 mm., with a diameter at the larger end of a little more than 1¼ mm., and at the smaller of 1 mm. Other specimens are about the same.

I am uncertain as to the real affinities of this form, but the probabilities seem to be much more favorable to placing it with the Dentaliidæ than with any other group. I have considered the genera *Styliola* and *Coleolus*, but rejected them because of the much more rapid taper which is found in the most typical species of those groups. While some of the individuals at first provisionally included here proved upon closer inspection to be septate, and so to belong to *Orthoceras* or *Bactrites*, it seems almost certain that others are not so. The figured specimen shows traces of neither septa nor siphuncle, and it is almost too long to be the chamber of habitation of a small orthoceratite. Some of the other shorter fragments may really be of this nature; I know of no way of determining. These forms are almost too large and too straight to be the spines of some other organism, such as *Productus*, and that possibility has been dismissed.

The same or a closely related species occurs in the Spergen limestone fauna, where it has been described as *Dentalium venustum*. Most of our specimens from that fauna are larger, and some are more rapidly tapering. One in size and shape is almost a duplicate of that from the Caney shale selected for illustration. The latter in many respects is similar to *L. illinoisense*, but is much smaller and less rapidly expanding.

In discussing our Carboniferous Dentaliidæ in 1903 I referred this species and *D. illinoisense* to the genus *Plagioglypta*. *Plagioglypta* is distinguished by being marked with obliquely transverse striæ, while these two species are almost absolutely smooth. It seems rather better, therefore, to place them under *Lævidentalium*, although *Lævidentalium* consists typically of curved shells, while these are straight.

Horizon and locality.—Caney shale, Antlers quadrangle (station 3948), Tishomingo quadrangle (stations 2083, 2091).

GASTEROPODA.

Genus PLEUROTOMARIA Defrance.

PLEUROTOMARIA ? sp.

Plate V, figure 4.

Our collection includes but a single specimen of this form, one so imperfect, withal, that only a partial description can be given of it.

The size is rather small and the shape elongate. Height about 6 mm., diameter of lower volution about 3 mm. Number of volutions six. The volutions are angular, the most prominent portion lying about two-thirds (or a little more) of the entire height of the whorl down from the suture. The sides are flattened, the sutures depressed, the lower portion of one volution projecting strongly from the upper portion of the next. The lateral surfaces are marked by three large but not strongly elevated spiral costæ. One of these constitutes the angular peripheral portion of the volution; another is found just before the shell rounds down beneath its contact with the preceding volution in a depressed suture; the third is intermediate. If other sculpture was present it has been lost.

This form represents a type of shell which has more often been referred to *Murchisonia* than to *Pleurotomaria*, and the most closely similar species seem to be *Murchisonia archimedea* and *M. nebraskensis*, though it is clearly not identical with either of them.

Horizon and locality.—Caney shale, Atoka quadrangle (station 2082).

Genus NATICOPSIS McCoy.

NATICOPSIS sp.

Plate V, figure 3.

All that is known of this species is the little shell represented by the figure. It has been impossible to free this specimen, which is very small and embedded in a closely adhering limestone, and the only portion known is the upper surface. The form comprises about three volutions, and has a diameter of 1 mm. or a little less. The spire is very low, scarcely projecting above the general level of the final volution.

Horizon and locality.—Caney shale, Atoka quadrangle (station 2082).

Genus MACROCHEILUS Phillips.

MACROCHEILUS? MICULA n. sp.

Plate V, figure 2.

Shell very small, conical, rapidly expanding, consisting of four volutions. Height about 1 mm., greatest diameter a little less. Whorls moderately rounded, sutures depressed.

Only one specimen of this diminutive species has come to hand, but it is in rather complete condition. The generic assignment to *Macrocheilus* is doubtful, though probably it belongs with the Pyramidellidæ.

M.? micula resembles some of the Carboniferous shells which have been referred to the genus *Holopea*. *H. proutana* is a similar though more slender form. *Loxonema oligospira* of the Kinderhook likewise resembles it, and also *L. shumardianum*. Among species referred to other genera which have the same general aspect may be mentioned *Soleniscus blairi* and *Sphærodoma subcorpulenta*. In addition to other differences which can in some cases be pointed out, *M.? micula* is very much smaller than any of the species mentioned, and occurs in a very different faunal association.

Horizon and locality.—Caney shale, Tishomingo quadrangle (station 2091).

MACROCHEILUS? sp.

Our collections contain two other specimens of the same general type as the foregoing and probably congeneric with it, but not belonging to the same species. They also are remarkable for little but their small size, and are distinguished from *M.? micula* chiefly by having a somewhat higher spire and a more acute apical angle. They are too imperfect to be described as new, and I am in some doubt as to whether both belong to the same species.

Horizon and locality.—Caney shale, Atoka quadrangle (station 2082), McAlester quadrangle (station 2079).

CEPHALOPODA.

Genus ORTHOCERAS Breyn.

ORTHOCERAS WAPANUCKENSE n. sp.

Plate VI, figures 11, 12.

Shell rather small, long, and very gradually tapering. The type specimen has a length of 52 mm., with a diameter above of $5\frac{1}{2}$ mm. and below of 4 mm. The section is circular and the siphuncle central. The septa are moderately far apart, the interseptal distance at any point being to the diameter about as 1 to $1\frac{1}{2}$, varying almost to the ratio of 1 to 2 in young specimens. The largest specimen observed has a diameter of 12 mm.

The surface is apparently entirely smooth.

This species rather closely resembles *Bactrites? smithianus* in general appearance, but is at once distinguished by the central position of the siphuncle. The septa are also somewhat more closely arranged, although as both species vary somewhat in this particular there is but little difference between the longest extreme of one and the shortest extreme of the other. At station 2082, where the two species occur in nearly equal abundance and where *B.? smithianus* occurs with unusually distant septa, the difference is more marked than when specimens from different localities are compared. The resemblance is much closer with *Orthoceras caneyanum*, to which reference is made elsewhere. As a rule, specimens from station 2082, where *O. wapanuckense* occurs most abundantly, appear to be smooth. In one instance, however, there are shown somewhat wavy cross striæ, like those of *Bactrites? smithianus*. This, however, is seen upon some of the inmost shell layers, the superficial ones, or what appear such, being smooth.

Horizon and locality.—Caney shale, Atoka quadrangle (station 2082), McAlester quadrangle (station 2079?), Antlers quadrangle (stations 3948?, 3983?).

ORTHOCERAS CANEYANUM n. sp.

Plate VI, figures 7, 8.

This species closely resembles *O. wapanuckense*, but has been differentiated because the septa are distinctly more closely arranged. The shell is slender and very gradually tapering. The siphuncle is subcentral. The diameter is twice, instead of one and one-half times, the interseptal distance. The surface appears to be smooth, without sculpture of any kind, though one example has a few strong, irregular, incremental lines encircling the living chamber. The largest specimen referred here with certainty has a diameter of 12 mm.

Many of the specimens placed in this species are internal molds and fail to exhibit any of the sculptural characters. Some, however, show areas which are either quite intact or but slightly exfoliated, and which, if transverse striæ like those of *O. crebriliratum* and *O. choctawense* were present, could hardly fail to retain traces of them. A few larger fragments which do not show the septa or siphuncle have wavy transverse striæ, such as have already been noted in the case of *O. wapanuckense* and *Bactrites? smithianus*. These fine wavy striæ seem to be upon the interior of the shell, the exterior being smooth, and they are different from and coarser than the rigid striæ which occur in *O. crebriliratum* and *O. choctawense*. They appear not to be found upon all molds or exfoliated specimens of this and the other species where they occur, being more often noted upon the larger specimens, especially the living chamber. They are not, however, entirely restricted in this way.

O. caneyanum resembles *O. okawense* and *O. epigrus*, but both species have the septa more closely arranged, while the latter is said to have faint longitudinal striæ.

Horizon and locality.—Caney shale, Antlers quadrangle (stations 2075, 3984?), McAlester quadrangle (stations 2078, 2079), Stonewall quadrangle (station 2080).

Orthoceras crebriliratum n. sp.

Plate VI, figures 9, 9a, 10.

Shell rather small, very gradually expanding. Section circular, siphuncle subcentral. Septa rather closely arranged, about two and one-half chambers to a diameter.

Sculpture consisting of very fine, regular, transverse striæ, separated by slender, rigid, annular liræ, about nine in 1 mm.

The largest specimen referred to this species has a diameter of 15 mm.

O. crebriliratum resembles *O. caneyanum* in a general way, but is distinguished by its fine transverse striæ, the surface of *O. caneyanum* being smooth. Its relation to *O. choctawense* is still more intimate. It is distinguished by its finer sculpture, less rapidly expanding shape, and somewhat higher chambers. I am not sure that the latter differences will always prove to be constant and well marked, but the difference in sculpture seems to be sufficiently great to afford an available distinction in most cases.

Horizon and locality.—Caney shale, Tishomingo quadrangle (stations 2083, 2091), Antlers quadrangle (station 2075?), McAlester quadrangle (station 2078).

Orthoceras choctawense n. sp.

Plate VI, figures 14, 14a, 14b.

Shell small, rather rapidly expanding. Section circular, position of siphuncle unknown. Septa closely arranged, about three chambers to a diameter.

Surface marked by fine, rounded, annular striæ separated by much narrower angular liræ, the direction being almost strictly transverse. There are 16 liræ in 5 mm.

The dimensions of the type are, length 14 mm., diameter below 2 mm., diameter above 4 mm. or a little less. A fragment of another specimen associated with the foregoing, and probably belonging to the same species, indicates a considerably larger size, as much as 7 mm. in diameter.

This species is based upon the single specimen shown by the figures. In the arrangement of its septa, and to a certain extent in the sculpture, it resembles *O. crebriliratum*. The annular striæ are considerably coarser and the shell is more rapidly expanding.

Horizon and locality.—Caney shale, Tishomingo quadrangle (station 2091), McAlester quadrangle (station 2079?).

ORTHOCERAS INDIANUM n. sp.

Plate VI, figures 13, 13a.

Shell small, straight, circular in section, gradually expanding. Siphuncle central. Suture straight, transverse. Chambers rather low, about two in one diameter.

Surface marked by rather low, flat-topped annulations, separated by grooves or striæ about as wide as or a little wider than the ridges which they divide. About five annulations and five striæ occur in the space of 2 mm.

The dimensions of the type are, length 13 mm., diameter above 4 mm., diameter below 3 mm.

This species is most closely similar to *Orthoceras choctawense*, but shows several noteworthy differences. The shell is perhaps less rapidly expanding, the chambers are higher, and the sculpture, though of like general character, presents the following variation. The annulations are somewhat coarser, and instead of being angular and much narrower than the striæ they are flat and nearly as broad as the intervals which separate them.

Horizon and locality.—Caney shale, McAlester quadrangle (station 2078).

ORTHOCERAS sp.

Of this species our collection contains only one specimen, which agrees very closely with *O. crebriliratum* in all points save the height of the chambers, which is only a little less than the diameter, the diameter being about one and one-fourth the interseptal distance. The surface is marked by fine, regular liræ, separated by broader, rounded striæ, just as in *O. crebriliratum*. The diameter of the present subcylindrical specimen is 7 mm.

In the arrangement of the septa this species can be compared with *O. wapanuckense*, but the latter species seems to have a smooth external surface, whereas the present one has a transversely striated sculpture. The fine rigid striæ which cross the outer surface of the form under consideration should not of course be confused with the still finer wavy markings which appear only upon the inner layers of *O. wapanuckense*.

Horizon and locality.—Caney shale, Tuskahoma quadrangle (station 2057).

Genus CYCLOCERAS McCoy.

CYCLOCERAS BALLIANUM n. sp.

Plate VI, figures 15, 15a.

This species forms straight, rather gradually expanding, strongly annulated, conical shells, which have a circular cross section and an eccentric siphuncle. The latter is not marginal, but situated about one-half of a radius from the margin. The annulations occur about three in a diameter, and they are more angular and projecting upon the shell itself than upon the internal mold. There is some evidence for believing that they are not straight, but have a sinus or lobe in the vicinity of the siphuncle. The septa appear to be disposed with relation to the annulations and to alternate with them, so that an annulation occurs about the middle of each chamber, or, in other words, the suture occurs about midway between two annulations.

This species is related to *Cycloceras randolphense*, but is distinguished by having the annulations farther apart. In the present form, besides, the section appears to be circular instead of elliptical.

Horizon and locality.—Caney shale, Tishomingo quadrangle (station 2083).

Genus ACTINOCERAS Bronn.

Actinoceras vaughanianum n. sp.

Plates VII, VIII, IX.

Of this fine species our collection contains fragments of six individuals. The shape is straight, conical, rather gradually enlarging. The size is very large. The largest fragment has a diameter at the larger end of 118 mm. and is 99 mm. across at the smaller, the length of the fragment being about 175 mm. Judging from the slow expansion of this and other specimens the complete length must have been very unusual, and as the fragment above noted is in the septate portion the chamber of habitation must have had a still greater diameter. The siphuncle appears to be central or subcentral in position. It is of large size and in the interseptal spaces enlarges into ellipsoidal expansions marked by longitudinal cracks or striæ, so that the whole resembles a string of large beads. The septa are rather close together, the chambers varying somewhat from six in a diameter to a little less. The septa have the appearance of being double.

The suture appears to have been straight in some specimens, but in others, possibly owing to unequal erosion, slightly sinuous. Whether there were persistent or appreciable lobes or sinuses is a little doubtful, though possibly such existed.

In so large a species the shell naturally attained a considerable thickness. The external surface, so far as can be determined, was smooth.

Horizon and locality.—Caney shale, Stonewall quadrangle (station 2080); Tishomingo quadrangle (near Tishomingo); Atoka quadrangle (station 2082 ?); McAlester quadrangle (float).

Genus CYRTORIZOCERAS Hyatt.

CYRTORIZOCERAS? HYATTIANUM n. sp.

Plate X.

This species consists of rather rapidly expanding conical shells, which are moderately bent in the lower portion and somewhat straighter above. The section is distinctly though not strongly elliptical, the shorter axis being naturally in the plane of curvature. The character and position of the siphuncle are not shown in the single specimen examined. The septa are rather close together, about 6 mm. apart, the distance between them varying somewhat in the different chambers in proportion to their distance from the apex, and in the same chamber according to the position of the point of measurement, the height being greater on the convex (ventral?) than on the concave (dorsal?) side. The suture is rather strongly sinuous. There is a distinct ventral saddle, opposite to which is a broad, shallow, somewhat rectilinear dorsal lobe. Between them, upon each side, lie a narrow lateral lobe and saddle. The suture is roughly divided into four equal parts by these flexures—a dorsal portion with a lobe, a ventral portion with a saddle, and two lateral portions each with a lobe and a saddle. The chamber of habitation is of moderate length for the size of the shell, if our specimen is perfect above. The length of the fragment is 54 mm., the chamber of habitation about 26 mm. The greatest diameter of the large end is 53 mm., the least diameter 49 mm. Of the smaller end the greatest diameter is 21 mm. and the least diameter about 18 mm.

The sculpture consists of rather regular, fine, annular striæ, which clearly do not pursue a straight course about the cone. Their flexures can not be made out from the single specimen at hand, but they are more or less independent of the suture line. In addition to the striæ there are rather numerous regularly distributed, small, round pustules, such as appear upon the surface of many *Orthoceras*-like shells.

The correct generic position of this species is a matter of doubt. It could not be placed with the Devonian genus *Cyrtoceras* because of the different section (since it is not triangular, and hence the venter is flattened and not elevated) and probable differences in the shape of the aperture. *Rizoceras* may possibly be the correct position, but I have referred it to *Cyrtorizoceras* because the latter genus is said to have a shorter living chamber and more sinuous suture. There are, however, said to be decided dorsal and ventral saddles in *Cyrtorizoceras*, whereas the present form has a flattened if not a concave suture along the ventral side.

Horizon and locality.—Caney shale, Atoka quadrangle (station 2082).

Genus CŒLONAUTILUS Foord.

CŒLONAUTILUS GRATIOSUS, n. sp.

Plate V, figures 1, 1a, 1b.

This interesting species is represented in our collection by two specimens, one of them small and both of them fragmentary. A fairly complete description can, however, be drawn up. The general shape is discoidal, with rather rapidly enlarging whorls and very wide, open umbilicus. The volutions are but slightly embracing, each rendered gently concave in a narrow band along the inner surface. The cross section is subelliptical and strongly transverse. The siphuncle is central. The sides are marked by broad, subangular revolving costæ, which are swollen or nodose at regular intervals, indicating possibly obscure annular enlargements. There are six of the revolving costæ on each side. The venter is gently concave along a relatively narrow zone, which in a measure corresponds to the sulcus separating any pair of revolving costæ, but is distinguished not only by its medium position but by its greater width, being perhaps twice as wide. The median depressed zone and the two bands of revolving costæ which it separates together occupy about half of the transverse section. The remainder consists of the rather narrow depressed dorsal zone, bounded upon either side by a smooth, gently convex surface, which occupies distinctly more than one-third of the dorsal half of the entire cross section. This rather long distance between the depressed zone and a pretty distinct umbilical shoulder represents the lateral extent of the volution beyond that which preceded it. The surface in question appears not to be entirely smooth, however, the specimen showing traces of a few delicate, widely spaced, elevated revolving lines, which in the younger volutions may have been obscure costæ.

The sutures are nearly straight, but bend backward over the concave ventral zone to form a rather deep ventral lobe. The height of the chambers along the median line of the ventral surface is a trifle more than 3 mm. The whole diameter of the larger specimen was about 30 mm.

Horizon and locality.—Caney shale, Atoka quadrangle (station 2082).

Genus BACTRITES Sandberger.

BACTRITES? QUADRILINEATUS n. sp.

Plate VI, figures 1, 1a, 1b, 2, 3, 4, 4a.

Shell small, elongate, very gradually enlarging. Section circular, siphuncle marginal. Suture straight, transverse, deflected, of course, in connection with the siphuncular collar. Chambers deep, about one and one-fourth to one and one-third in a diameter. The chamber of habitation is long. In one specimen (see fig. 3 of Pl. VI), which measures only 2½ mm. at the smaller end, there is an unchambered portion of almost 30 mm., the entire length of the fragment being 39 mm. The size attained is not large, the largest specimen referred here having a diameter of 8 mm.

The surface is marked by very delicate striæ, leaving between them flattened bands many times wider than the striæ themselves. From 30 to 32 occur in the space of 2 mm. The course of the striæ is not directly transverse, but strongly zigzag, forming in fact two reentrant and two projecting angles. In each case the angle is a little greater than 90°. The sculpture described above does not, it would appear, indicate that the aperture is not entire, for the striæ become evanescent toward the larger end along a nearly straight transverse line, leaving a smooth band which lacks the characteristic markings. The striæ are not absolutely straight, being somewhat wavy, especially in the neighborhood of the change in direction, which is not effected by a true geometric angle.

This species is related both to *B.? carbonarius* and *B.? smithianus*, but although I at one time combined it with *B.? smithianus* and identified it as *B.? carbonarius* it now seems probable that all three are distinct. The latter species has about the same height of chamber as the present form, but its surface is described as being smooth, except for fine, sinuous, imbricating cross striæ of growth. This is, of course, distinctly different from the sculpture of *B.? quadrilineatus*. The same difference distinguishes *B.? quadrilineatus* from *B.? smithianus*, and the height of the chamber is moreover somewhat less.

The sculpture of this species is peculiar, and it is true that it has been noted upon surfaces more or less exfoliated. The hypothesis has been carefully considered and abandoned that these striæ are due to any mineralogic character of the material by which the original shell has been replaced. They are extremely even and regular in arrangement. The angles where the direction changes occur along four straight, equidistant, longitudinal lines. There are, furthermore, no divaricating series of striæ. It seems almost necessary to believe, therefore, that this sculpture, though preserved upon the inner shell layers, is the real sculpture of the exterior, or, at all events, that it is not due to cleavage.

This species has been found only at station 2083, but all the specimens obtained from there do not show the characteristic sculpture either upon internal molds or upon external surfaces in the rare cases where the latter are shown. A number do not exhibit any sculpture whatever, while several large fragments, one of them illustrated on Plate VI, figure 6, show the striæ and punctæ which appear to belong to *B.? smithianus*. The punctæ which occur also in the smaller specimens of *B.? smithianus* have not been observed in the smaller shells found at station 2083. One specimen, the original of figure 4 of Plate VI, which shows the striæ and their zigzag arrangement with peculiar perfection, appears to be a living chamber, for, at all events, no septa or siphuncle can be seen, so that I originally mistook it for one of the Dentaliidæ. Of the specimens figured from station 2083 the originals of figures 1, 3, and 4 show the characteristic sculpture. One appears to be smooth (fig. 2) and one shows wavy striæ and punctæ (fig. 6). The latter I have provisionally identified as *B.? smithianus*, although it may prove to represent the mature sculpture of *B.? quadrilineatus*. The shells on which no sculpture has been observed have been provisionally referred to *B.? quadrilineatus*.

I may also remark that some of the specimens of *B.? quadrilineatus*, especially the smaller ones, for the chambers appear to grow proportionately shorter with advancing age, have longer chambers than others, and are practically indistinguishable from *B.? smithianus* in this particular. While the evidence at hand seems practically to require the separation here adopted, I am somewhat doubtful whether it will be upheld by more complete data.

I am disposed to think that J. P. Smith attaches too much importance to what he calls the siphonal lobe in these forms, and to doubt whether they really belong to the Devonian genus *Bactrites*. *Orthoceras*, it is true, as a rule has the siphuncle nearly central in position, and the septa, though deflected in its vicinity to form a sheath or collar, make a more or less straight and transverse intersection with the conical sides of the shell. If, however, the siphuncle were moved to a marginal position the deflection of the septa would show itself by a deflection of the suture, much as we see it in the present form. The fundamental point here, therefore, seems to be not the deflection of the suture, but the marginal position of the siphuncle, and it is not certain that variation in the position of the siphuncle, even in this degree, would justify the discrimination of a distinct genus. In regard to the genus *Bactrites*, we note that it is a Devonian type, excepting for the present species, and that the suture is sinuous and oblique, instead of straight and horizontal. I should judge that what is regarded as a lobe in *Bactrites* is not homologous with the deflection of the suture which J. P. Smith regards as a lobe in the Carboniferous species.

Horizon and locality.—Caney shale, Tishomingo quadrangle (station 2083).

Bactrites? smithianus n. sp.

Plate VI, figures 5, 6.

Shell elongate, very gradually tapering. Section circular; siphuncle small, marginal. Chambers high, very nearly one to a diameter. Suture straight, transverse. Sculpture consisting of regular, fine, wavy, transverse striæ.

This species is obviously related to J. P. Smith's *Bactrites? carbonarius*, and I originally identified it with that species. The rate of expansion appears to be about the same, and it has the same sort of sculpture, but the present species probably has distinctly higher chambers. Smith merely says "chambers deep," and does not give measurements. His figures indicate that there are about one and one-third to one and one-half chambers to a diameter at any point, so that the interseptal distance is distinctly shorter than in the Caney form. This is the chief evidence upon which they are separated.

Although the largest septate fragment which can be referred to this species scarcely measures 10 mm. in diameter, fragments of living chambers indicate much larger dimensions, probably no less than 25 mm. They have been provisionally placed here on account of their sculpture. This consists, as already noted, of fine, wavy, transverse striæ and of somewhat inconspicuous irregularities of growth. The growth lines and striæ do not always correspond in direction, the growth lines in some cases at least being slightly oblique. This sculpture is best seen on the large fragments, one of which is represented by figure 6 of Plate VI, but the same sort of markings can be made out here and there upon the smaller camerated fragments. Often the best external surfaces that can be found appear to be smooth, and for a while I was disposed to believe that these striæ were developed only upon internal molds or upon exfoliated surfaces, but later they were observed upon external molds as well. Unless we assume that there is a normal variation from striated to smooth surfaces, or that there are two species, one smooth and one striated, it seems necessary to account for the lack of striæ upon some specimens as the result of erosion, the hypothesis adopted here.

In addition to the striæ there are numerous little round spots or punctæ, which represent perforations in the shell. No other conclusion seems possible from my observations. In some cases the shell is replaced by transparent calcite, and these prolongations of the matrix can be clearly seen traversing it. They thus pass nearly, if not quite, through the test. They appear partly as elevations and partly as depressions on the same specimen, according, I believe, as they break off near one or the other of the two surfaces of matrix to which they were attached. These perforations occur with equal abundance upon the small camerated frustums. They are, I believe, an intrinsic character of the shell and occur in other forms also. They are too equal in size, too regular in distribution, and too invariably transverse to have been produced by a boring animal.

Horizon and locality.—Caney shale, Atoka quadrangle (stations 2077 ?, 2082), Stonewall quadrangle (station 2081), Tishomingo quadrangle (station 2083).

Genus GASTRIOCERAS Hyatt.

The genus *Gastrioceras* is in an unsatisfactory condition, being more or less complicated with *Goniatites* s. s., with which it is said to intergrade. The chief distinction from that genus seems to lie not in the suture, but in the configuration, the typical species having wide umbilici, but slightly embracing volutions, and rather prominent lateral nodes. The two species referred to *Gastrioceras* in the present report clearly do not belong to the typical section of the genus, if they belong to the genus at all. They have been referred to *Gastrioceras* because one of them (*G. richardsonianum*) appears to be closely related to *G. kingi*, which Hyatt, who proposed the genus, placed in *Gastrioceras*. Furthermore, in the form of the larval shell both species show important differences from *Goniatites choctawensis*, which is clearly a characteristic species of *Glyphioceras* (=*Goniatites*). Therefore, at all events, it seems that we must consider these shells to be distinct from *Goniatites* unless the difference already noted be regarded as inadequate to distinguish them, and I am rather disposed to think that it would be well to separate them from *Gastrioceras* also.

The two forms here provisionally grouped together and assigned to *Gastrioceras* show such differences from each other in the sculpture of the mature shell that they apparently belong to different sections, if not to different subgenera. In the larval stage, however, the sculpture is similar, and both have the same flat discoidal shape which distinguishes them from the young of *Glyphioceras* (=*Goniatites*).

GASTRIOCERAS RICHARDSONIANUM n. sp.

Plate XI, figures 1–11.

?1903. *Glyphioceras calyx*. Smith, U. S. Geol. Surv., Mon. 42, p. 62, pl. 18, figs. 1–11.
Lower Carboniferous: Moorefield, Ark.

This species attains a medium size, with a crescentic whorl section, strongly rounded ventral surface, and a small umbilicus. Some specimens measure 45 mm. in diameter, and possibly more. The type has a diameter of 33 mm. and a thickness of 21 mm. The height of the last whorl is 9.5 mm., while the umbilicus measures 8 mm. across. Constrictions occur a little more than a quadrant apart. The umbilical shoulder is rather sharply angulated.

The surface is marked by regular, transverse, sublamellose raised lines, coming about ten in 5 mm., but of course more closely crowded toward the umbilicus.

There is a moderately broad, rather low siphonal saddle, indented on top. The siphonal lobes are rather narrow and obscurely lanceolate. The first lateral saddles are rounded and moderately broad. The first pair of lateral lobes are broadly though strongly lanceolate. The second lateral saddle is broadly and unsymmetrically rounded, the greater curvature being on the more median side. The second lateral lobe is small, somewhat lanceolate, and situated upon the angular umbilical shoulder. Upon the inner side the second or outer saddle is rounded and very broad. The first lateral lobe is moderately broad and strongly lanceolate. The first lateral saddle is rather broadly rounded, and the antisiphonal lobe narrow and symmetrically lanceolate.

Apparently owing to a thickening of the inner surface of the shell along the siphon, the median portion of the venter in much exfoliated specimens is sometimes marked by a narrow, strong sulcus.

This species is closely allied to *Gastrioceras kingi*, but is distinguished by being narrower, with a more strongly arched ventral surface and a narrower umbilicus. The sculpture appears to be about the same in both species. In the present form also the space included by the siphonal saddle and siphonal lobes is broader than in *G. kingi*, though the latter has on the whole a broader and flatter ventral surface.

The specimens representing this species do not break down so as to show the early stages, and while at one locality the mature shells are associated with great numbers of larval ones, their sutures are almost always concealed. Nor is it easy to connect them into a continuous developmental series, although some data have been gathered, at least relating to the configuration of the early stages. When rather young this shell has a discoidal shape, consisting of a number of slowly enlarging volutions, which have an elliptical cross section and are scarcely at all embracing. During this stage they accomplish about four volutions and attain a size of 4 mm. or a little less. Then the shell begins to expand rather suddenly in a transverse direction and to become more projecting at the sides, the height remaining nearly stationary. The shape of the cross section at this stage is very broad and flattened across the ventral surface. Later the ventral surface becomes more and more arched and the height greater in proportion to the width, until at maturity the transverse section is high and somewhat helmet-shaped. The umbilicus is largely defined by the early growth, increasing very gradually during later developments, owing to the volutions encroaching more at the sides.

In the early stages the surface is marked by very fine, sharp transverse striæ of almost microscopic dimensions. A little later, probably about the time of the sudden enlargement of the whorls, the sculpture is much strengthened and coarsened, becoming, in some specimens at least, changed to relatively strong, transverse corrugations. These become less strong at maturity, relatively to the size much less strong, when the elevations have the appearance of being sublamellose.

Gastrioceras richardsonianum is by no means a typical representative of the genus, and I have been in some doubt as to whether it should be placed in *Gastrioceras* at all, rather than in *Goniatites* s. s. It is narrower than the typical species of the genus, with a more highly arched venter and a narrower umbilicus, and it lacks the characteristic lateral nodes. Except for the umbilicus, which is somewhat large, the configuration is rather that of *Goniatites*, and certain members of that genus appear to have a similar type of sculpture. The present species has been placed with *Gastrioceras*, however, because it appears to be closely related to *G. kingi*, which is one of the species originally included by Hyatt under *Gastrioceras*, and because of marked differences from *Goniatites*, displayed in its larval stages, differences not as yet in the suture (which is not known for larval *G. richardsonianum*, though J. P. Smith has worked it out for *Goniatites*), but in the configuration. In the associated *Goniatites choctawensis*, which is a characteristic *Goniatites*, the young stages are persistently globose, with almost completely embracing whorls and a closed, or nearly closed, umbilicus, contrasting very strongly with the flat discoidal early stages of the present species, with its volutions scarcely embracing at all and its umbilicus, if the term may be employed, covering the whole side of the shell.

There is one large specimen belonging to this species, or at least referred to it, that shows some unusual characters which are, however, at present regarded as gerontic, though the existence of the normal ones at an earlier stage has not been proved. The maximum diameter is no less than 45 mm. and the umbilicus measures 11 mm. The height of the last volution is 10 mm. The general configuration, therefore, agrees essentially with the smaller typical forms. The surface appears to be almost smooth, although there are constrictions apparently at quadrant intervals, and some not very regular though very obscure transverse ridges corresponding, probably, to the transverse lamellæ of the adult condition. The umbilical shoulder is strongly marked, the shell abruptly assuming a radial direction, and the angle thus formed is emphasized by a projecting seamlike edge, which is finely crenulated, and still further by a relatively broad, shallow depression or sulcus coming in just above.

Smith seems not to have found this species in the closely related fauna which he described from Moorefield, Ark., but I suspect that the form which he recognizes as *Glyphioceras calyx* is really only a youthful stage of *Gastrioceras richardsonianum*. That *Gastrioceras richardsonianum* in its youthful stages has a shape and other characters very close to the Moorefield form is pretty certain. Some of the Caney specimens are plumper than others; that is, the whorls seem to begin their rapid lateral enlargement at a slightly earlier stage. The mature forms also show similar variations, some individuals being broad and others relatively narrow. While I have regarded these variations in the small examples as merely such as are wont to occur between different individuals, it is not impossible that one type represents the larval stage of the present species and the other the mature stage of Smith's *Glyphioceras calyx*. This seems to me, however, far from probable, and I have tentatively included Smith's citation in the synonymy of *Gastrioceras richardsonianum*.

Horizon and locality.—Caney shale, Antlers quardrangle (stations 2075, 3948), Atoka quadrangle (stations 2076, 2077, 2082), McAlester quadrangle (station 2079), Tishomingo quadrangle (stations 2091, 5113?), Tuskahoma quadrangle (stations 2057, 3982, 3985).

GASTRIOCERAS CANEYANUM n. sp.

Plate XII, figures 4–10.

Shell rather small. The largest specimen definitely referred here has a diameter of 22 mm.; usually the diameter is 15 mm. or less. Cross section subcrescentic, somewhat flattened upon the ventral and lateral surfaces, deeply indented for about one-half the entire height by the preceding volution, which it almost completely incloses. The shape of the entire shell is thick-discoidal. Umbilicus moderately large, about one-fourth the entire diameter. Constrictions strong, about four to a volution; somewhat sigmoid, with a backward curve over the ventral surface.

Surface marked by rather sharp, strongly elevated, revolving liræ, separated by relatively broad, rounded striæ, which are narrower over the ventral area and broader toward the umbilicus. There are about 36 of the revolving liræ, and as the number seems to remain fairly constant the striation appears to be finer upon young than upon older shells. It is also finer over the ventral surface than upon the sides. Well-preserved surfaces show also fine, closely arranged, transverse, raised lines, which extend forward from the umbilicus, but are withdrawn in a concave curve over the venter.

There is a rather small, narrow siphonal saddle indented on top. The two lateral saddles are relatively large and broad, the second one being lower and broader than the first. The siphonal lobes are small, narrow, and pointed; the lateral lobes large, pointed, and somewhat lanceolate.

I have not satisfactorily determined the generic position of this form between *Gastrioceras* and *Goniatites* (*Glyphioceras*), but have provisionally placed it with the former genus, chiefly because the larval stages are flat and discoidal, like those of *Gastrioceras richardsonianum*, not at all like the globular *Glyphioceras choctawense.* Even the sculpture resembles *G. richardsonianum* at these early stages, the revolving liræ having given place to more or less lamellose, regular, transverse lines. The development of the suture lines has not been completely studied, but appears to be like that described by J. P. Smith for *Goniatites crenistria*, differing only in detail. In two groups as closely related as *Gastrioceras* and *Goniatites* are supposed to be, a fundamental difference in the development of the suture is hardly to be expected. In view of the rather striking differences in configuration exhibited by the early stages of *Gastrioceras richardsonianum* and *Goniatites choctawensis*, and the agreement of the present type with the former, it seems probable that *Gastrioceras richardsonianum* and the present type belong to the same genus. Whether that genus is really *Gastrioceras*, however, is another matter. In its sculpture the present form is very different from typical *Gastrioceras*, and different also from *Gastrioceras richardsonianum*, although resembling it in its early stages.

Gastrioceras caneyanum closely resembles two species which J. P. Smith has placed under *Goniatites* (*Glyphioceras*), namely, *G. newsomi* and *G. subcircularis.* The size of the umbilicus suggests the former rather than the latter, but it is a distinctly narrower shell than *G. newsomi*, agreeing in this respect rather with *G. subcircularis.* The descriptions of both these species are deficient in that they fail to indicate the size of the sculpture. It may be noted in this connection that the form identified by Smith with *Goniatites subcircularis* differs from Miller's description and figures in having a narrow though distinctly open umbilicus, while Miller represents this feature as entirely closed.

Among the species referred by Smith to *Gastrioceras* the present form most closely resembles *Gastrioceras entogonum.* It is distinguished by its narrower umbilicus and by the persistence of the striæ onto the sides, which in *G. entogonum* are said to be smooth.

I am not entirely satisfied that the present form does not belong with the same genus as *Goniatites newsomi* and *G. subcircularis*, but in any event it appears to be at least varietally distinct from either of them.

Horizon and locality.—Caney shale, Tuskahoma quadrangle (station 2047), Antlers quadrangle (station 3984), McAlester quadrangle (stations 2078, 2079), Stonewall quadrangle (stations 2080?, 2081?), Tishomingo quadrangle? (station 5113?).

Genus GONIATITES de Haan.

GONIATITES CHOCTAWENSIS Shumard.

Plate XIII.

1863. *Goniatites choctawensis.* Shumard, St. Louis Acad. Sci., Trans., vol. 2, p. 109.
Coal Measures: Choctaw Nation.
1903. *Goniatites choctawensis.* Smith, U. S. Geol. Survey, Mon. 42, p. 67. 66–67.
St. Louis-Chester stage?: Choctaw Nation?, Ind. T.
?1903. *Goniatites striatus.* Smith, U. S. Geol. Surv., Mon. 42, p. 80, pl. 10, figs. 1–11; pl. 26, figs. 6–13.
Bend formation: Lampasas, Texas.
Fayetteville shale: Batesville, Arkansas.

I am able to add but little to Shumard's description of this species, which is found in abundance at several localities in our collection. It possesses the usual characters of Goniatites of the *striatus* and *crenistria* groups, its distinguishing marks being the small, almost closed umbilicus and the fine sculpture. The latter varies greatly at different stages of development. Until of considerable size the shell is crossed only by regularly arranged transverse lamellose lines, about 15 in 3 mm. These have a slightly sinuous course, gently concave in the middle of the ventral surface, with another inward sweep about midway upon each side. The transverse lamellæ later begin to have a sharply and minutely zigzag outline, due, I believe, to the development of small tubercles at regular intervals. The tubercles and zigzags increase in strength until they become connected into longitudinal liræ, which in mature shells are prominent, the transverse lamellose lines being relatively obscure but producing elegant crenulations upon the liræ and the intervening striæ. The revolving liræ measure 8 to 10 in 3 mm. on mature shells. They are sharply and strongly elevated, with flattened interspaces, which are one or two times as wide as the liræ themselves. The latter are flattened on top and not infrequently marked by a distinct longitudinal groove. In the young stages the crenulation of the transverse lamellæ appears to be stronger upon the sides than over the ventral surface, and as the lamellæ are naturally more crowded toward the umbilici the revolving liræ, possibly on that account, appear to be initiated earlier there.

This species attains a considerable size. A large fragment indicates that the diameter may have reached 70 mm. Our next largest specimen, however, is only 44 mm., and the large figured specimen is considerably above the average. The chamber of habitation is long, at least a volution and probably more. Being unsupported by septa, it is frequently broken. The characteristic transverse constrictions are strong and come at almost exactly intervals of a quadrant.

G. choctawensis is extremely abundant at station 2083, our specimens from that point showing variation in numerous respects, though within not very broad limits, in specimens of the same age (size), aside from those which are obviously connected with ontogeny. Some individuals are more compressed than others. Certain variations occur in the suture line also, the plications being more rounded here, more lanceolate there, slightly narrower in this one, somewhat broader and lower in that, and so on. The constrictions vary most of all. In many specimens they are strong and in others are absent altogether. They are clearly a development on the inside of the shell, and consequently do not appear on testiferous specimens. They seem to be nearly straight, though usually a gentle sinus can be detected when looked for.

More striking, however, are the changes which come with size. The shape apparently remains almost uniform, though possibly the youthful stages are somewhat more globular and less compressed laterally than the mature ones. The umbilicus, however, is relatively larger in young specimens. The suture of course varies considerably, chiefly by the plications becoming ever deeper and more angular.

No feature shows ontogenetic changes to a greater degree perhaps than the sculpture. This begins as sublamellose transverse liræ, which gradually become denticulate, and so pass into connected longitudinal liræ. About the transition stage the transverse lamellæ become considerably more crowded and maintain this close arrangement until the end. The revolving liræ when they begin are equally fine and in equally close order with the transverse ones, but they become gradually more prominent and at the same time more widely spaced, so that the crenulating transverse liræ are relatively an inconspicuous feature at maturity.

I have identified this species at a number of other points besides station 2083. In most cases the material is so scanty or so poorly preserved as to contribute nothing to the data already set down. At two points, however, stations 2047 and 2078, the fossils are more abundant and better preserved, and they appear to show certain local mutations, which have made me hesitate between referring them directly to *G. choctawensis* or recognizing them as distinct varieties. In the specimens from 2047 the only character which seems positively to distinguish them is the sculpture, which in the average specimen is appreciably coarser than at station 2083. The constrictions also probably have a deeper backward concavity or sinus on the ventral surface.

The same feature is found in the specimens from station 2078, but here the sculpture is clearly as fine as at station 2083; the revolving striation, however, begins at a considerably earlier period, so that when specimens from 2083 show only transverse or possibly denticulated transverse liræ those from 2078 show fine revolving liræ with very subordinate transverse ornamentation. In both cases (stations 2078 and 2047) I have sometimes thought I could detect slight correlated differences in configuration or suture, but different individuals from a single station, such as 2083, show such differences among themselves that while those of sculpture mentioned as occurring at the two localities are appreciable, those of configuration, etc., it seemed upon reflection, were probably not sufficiently clear for practical use. The differences developed between different individuals from the same station have even led me to minimize those which seemed to be constant and tangible in the case of the two other occurrences, so that for the present they are all included under the same species.

There is very little doubt that Shumard's species *G. choctawensis* was introduced for one of these modifications, or it may be for more than one, but it is not possible to tell from his discriptions to which it was intended to apply. I will assume that the name should go with the form from 2083, because of its finer sculpture.

This species is probably the same which J. P. Smith found in Arkansas and identified as *G. striatus*, rather than as *G. crenistria*, as he suggested. There can be no question that the two forms belong to the same general type. Specimens from Moorefield resemble those from station 2047 in the Caney, having somewhat coarser sculpture than the variety furnished by station 2083. Both the Caney varieties differ from that occurring in Arkansas (at least in such instances as I have seen) in the fact that the revolving striæ begin earlier and are continuous at a stage (size) in which the Arkansas form is still marked only by crenulated transverse lamellæ.

After prolonged study of these specimens and after much consideration it has seemed that to adopt the differences noted as a basis for specific discrimination, and to carry through a division upon a corresponding scale, would lead to a great multiplication of specific names and the separation on paper of subdivisions which it would be practically impossible to establish satisfactorily among the specimens themselves. I am disposed to think, therefore, that the form here called *G. choctawense* and that identified by Smith as *G. striatus* would for the present best be regarded as the same species. That typical *G striatus* occurs in this continent has, I believe, never been satisfactorily proved, and on this account I am retaining Shumard's name for the species.

Horizon and locality.—Caney shale, Tuskahoma quadrangle (station 2047), Antlers quadrangle (station 3984), McAlester quadrangle (station 2078), Tishomingo quadrangle (stations 2083, 2084?, 2088, 5113?), Stonewall quadrangle (station 2081).

GONIATITES NEWSOMI Smith.

Plate XII, figures 11, 11a.

1903. *Goniatites newsomi.* Smith, U. S. Geol. Survey, Mon. 42, p. 78, pl. 17, figs. 2–5.
Fayetteville shale: Batesville, Independence County, Ark.

The shell referred to this species is of moderate size, thick-discoidal, with lunate section and wide umbilicus, which shows a number of younger whorls.

The sutures are not known. The sculpture consists of rather coarse, strong, revolving liræ, about 29 in number, and of delicate but sharp transverse liræ, much finer than the revolving ones. The latter are more crowded over the ventral surface, where they are separated by striæ a little more than their own diameter in width. At the sides the striæ are two or three times as wide as the liræ. The transverse liræ have the same direction as the well-marked constrictions, bending strongly forward at the sides, but with a distinct sinus or lobe across the median portion.

The height of a characteristic specimen is 21 mm., the width of the umbilicus 9 mm., the thickness of the final whorl 12 mm.

In general appearance this form strongly suggests *G. newsomi*, but in default of complete knowledge of the Caney form, and without specimens of that from Arkansas to compare it with, a satisfactory identification is not possible. It also so closely resembles *Gastrioceras caneyanum* that it hardly seems likely they should be referred to different genera. The ontogeny of typical *G. newsomi* is not known, but the mature suture resembles that of *Gastrioceras caneyanum* more than that of *Goniatites choctawensis.* The first lateral saddle of *G. choctawensis* is narrow, lanceolate, and pointed, while that of *Gastrioceras caneyanum* is broad and rounded. I know not how far this feature is characteristic of the natural groups to which these species belong, but using it for *Goniatites newsomi* the latter would go with *Gastrioceras caneyanum* rather than with *Goniatites choctawensis.*

In its specific characters the Caney form referred to *G. newsomi* is distinguished from *Gastrioceras caneyanum* by its larger size, coarser liræ, and wider umbilicus.

Horizon and locality.—Caney shale, Antlers quadrangle (station 3984).

GONIATITES sp. *a*.

Under this title I am considering two examples from station 3987 which resemble several of the species recognized in this paper, but present differences that make it advisable, provisionally at least, to retain them under a separate title. Their suture and their immature stages are unknown, but their general shape is fairly well exhibited and the sculpture excellently preserved. They are subglobose in shape, somewhat flattened at the sides, with a rather small umbilicus. The sculpture consists of numerous very fine, sharply elevated revolving liræ, crossed by rather inconspicuous transverse lines.

In general appearance this shell at once suggests a possibly distinct variety of *G. choctawensis*, which is shown by fig. 11 of Pl. XIII. When of the same size, however, *G. choctawensis* is cancellated by transverse liræ, which are at least as strong as the revolving ones, while in the present case the transverse lines are very inconspicuous. It also resembles the form described as *Gastrioceras caneyanum*, but is thicker in the diametric direction, with smaller umbilicus and finer revolving striæ. It is thicker and more finely striated than *Goniatites subcircularis*, as identified by J. P. Smith; similarly distinguished also from *G. newsomi*, which is said by Smith to be more coarsely striated than *G. subcircularis*. What divisions can properly be recognized in this apparently closely related series of forms, and to which of them the present species should be referred, are questions on which, from the data examined, I have been unable to reach a decided opinion.

Horizon and locality.—Caney shale, Antlers quadrangle (station 3987).

GONIATITES sp. *b*.

This form is represented by several specimens, one of them probably mature, but in a very unsatisfactory condition, the others small and also more or less fragmentary. The large specimen has a radial diameter of about 40 mm., and in general so much resembles *Gastrioceras richardsonianum* that it was at first thought to belong to that species. The shape, so far as can be told, is very much the same, and the sculpture also, consisting of fine, even, transverse striæ, without revolving lines. It is possible that the umbilicus is small, but no certain determination can be made. The suture and the development are distinctly different from those of *G. richardsonianum*. The latter conclusion is based upon the hypothesis that the smaller specimens are immature individuals, belonging to the same species as the large one. There is at present nothing to bring this hypothesis into doubt. Instead, however, of assuming a discoidal shape with flat volutions and wide umbilicus, these immature shells retain much of the shape of the mature form, being subspherical, with arched, deeply embracing volutions and nearly closed umbilicus. The sutures share the maturity of expression exhibited in the full-grown form, being more highly flexed than in *G. richardsonianum* of equal size. At least they become strongly flexed at a much earlier period as determined by size. They are also differently proportioned. This difference in suture is maintained in the mature form also, as already intimated. The plications are higher and the septa considerably farther apart. The siphonal saddle is higher, and, by reason of the siphonal lobes being more lanceolate, is much more spreading below. The first lateral saddles are also more lanceolate.

On the whole it seems not only that the form in hand is distinct from *G. richardsonianum*, but that it belongs to an altogether different group, being probably more closely allied to *Goniatites choctawensis*. In my estimation this is emphasized by the configuration of the earlier stages. Both in the young and in the mature stages, however, it seems to differ from *G. choctawensis*. At maturity it is readily distinguished by its wide umbilicus and by the absence of revolving striæ. In mature stages the siphonal saddle is much broader below, the siphonal lobes are broader, and the first lateral saddle is narrower and more bluntly pointed. In the young stage (8 mm. in diameter) the first lateral saddle is singularly broad.

Thus the mature form, though it considerably resembles *G. richardsonianum*, can nevertheless not be referred to that species, nor can the youthful form be identified as *Goniatites choctawensis*, which it especially resembles. I am disposed to believe that the two manifestations belong to the same species, one which is a representative of the same group as *G. choctawensis*, but quite distinct from it specifically.

Horizon and locality.—Caney shale, Ardmore quadrangle (station 5944).

Genus ADELPHOCERAS n. gen.

This name, which it may possibly be found best to employ only in a subgeneric sense, is introduced for a very handsome shell showing relationship both to *Gastrioceras* and *Paralegoceras*, but possessing characters incompatible with either of the genera mentioned. In configuration the present form more nearly resembles *Paralegoceras*, being discoidal in shape, with the final volutions increasingly lofty, helmet shaped, and deeply embracing. The sutures are simple and of the general type of both of the genera mentioned; but if *Paralegoceras* is distinguished fundamentally from *Gastrioceras* by possessing an additional pair of lateral lobes situated on the umbilical shoulders, the present form is distinctly not *Paralegoceras*, with which I should have been disposed to unite it, but is more nearly allied to *Gastrioceras*, having exactly the number and arrangement of lobes and saddles found in that genus. These plications of the septa are, however, less narrow and profound than is often observed in *Gastrioceras*.

It is the configuration and to some extent the sculpture which makes it undesirable to unite *Adelphoceras* with either *Glyphioceras* or *Gastrioceras*. The sculpture, which has not yet been mentioned, is elegant and probably characteristic, consisting of fine, regular, sharply angular plications, which arise at the umbilicus and become faint or die out entirely over the ventral surface. This region, in general appearance nearly smooth, is, however, in the typical species traversed by very delicate microscopic revolving liræ which extend onto the sides, possibly even to the umbilicus. Another feature deserving mention at this point is the constrictions, which have an unusually sigmoidal curve. This sculpture somewhat suggests that of typical *Gastrioceras*, but the transverse plications are too fine and prolonged to be really comparable with the lateral nodes of that genus. It more strongly perhaps recalls that group of Permian *Gastriocerata* which has lateral nodes and revolving lines over the ventral area.

Adelphoceras appears to complement the cycle of forms represented by *Gastrioceras* and *Glyphioceras*, though other units in the series may be discovered. Each has a more or less distinctive configuration and sculpture: *Glyphioceras*, with globose shape, crescentic, strongly embracing whorls, and sculpture consisting of fine transverse lines or fine revolving lines with transverse crenulation; typical *Gastrioceras*, with transverse, quadrate, or subelliptical, slightly embracing volutions, broadly open umbilicus, and sculpture consisting of heavy elongate lateral nodes; and *Adelphoceras*, with discoidal shape, high and deeply embracing volutions, and sculpture consisting of fine, transverse wrinkles and microscopic revolving striæ. These types, which show almost identical sutural development and differ only in sculpture and general expression, appear to be more closely related to one another than to some of the other genera associated in the same family. It may seem preferable, therefore, to regard them as subgeneric developments of a single genus. Apparently the generic term which must be employed is *Goniatites*, and the three subordinate groups would have to be called *Goniatites* s. s., *Gastrioceras*, and *Adelphoceras*. I should like to retain *Glyphioceras* instead of *Goniatites* s. s., but that seems impossible under existing rules of nomenclature. Nor can I agree with those authors who retain *Glyphioceras*, but use it for a different group of shells from that typified by *Goniatites crenistria*.[a] The type of *Glyphioceras* is, unfortunately,

[a] J. P. Smith states that *G. sphæricus* is first mentioned by Hyatt under the description of *Glyphioceras*, and must be regarded as the type of the genus, though authors usually cite *G. crenistria*. He appears to be mistaken in this point, *G. crenistria* being the first-mentioned species.

congeneric with the type of *Goniatites*, so that if we retain *Goniatites* in its restricted rather than in its common, more general sense, it must supplant *Glyphioceras*, while the latter name should not, I believe, be diverted to another group.

So far as has been determined the development as well as the mature form of suture of *Adelphoceras* allies it with *Gastrioceras* and with *Glyphioceras* (= *Goniatites*). The development, however, has by no means been completely worked out. In one of its early conditions the type species, while manifesting the immature condition of the suture, passes through a stage in configuration suggestive of typical mature *Gastrioceras*, having a subdiscoidal shape, with broad, open umbilici, and a transverse, subelliptical or subquadrate, slightly embracing whorl marked on its sides by rather large though not strong nodes. The two small discoidal species which Professor Smith cites as *Gonioloboceras ? limatum* and *Glyphioceras leviculum* are somewhat suggestive of *Adelphoceras meslerianum*, and may prove to belong to the present genus.

Type.—*Adelphoceras meslerianum.*

Adelphoceras meslerianum n. sp.

Plate XII, figures 1–3c.

Shell small, discoidal, the largest specimen seen having a diameter of 21 mm. and a thickness of 8 mm. When mature the cross section of the whorls is very high and helmet shaped, deeply embracing, so as to largely inclose the preceding volution and leave only a narrow though deep umbilicus.

The sculpture of the mature portion consists of rather fine, regular, transverse striæ, separated by delicate though strong and angular folds. These are well defined toward the umbilicus, but die out over the venter or become very faint. The direction of these lines is sinuous—concave over the ventral portion, then convex, with another reentrant curve half way toward the umbilicus. The venter, which is almost free from transverse costæ, is crossed by extremely fine, delicate revolving striæ, so faint that they might readily be overlooked even with a moderately strong hand lens. These revolving striæ are continued laterally until they become implicated with the transverse wrinkles or plications, to which, however, they are very subordinate, and they may continue quite to the umbilicus. The constrictions are unusually deep and occur about a quadrant apart. They follow the course of the plications in the main, but are strong over the ventral region, where they show a deep sinus.

The sutures are those of *Glyphioceras* and *Gastrioceras*. The saddles are broadly rounded, the lobes broadly lanceolate. There is a low, narrow siphonal saddle indented on top, followed by a pair of small, narrow, pointed, siphonal lobes. The first lateral saddle is high, broadly rounded, and moderately narrow. The lateral lobe is broadly lanceolate, and the second lateral saddle is broadly rounded, much lower and wider than the first. A narrow, pointed lobe occupies the umbilical shoulder. Upon the dorsal surface there is a rather narrow lanceolate antisiphonal lobe, followed by a symmetrically rounded saddle. A narrow rounded lobe follows, succeeded by a very broad low saddle and then an obscure lobe on the umbilical shoulder. The inner sutures, as described above, are taken from an immature specimen, but doubtless afford an accurate idea of the number of lobes, which are nine for the entire suture.

In the young stages both shape and sutures naturally undergo considerable modification. The very earliest volutions appear to be of a regular elliptical shape in section and, in strong contrast to the mature outline, are much wider than high, with rounded sides. A little later the sides become flattened and slope inward, their union with the ventral surface becoming decidedly angular and marked by nodes (in the third and fourth volutions). In this early condition the volutions are very slightly embracing and the angular nodose shoulder and transverse subquadrate section are suggestive of *Gastrioceras*. The sutures seem in the main to follow in their development that shown by J. P. Smith to exist in the youthful *Glyphioceras*, the lobes and saddles in earlier stages being more uniform in size and shape. Where the side of the volution is flattened, as in the third and fourth round, it is occupied by a broad, shallow saddle, broader than those upon the venter and less strongly concave.

Horizon and locality.—Caney shale, McAlester quadrangle (station 2078), Tishomingo quadrangle (station 2083), Antlers quadrangle (station 3984).

Genus EUMORPHOCERAS n. gen.

The type included under this title in its larval stages forms a small discoidal shell of slowly enlarging volutions which have a transversely elliptical section, with flattened venter, one volution projecting but little beyond that preceding and scarcely at all embracing it. The umbilicus in this stage is relatively very wide. In later growths the height of the volutions increases rapidly in comparison with their width, and the volutions become more and more embracing, until at maturity their shape is radially elongate, to a greater or less degree, and the umbilicus relatively small. At first the general shape is thick-discoidal, or globular; at maturity it is thin-discoidal.

In the very youthful stages the sides of the ventrally flattened whorls are ornamented with elongated nodes, which become more and more pronounced and elongated as their size increases. Considerably after the nodes have begun to show themselves two sulci are gradually introduced upon either side, dividing the external portions of the volutions into three approximately equal divisions. The area between the umbilicus and the sulcus on each side is occupied by the nodes or plications, which die out as such toward the sulcus, bending sharply and strongly forward in so doing. At this point they degenerate into or are replaced by growth lines, which are continued across the ventral surface defined by the two sulci. Here these sharp growth lines have a deeply concave direction, so that the aperture shows a deep hyponomic sinus defined by two strongly projecting points, whose situation is marked by the two sulci. (See fig. 15a of Pl. XI.)

The internal sutures have not been determined. The external ones show the general characters of *Glyphoceras*. There is a low siphonal saddle, which is sharply indented on top. The two lateral saddles are both rounded, the first being narrower than the second and projecting far beyond the siphonal saddle. The pair of siphonal lobes are low and narrow, the outer limb being much longer than the inner. The lateral lobe is rounded and rather large and broad.

The foregoing description, based upon the only known species, probably includes characters which will not be found without modification in related forms when such are discovered.

This is a rather well-marked type, and I hardly feel called upon to point out the obvious differences which distinguish it from other genera of the same family. From *Gastrioceras*, as the term is here used, it is distinguished by its discoidal shape, its radially elongated cross section, its sculpture, consisting of two revolving sulci and plications radiating from the umbilicus (though the latter feature is found in the typical section of the genus), by the shape of the aperture, by the suture, both lobes and saddles being rounded throughout, and by the absence of constrictions. Much more nearly related is it to the associated type which I have distinguished under the title *Adelphoceras*. The differences here are the absence of constrictions; the widely different ornamentation, resulting in part from the peculiar shape of the aperture in the form under consideration; and the suture, the lobes being rounded in *Eumorphoceras* and angular in *Adelphoceras*.

Type.—Eumorphoceras bisulcatum.

EUMORPHOCERAS BISULCATUM n. sp.

Plate XI, figures 15–19a.

Shell small, probably attaining a diameter of 30 mm., but so far as observed usually not exceeding 10 mm. The shape is discoidal, becoming increasingly so with advancing age. Umbilicus moderately large, proportionately smaller in old specimens than in young ones. The cross section varies greatly, from transverse and elliptical in the larval stages to radially elongate and elliptical at maturity. The type specimen has a diameter of 11 mm., the height of the last volution being 6 mm. and its width about 5 mm. The umbilicus measures 2.5 mm.

The surface is divided by two revolving sulci into three nearly equal portions. The areas nearest the umbilici are marked by regular, strong, angular, radiating ribs, separated by subangular channels of about the same width. Near the revolving sulci the ribs and channels are bent strongly forward, and at the same time they rapidly die out and disappear. The ventral area rises rather strongly from the two sulci, by which it is defined. Its borders are marked by an additional depressed line, which is less distinct than the main ones, in connection with which they give rise to a low revolving carina on either side. The remainder of the ventral surface is marked only by growth lines, which spring strongly backward in nearly straight lines, bending somewhat suddenly to become continuous across the median ventral area. The growth lines indicate the presence of a deep hyponomic sinus, on either side of which project long points whose position is indicated by the two revolving sulci. In old age the transverse or radiating plications near the umbilicus die out, leaving the surface marked only by growth lines and the two revolving sulci. Periodic constrictions appear to be wanting.

The siphonal saddle is low and indented above. The remaining lobes and saddles, two of each, are all rounded. The first lateral saddle projects far above the siphonal one and is narrower and somewhat higher than the second lateral. The pair of siphonal lobes are small, much smaller than the pair of laterals, which are as large as the lateral saddles.

In its young stages this form has a thick-discoidal shape, with volutions which are transverse, elliptical, flattened along the venter, and wrapped one upon the other, scarcely embracing at all. The umbilicus is practically the entire diameter of the shell. The height of the volutions increases more rapidly than the width, and at the same time they become more and more embracing, until the cross section is radially elongated and until the umbilicus occupies a fourth or less of the entire diameter. The characteristic sculpture is developed early, consisting at first of elongated nodes along the sides of the ventrally-flattened volutions. The two revolving sulci do not appear until later. By the gradual change in shape of the volutions and the gradual introduction and modification of the sculpture, the lateral plications appearing before the sulci and being lost before them in the gerontic stages, the characteristic features of this shell are evolved.

In its larval stage this form resembles *Gastrioceras richardsonianum* and occurs associated with it. It may be distinguished by being thicker, not compressed-discoidal, and by being marked by transverse costæ, coarser and stronger than the liræ of the *Gastrioceras*.

Horizon and locality.—Caney shale, Tuskahoma quadrangle (station 2057), Antlers quadrangle (stations 2075, 3948), Atoka quadrangle (station 2082), McAlester quadrangle (station 2079), Tishomingo quadrangle (stations 2084, 2091, 5113).

Genus TRIZONOCERAS n. gen.

This type is represented by two species having very well-marked characters, which forbid uniting them with any of the genera known to me.

The shape is more or less discoidal, with nearly closed umbilicus. The cross section is subtriangular to sublunate, narrow across the venter and expanded below in the typical species, and extending out near the umbilicus in auriculate projections. The surface appears to be smooth. The suture in its general scheme is like that of *Paralegoceras*, rather than *Goniatites*, there being three lobes and three saddles, besides a siphonal saddle, in the external suture. The siphonal saddle is narrow and indented above. The others are all rounded, the outer differentiated from the two inner ones by being larger and asymmetric. The outer lobe is correspondingly differentiated from the two inner lobes by being larger and simple and lanceolate, while the two inner ones are smaller and markedly bifid.

The apparent formation, upon each side, of a continuous revolving partition made by the outer sides of the second lateral saddles (see fig. 12 of Pl. XI) conspicuously divides the external portion of the volution into three parts, correspondingly occupied by the small median lobes and saddles, and the large, somewhat differently shaped lateral ones.

This genus is related to *Dimorphoceras*, but is clearly distinguished by important differences in the suture line.

Type.—*Trizonoceras typicale.*

TRIZONOCERAS TYPICALE n. sp.

Plate XI, figures 12, 12a. 12b.

This species is based upon a single mature specimen, which shows the following characters. The size is small, the general shape discoidal, with closed or nearly closed umbilicus. The volutions increase rapidly, so that the aperture occupies considerably more than half of the entire diameter. The cross section is subtriangular, very narrow across the venter, expanding below, and more or less projecting at the umbilicus in little ears.

The surface appears to have been smooth.

The siphonal saddle is rather narrow and high. It is deeply indented above, but this part of the specimen is obscure, and it can not be determined whether the indentation is angular, whether it is formed by two parallel lines which do not meet across the bottom, or whether the center is elevated into a denticle, thus making the saddle three-pronged. The first lateral lobe is considerably broader than the siphonal saddle, and is bifid or bilobed, by reason of a moderately strong, median, saddle-like depression at its end. The first lateral saddle is broadly rounded, about the size of the first lobe, and about the width of the siphonal saddle, though not so high. The second lateral lobe is somewhat smaller than the first, but, like it, bifid. The second lateral saddle, though similar to the first, is considerably larger. The third lateral lobe is larger than any of the others, and unlike them is simple and lanceolate. The third lateral saddle is much larger than the others; it is rounded, but instead of being regular is asymmetric. The internal sutures are not known.

The mesial portion of the structure of this species is rather sharply defined from the two lateral areas, having lobes and saddles which are not only smaller but differently shaped. There is another still more obvious peculiarity, which appears to divide the external portion of the shell into three distinct areas. The sutures occur very close together, and the external limb of the second lateral saddle not only almost connects with the same portion of the sutures preceding and following it, but, having the same direction, forms part of an apparently straight, continuous, revolving line. One of these occurs, of course, upon each side, and they appear to divide the sutural pattern into three quite distinct areas.

Horizon and locality.—Caney shale, Antlers quadrangle (station 3948).

TRIZONOCERAS LEPIDUM n. sp.

Plate XI, figures 13–14a.

This species can best be described by comparing it with the typical and only other known representative of the genus. The size is small and the rate of expansion rather rapid. The umbilicus is closed. The whorl section is sublunate, projecting at the umbilicus, and contracting, though rather broadly rounded above. It is thicker than *T. typicale* and more broadly rounded across the ventral surface. Consequently the shell as a whole is rather more globose. The suture is also different in detail, the outer zones being relatively narrower and the median one and the individual lobes which are comprised in it relatively wider. The surface is smooth, so far as known.

Horizon and locality.—Caney shale, Atoka quadrangle (station 2082), McAlester quadrangle (stations 2078, 2079), Antlers quadrangle (station 3894), Tishomingo quadrangle (station 2091).

OSTRACODA.

Genus CYTHERELLA Jones.

CYTHERELLA aff. BENNIEI Jones, Kirkby, and Brady.

Plate V, figure 8.

The only station at which Ostracoda have been noted in the fauna under consideration is 3981. The material from this point is none too well preserved, but two widely different forms appear to be present in it. One of these has a deep transverse furrow, a spine, and a tubercle. The other seems to be without such distinguishing marks altogether. It is of about the same size as *Entomis unicornis*, with which it is associated. The shape is elliptical, a little less than twice as wide as long, somewhat contracting in front, and more or less rectilinear along the upper and lower margins. The convexity is moderate, rather abruptly rounding down at the margins, thickest behind. Surface smooth.

So far as can be determined from the material examined, the Caney form is closely related to the English one cited above.[a]

Horizon and locality.—Caney shale, Ardmore quadrangle (station 3981).

Genus ENTOMIS Jones.

ENTOMIS UNICORNIS n. sp.

Plate V, figure 7.

Shell fabiform, about twice as wide as high or a little less. Hinge straight, somewhat shorter than the greatest width. Lower margin gently convex. Ends strongly and rather regularly rounded. A well-defined furrow perpendicular to the hinge begins a little in front of the middle and passes about halfway to the lower margin. Anterior portion of shell perhaps a trifle more convex than the posterior.

A small but strongly elevated tubercle is situated close to the hinge and posterior to the front margin by about one-third the distance between the latter and the nuchal furrow. A short, stout spine projects backward from the posterior half. Its position is almost marginal, a short distance below and posterior to the end of the hinge line. Surface nearly or quite smooth, without the ridges which characterize the more common group of the genus.

The majority of the species of *Entomis* are marked by concentric or transverse ridges or liræ of greater or less fineness, though smooth species are not unknown. The present form is distinguished by its smooth surface and by the small spine projecting from near the posterior margin.

Horizon and locality.—Caney shale, Ardmore quadrangle (station 3981).

[a] Jones, T. R., Kirkby, J. W., and Brady, G. S., British Carboniferous Entomostraca; Palæontographical Soc., 1874–1884, p. 70.

REGISTER OF LOCALITIES.

2047. Tuskahoma quadrangle, north of center of sec. 16, T. 3 N., R. 18 E. In creek bed.
Caney shale (collected from blue shale and limestone concretions, surface material, exact stratigraphic position not determined).
G. I. Adams.

2057. Tuskahoma quadrangle, SW. ¼ SW. ¼ sec. 17, T. 4 N., R. 22 E.
Caney shale. Fossils occur in limestone segregations in bituminous black shale; contact relations not determinable.
J. A. Taff.

2075. Antlers quadrangle, SW. ¼ sec. 2, T. 1 S., R. 16 E., valley of Caney Creek.
Caney shale (central and lower part; black shale and limestone concretions in same exposed along Caney Creek).
J. A. Taff and G. H. Girty, November 19, 1898.

2076. Atoka quadrangle, SW. corner of sec. 36, T. 2 S., R. 9 E.
Caney shale.
J. A. Taff.

2077. Atoka quadrangle, SW. ¼ SW. ¼ sec. 36, T. 2 S., R. 8 E., in creek 200 paces north and 56 paces east of corner.
Caney shale. Sandy shales lying above chert which overlies the Silurian limestone. This shale is probably not 100 feet above the Silurian limestone. Dip 35° N. 50° E.
J. A. Taff.
G. B. Richardson and G. H. Girty, later, 1898.

2078. McAlester quadrangle, near center of sec. 4, T. 2 N., R. 15 E., where small run crosses chert ridge.
Caney shale (lower part, but not base; from concretions in black shale).
J. A. Taff and G. H. Girty, November 28, 1898.
J. A. Taff and E. O. Ulrich, later.

2079. McAlester quadrangle, along tributaries to Elm Creek just north of Ti post-office, northeasten portion of sec. 20, T. 3 N., R. 16 E. (Ti post-office is no longer situated where shown on map.)
Caney shale (exact stratigraphic position not determined, but presumably lower part).
G. I. Adams and J. A. Taff, November 28, 1898.
G. B. Richardson and G. H. Girty, later.
J. A. Taff and E. O. Ulrich, later.

2080. Stonewall quadrangle, base of bluff on Boggy Creek 3 miles above Stonewall, Chickasaw Nation.
Caney shale? (nodules washed out of clay).
— Elliott and T. W. Vaughan, November 15, 1896.

2081. Stonewall quadrangle, about 2½ miles west of Stonewall, Chickasaw Nation.
Caney shale?
T. W. Vaughan, November 14, 1896.

2082. Atoka quadrangle, about center of SE. ¼ sec. 36, T. 2 S., R. 8 E.
Caney shale (limestone concretions in black fissile shale in Sandy Creek).
G. B. Richardson and G. H. Girty, November 16, 1898.
J. A. Taff, R. D. Mesler, S. H. Ball, and G. H. Girty, June 24, 1900.

2083. Tishomingo quadrangle, center of north side of sec. 14, T. 2 S., R. 7 E.
Caney shale (lower part of shaly portion).
J. A. Taff, S. H. Ball, and G. H. Girty, June 27, 1900.

2084. Tishomingo quadrangle, east side of NW. ¼ sec. 14, T. 2 S., R. 7 E.
Caney shale (in black shale 100 feet above chert).
J. A. Taff, S. H. Ball, and G. H. Girty, 1900.

2085. Tishomingo quadrangle, ravine a short distance (one-eighth mile) west of Viola.
Caney shale (20 feet above exposures of chert at base).
G. H. Girty, June 26, 1900.

2086. Tishomingo quadrangle, east side of NW. ¼ sec. 14, T. 2 S., R. 7 E.
Caney shale (at top of chert or base of black shale).
J. A. Taff, S. H. Ball, and G. H. Girty, 1900.

2087. Tishomingo quadrangle, ravine a short distance (one-eighth mile) west of Viola.
Caney shale (50 feet above exposures of chert forming base of Caney).
G. H. Girty, June 26, 1900.

2088. Tishomingo quadrangle, small ravine about one-eighth mile west of Viola, SW. ¼ sec. 13, T. 2 S., R. 7 E.
Caney shale (about 40 paces above 2091 and probably near base of shale and top of chert).
G. H. Girty, 1900.

2089. Atoka quadrangle, NE. ¼ SE. ¼ sec. 35, T. 2 S., R. 8 E.
Caney shale (near top of chert).
J. A. Taff, R. D. Mesler, S. H. Ball, and G. H. Girty, June 24, 1900.

2090. Tishomingo quadrangle, west side sec. 13, T. 2 S., R. 7 E.
Caney shale (about 50 feet above the chert).
G. H. Girty, June 26, 1900.

2091. Tishomingo quadrangle, SW. ¼ sec. 13, T. 2 S., R. 7 E., little ravine about one-eighth mile west of Viola.
Caney shale (some distance above chert beds at the base).
G. H. Girty, June 26, 1900.

3948. Antlers quadrangle, NW. ¼ sec. 19, T. 1 S., R. 14 E.
Caney shale (from numerous bowlders on surface; exact stratigraphic position not known).
E. O. Ulrich, J. A. Taff, and R. D. Mesler, October 5, 1902.

3981. Ardmore quadrangle, bluff on Sandy Creek, 3 miles northeast of Dougherty.
Caney shale, lower part.
E. O. Ulrich.

3982. Tuskahoma quadrangle, Windingstair Mountain, E. ½ sec. 32, T. 4 N., R. 20 E.
Caney shale (concretions well down in Caney, seemingly in lower part).
E. O. Ulrich and J. A. Taff.

3983. Antlers quadrangle, SE. ¼ sec. 4, T. 1 S., R. 16 E., branch of Caney Creek, near 2075.
Caney shale (seems to be central part).
J. A. Taff, E. O. Ulrich, and party, August 19, 1904.

3984. Antlers quadrangle, SW. ¼ sec. 3, T. 1 S., R. 16 E., Caney Creek branch, near 2075.
Caney shale (structure not clear; limestone bowlder (concretion?) seemingly in upper part).
M. K. Shaler and C. D. Smith.

3985. Tuskahoma quadrangle, SE. ¼ sec. 18, T. 4 N., R. 22 E., in railroad cut in vicinity of Compton, Choctaw Nation.
Caney shale (too much disturbance of rocks to interpret stratigraphic position).
J. A. Taff and E. O. Ulrich.

3986. Antlers quadrangle, branch of Caney Creek, W. ½ sec. 3, T. 1 S., R. 16 E., near 2075.
Caney shale (appears to be in central part).
J. A. Taff, E. O. Ulrich, M. K. Shaler, and C. D. Smith, August 19, 1904.

3987. Antlers quadrangle, Potapo Creek, SW. ¼ sec. 2, T. 2 S., R. 13 E.
Caney shale (supposed to be central to lower part).
J. A. Taff and M. K. Shaler, September 2, 1904.

3988. Antlers quadrangle, near northeast corner SW. ¼ sec. 32, T. 2 S., R. 14 E., in gulch leading to McGee Creek.
Caney shale (indeterminate).
J. A. Taff and M. K. Shaler, September 2, 1904.

5113. Tishomingo quadrangle (?), east bank of Washita River, 1 mile below lower gorge, Chickasaw country.
Caney shale.
O. St. John, February 20, 1887.

5114. Atoka quadrangle, NW. ¼ sec. 36, T. 2 S., R. 8 E., in branch of Sandy Creek.
Woodford chert? (cherty beds below typical Caney at stations 2077 and 2082, as recalled).
G. B. Richardson and G. H. Girty, November 16, 1898.

5944. Ardmore quadrangle, Cool Creek, center sec. 1, T. 3 S., R. 2 E.
Caney shale? (1,000 feet ± stratigraphically below fossil locality on railway south side sec. 1, T. 3 S., R. 2 E.).
J. A. Taff, S. H. Ball, and G. H. Girty, July 8, 1900.

PLATE I.

PLATE I.

LINGULA PARACLETUS Hall and Clarke (p. 15).

FIGURE 1. A fragmentary specimen with both valves in conjunction, though slightly displaced. The ventral valve is preserved as an internal, the dorsal as an external mold, × 3.

2. Internal mold of a large ventral valve, more or less broken in being flattened.

3. External mold of a dorsal valve. In the original the two valves are in conjunction, as in figure 1. The relative overlap posteriorly of the ventral valve, and the shapes of both, are the same as in figure 1, indicating that that is about their normal relation.

4. Apparently a dorsal valve.

5. Internal mold of a ventral valve showing muscular imprints. The posterior end is blunter than in figure 2, × 3.

Originals of figures 1–5 from station 2077.

LINGULA ALBAPINENSIS Walcott (p. 17).

FIGURE 6. A large specimen preserved as an internal mold, × 2.

6a. Same, natural size.

7. A small testiferous specimen, × 2.

Originals of figures 6 and 7 from station 3986.

LINGULA ALBAPINENSIS Walcott? (p. 17).

FIGURE 8. A very small individual from a different locality and of a different shape from the foregoing, × 5. This shell is less like typical *L. albapinensis* than the others.

Original from station 2089.

LINGULIDISCINA NEWBERRYI, var. ovata n. var. (p. 20).

FIGURE 9. A dorsal valve which over portions of the surface has been but slightly exfoliated, × 3.

Original from station 3986.

10. A somewhat exfoliated dorsal valve. × 2.

Original from station 2076.

11. Impression of the interior of a ventral valve.

Original from station 3986.

LINGULIDISCINA BATESVILLENSIS Weller (p. 22).

FIGURE 12. A large dorsal valve, somewhat exfoliated.

12a. Side view in outline.

Original from station 2076.

LINGULIDISCINA NEWBERRYI var. caneyana n. var. (p. 19).

FIGURE 13. A large testiferous ventral valve, × 2.

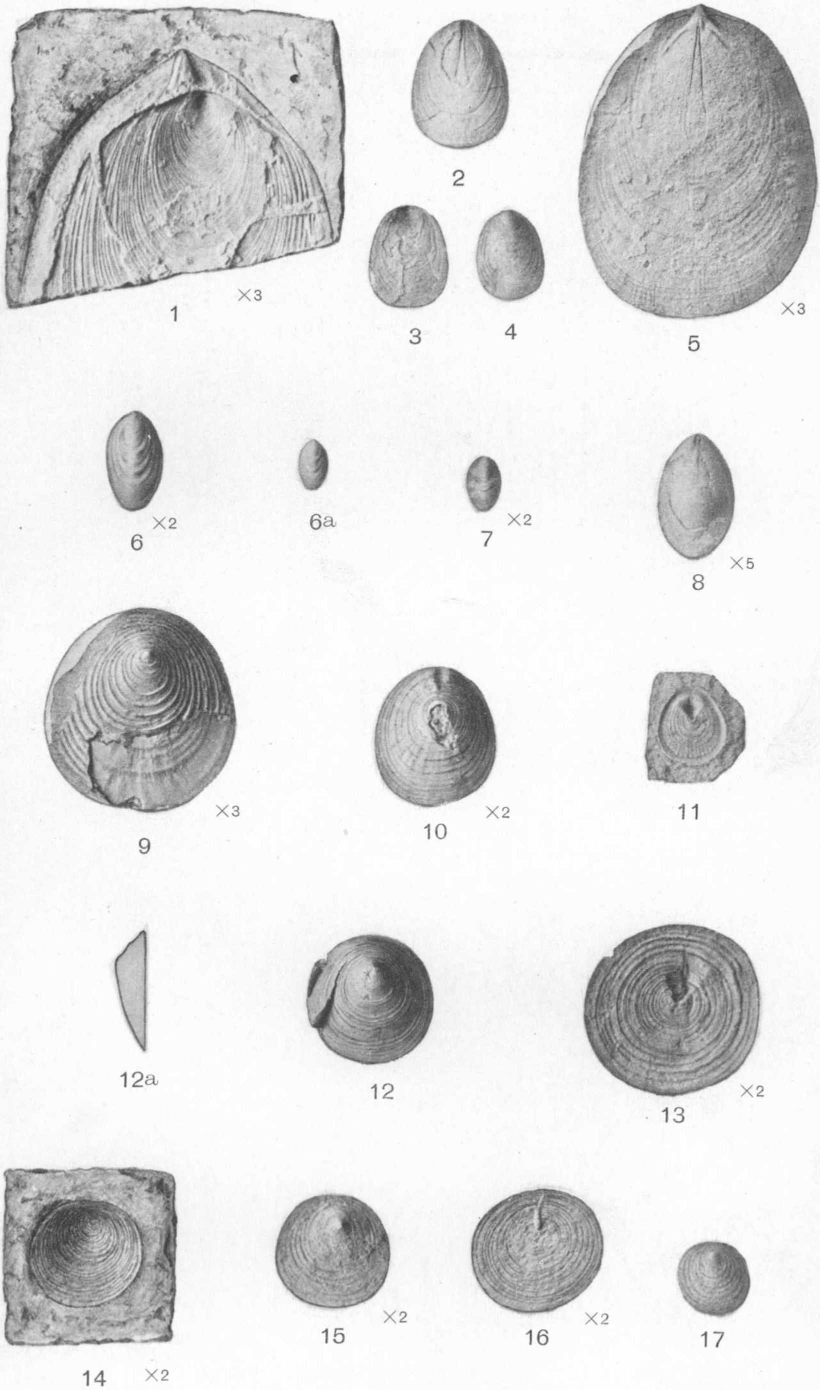
14. External mold of a dorsal valve.

15. A dorsal valve preserved in a more or less exfoliated condition. × 2.

16. A macerated ventral valve, × 2.

17. A large dorsal valve preserved as a mold and more or less flattened.

Originals of figures 13–17 from station 2077.



FAUNA OF THE CANEY SHALE

PLATE II.

PLATE II.

CHONETES PLANUMBONUS var. choctawensis n. var. (p. 23).

FIGURE 1. A ventral valve which is almost without a trace of costæ, × 2.
1a. Same, natural size, in outline.
2. A ventral valve showing obscure costæ, possibly owing to exfoliation, × 2.
2a. Same, natural size, in outline.
3. A ventral valve which is nearly smooth.
Originals of figures 1, 2, and 3, from station 2077.

PRODUCTELLA HIRSUTIFORMIS Walcott (p. 24).

FIGURE 4. A large ventral valve deformed by pressure.
5. A small ventral valve flattened in shale.
Originals of figures 4 and 5 from station 2077.
6. External mold of a small dorsal valve.
Original of figure 6 from station 2086.

PRODUCTUS PILEIFORMIS McChesney (p. 26).

FIGURE 7. A small dorsal valve preserved as an external mold, × 2.
Original of figure 7 from station 2079a.

SPIRIFER sp. (p. 28).

FIGURE 8. A ventral valve, the only representative of the species yet found. Preserved largely as an internal mold.
Original of figure 8 from station 2077.

MARTINIA sp. (p. 29).

FIGURE 9. A specimen retaining both valves spread out and flattened down.
Original of figure 9 from station 2089.

COMPOSITA? sp. (p. 29).

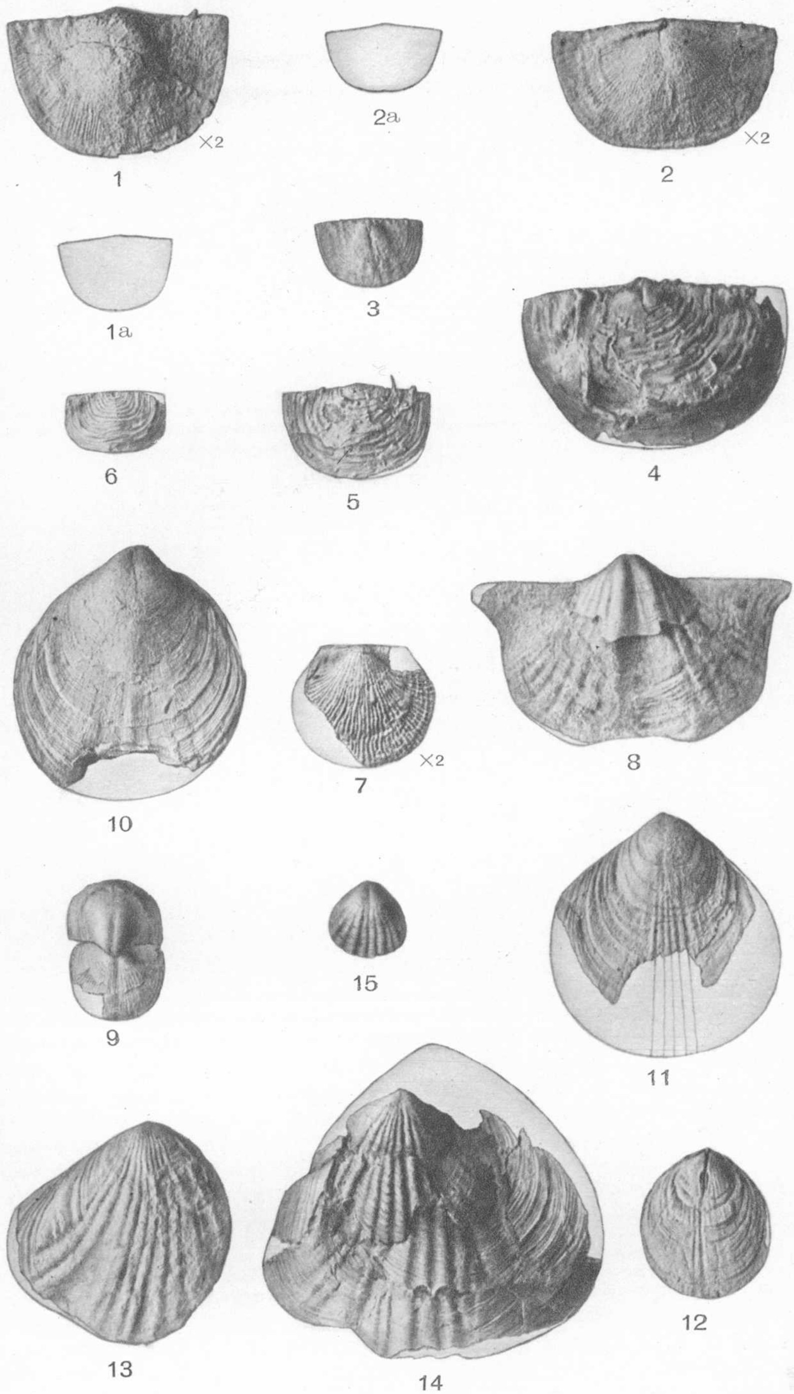
FIGURE 10. A ventral valve which may really be a *Liorhynchus* with obsolete plications.
Original of figure 10 from station 2077.

LIORHYNCHUS aff. MESICOSTALE Hall (p. 26).

FIGURE 11. An imperfect ventral (?) valve retaining part of the shell.
12. Internal mold of a macerated and compressed dorsal valve.
Originals of figures 11 and 12 from station 2077.

LIORHYNCHUS aff. LAURA Billings (p. 27).

FIGURE 13. A large dorsal valve macerated in shale and crushed to one side.
Original of figure 13 from station 2085.
14. A large specimen retaining both valves, which have been skewed and crushed together.
15. A small dorsal valve.
Originals of figures 14 and 15 from station 2075.



FAUNA OF THE CANEY SHALE

PLATE III.

PLATE III.

DELTOPECTEN? CANEYANUS n. sp. (p. 31).

FIGURE 1. The typical specimen, a left valve.
2. Fragment of a right valve showing the shape of the anterior ear.
Originals of figures 1 and 2 from station 2085.
3. A right valve from another locality referred to this species. The anterior ear is probably imperfect.
Original of figure 3 from station 2077.

PARALLELODON MULTILIRATUS n. sp. (p. 39).

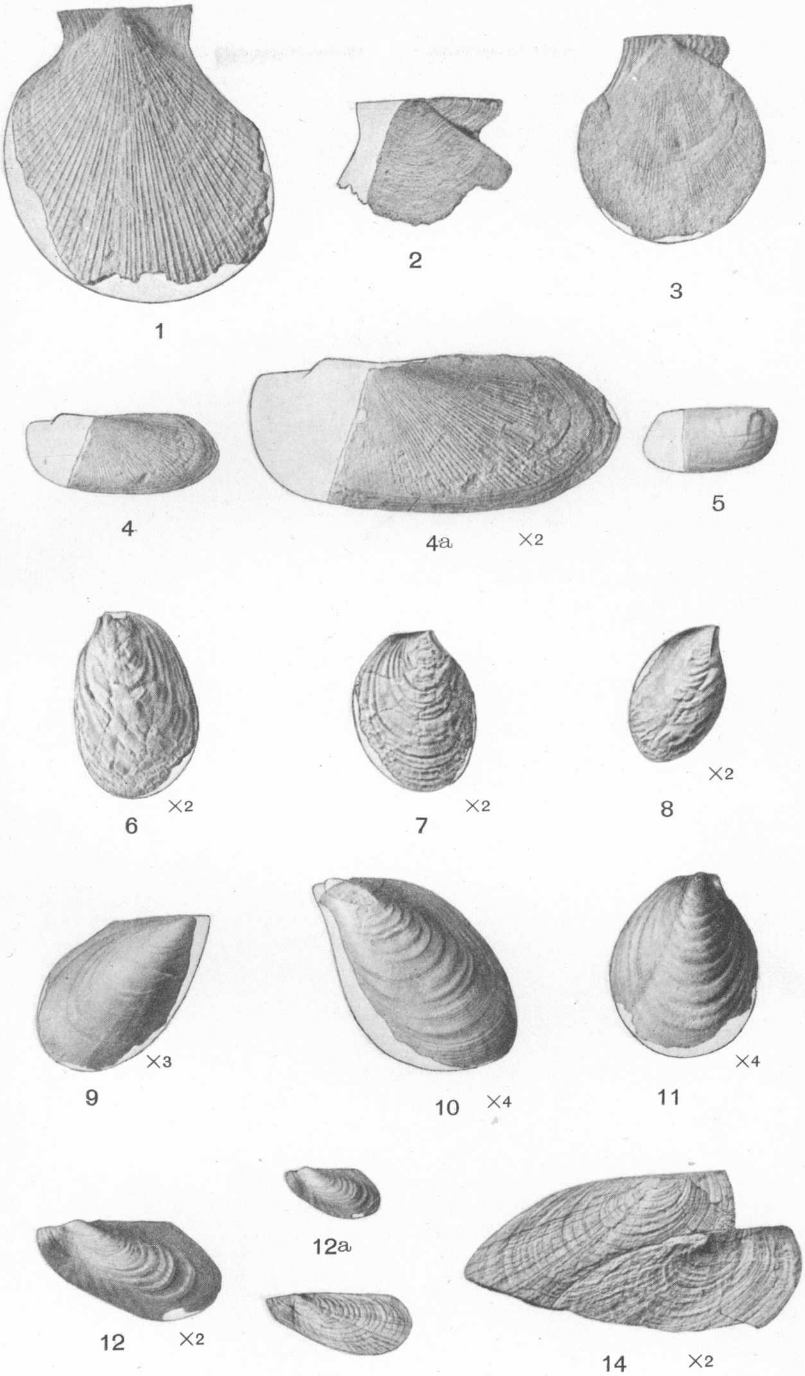
FIGURE 4. Posterior portion of a left valve.
4a. Same, × 2.
Original of figure 4 from station 2085.
5. Anterior portion of a right valve.
Original of figure 5 from station 2089.

CANEYELLA WAPANUCKENSIS n. sp. (p. 34).

FIGURE 6. A left valve, crushed in shale. × 2.
7. A right valve, similarly preserved, × 2.
8. A narrower right valve, similarly preserved, × 2.
Originals of figures 6, 7, and 8 from station 2079.
9. An imperfect right valve, preserved in limestone, × 3.
Original of figure 9 from station 2082.
10. An imperfect left valve, preserved in limestone, × 4.
Original of figure 10 from station 3948.
11. A broader, nearly perfect right valve, × 4.
Original of figure 11 from station 2082.

CANEYELLA NASUTA n. sp. (p. 37).

FIGURE 12. The typical specimen, a left valve, preserved in limestone, × 2.
12a. Same, natural size.
Original of figure 12 from station 2047.
13. Another left valve, compressed in shale.
14. A right valve plainly showing radial sculpture, somewhat complicated with an overlapping left valve, probably belonging to the same individual, both compressed in shale.
Originals of figures 13 and 14 from station 3983.



FAUNA OF THE CANEY SHALE

PLATE IV.

PLATE IV.

CANEYELLA RICHARDSONI n. sp. (p. 38).

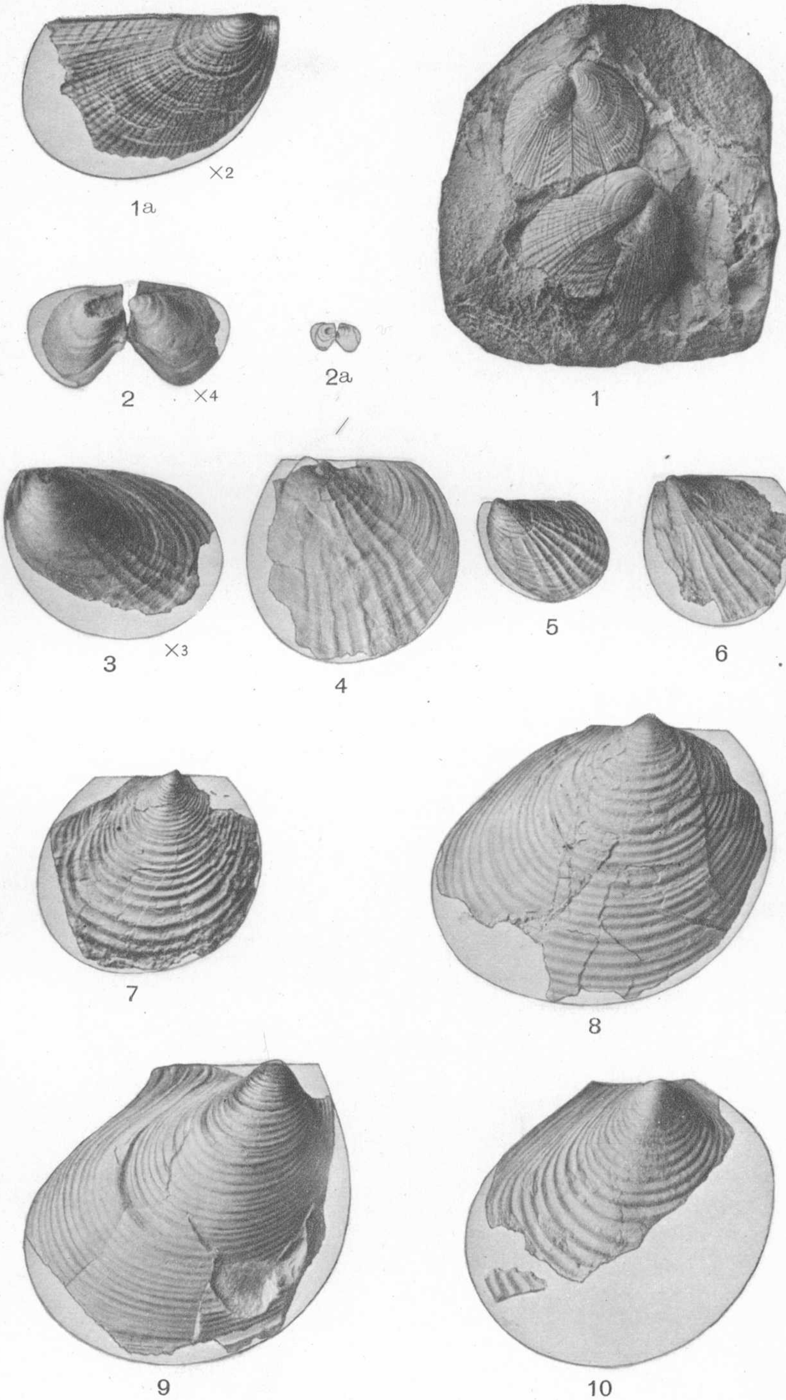
FIGURE 1. A slab of calcareous shale containing two pairs of valves.
1a. One of the specimens, × 2.
Original of figure 1 from station 2083.

CANEYELLA PERCOSTATA n. sp. (p. 37).

FIGURE 2. A pair of very young valves referred with doubt to this species. They may really belong to *C. vaughani*, × 4.
2a. Same, natural size in outline.
3. A small imperfect left valve with well-preserved anterior lobe, × 3.
Originals of figures 2 and 3 are from station 2078.
4. A large imperfect left valve, probably distorted by pressure.
5. A nearly perfect left valve.
Originals of figures 4 and 5 from station 2084.
6. A left valve, crushed, but with well-preserved sculpture.
Original of figure 6 from station 2078.

CANEYELLA VAUGHANI n. sp. (p. 35).

FIGURE 7. A small specimen restored as a right valve.
8. A large right valve.
Originals of figures 7 and 8 from station 2078.
9. A right valve with somewhat finer and less distinct plications than usual.
Original of figure 9 from station 2083.
10. Impression from an imperfect mold of a right valve.
Original of figure 10 from station 2080.



FAUNA OF THE CANEY SHALE

PLATE V.

PLATE V.

Cœlonautilus gratiosus n. sp. (p. 50).

Figure 1. Restoration of a fragmentary specimen selected as the type. Ventral view.
1a. Side view.
1b. Ventral view showing aperture.
Original of figure 1 from station 2082.

Macrocheilus? micula n. sp. (p. 43).

Figure 2. Side view of the typical specimen, × 10.
Original of figure 2 from station 2091.

Naticopsis sp. (p. 43).

Figure 3. A small form, probably belonging to the genus *Naticopsis*, × 10.
Original of figure 3 from station 2082.

Pleurotomaria? sp. (p. 42).

Figure 4. A fragmentary specimen of an undetermined species, × 2.
Original of figure 4 from station 2082.

Lævidentalium venustum Meek and Worthen (p. 41).

Figure 5. A specimen referred to this species, though it may really have been an *Orthoceras*. Side view.
5a. Same, × 3.
Original of figure 5 from station 2083.

Idiotheca rugosa n. sp. (p. 40).

Figure 6. A peculiar organism of somewhat doubtful affinities. Side view.
6a. End view.
6b. Opposite end.
6c. Aperture, in outline.
Original of figure 6 from station 5114. The horizon is probably that of the Woodford chert.

Entomis unicornis n. sp. (p. 72).

Figure 7. A right (?) valve, × 20.
Original of figure 7 from station 3981.

Cytherella aff. benniei Jones, Kirkby, and Brady (p. 72).

Figure 8. A left (?) valve, × 20.
Original of figure 8 from station 3981.

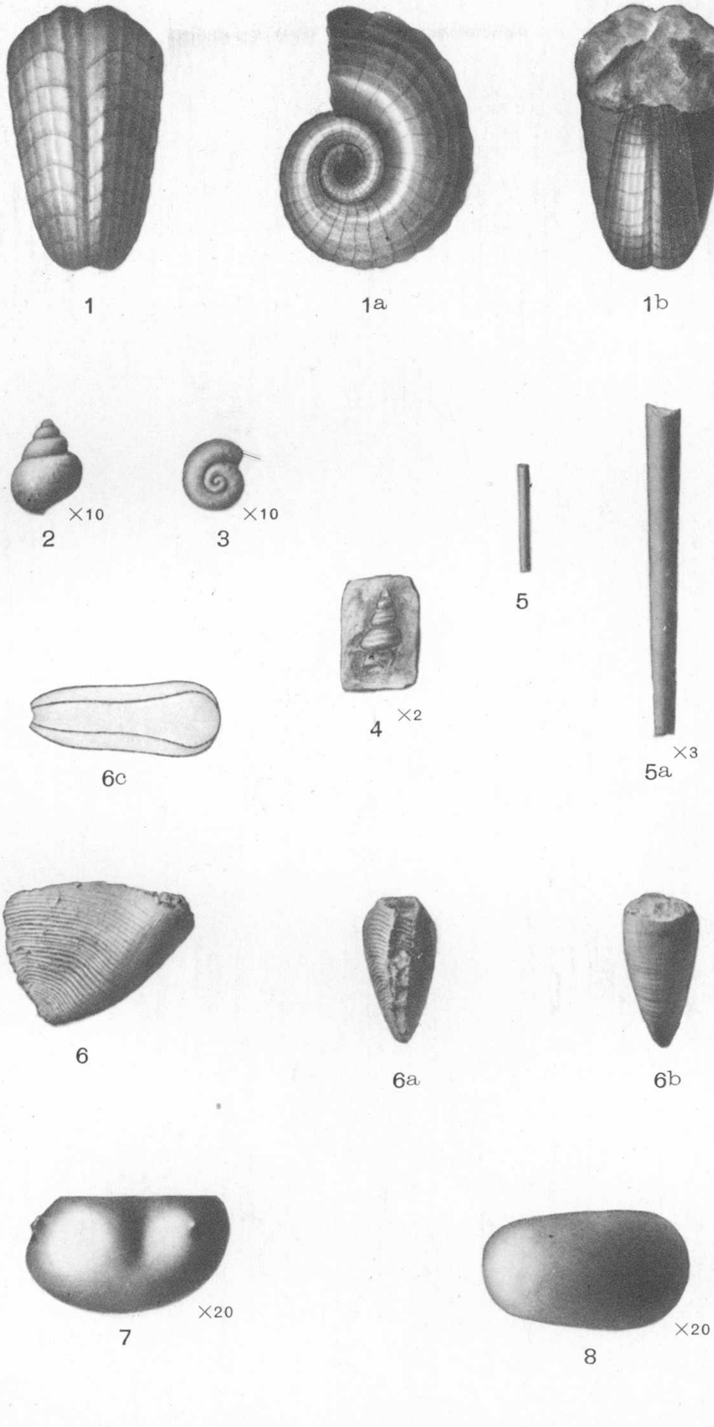


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PLATE VI.

PLATE VI.

BACTRITES? QUADRILINEATUS n. sp. (p. 50).

FIGURE 1. Side view of a medium-sized specimen, × 2.
1a. Opposite side showing marginal siphuncle, × 2.
1b. Same, natural size.
2. View of the siphonal side of another fragment of medium size, × 2.
3. A small specimen with long chamber of habitation.
4. A specimen probably belonging to this species, though it shows neither siphuncle nor septa. Possibly it represents only the living chamber.
4a. Portion of the same near the apex, showing peculiar sculpture, × 5.
Originals of figures 1–4 from station 2083.

BACTRITES? SMITHIANUS n. sp. (p. 53).

FIGURE 5. Side view of a medium-sized specimen selected as the type.
Original of figure 5 from station 2082.
6. Portion of the living chamber of a large specimen, showing the surface ornamentation, wavy transverse striæ, and scattered punctæ, × 5.
Original of figure 6 from station 2083.

ORTHOCERAS CANEYANUM n. sp. (p. 45).

FIGURE 7. A small free specimen.
Original of figure 7 from station 2078.
8. A small, partly eroded specimen.
Original of figure 8 from station 2079.

ORTHOCERAS CREBRILIRATUM n. sp. (p. 46).

FIGURE 9. Side view of the typical specimen.
9a. Portion of the surface, × 5.
Original of figure 9 from station 2078.
10. Portion of the surface of another specimen, × 3.
Original of figure 10 from station 2083.

ORTHOCERAS WAPANUCKENSE n. sp. (p. 44).

FIGURE 11. A small specimen selected as the type. Side view.
12. Side view of a large fragment.
Originals of figures 11 and 12 from station 2082.

ORTHOCERAS INDIANUM n. sp. (p. 47).

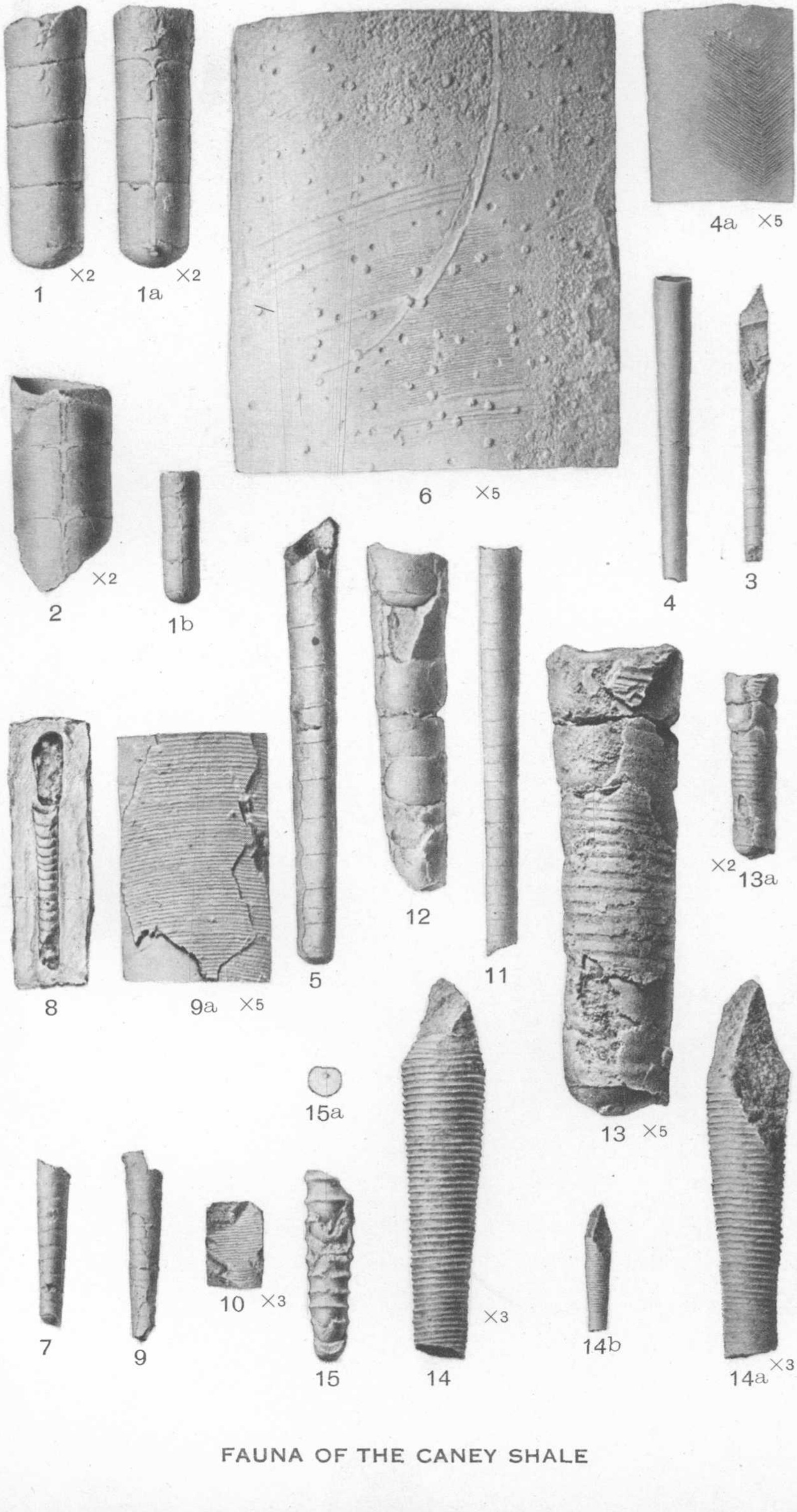
FIGURE 13. A decorticated specimen, × 5.
13a. Same, × 2.
Original of figure 13 from station 2078.

ORTHOCERAS CHOCTAWENSE n. sp. (p. 46).

FIGURE 14. Side View of the type specimen, × 3.
14a. Opposite side, × 3.
14b. Same, natural size.
Original of figure 14 from station 2091.

CYCLOCERAS BALLIANUM n. sp. (p. 47).

FIGURE 15. Side view of the type specimen.
15a. End view of same.
Original of figure 15 from station 2083.



FAUNA OF THE CANEY SHALE

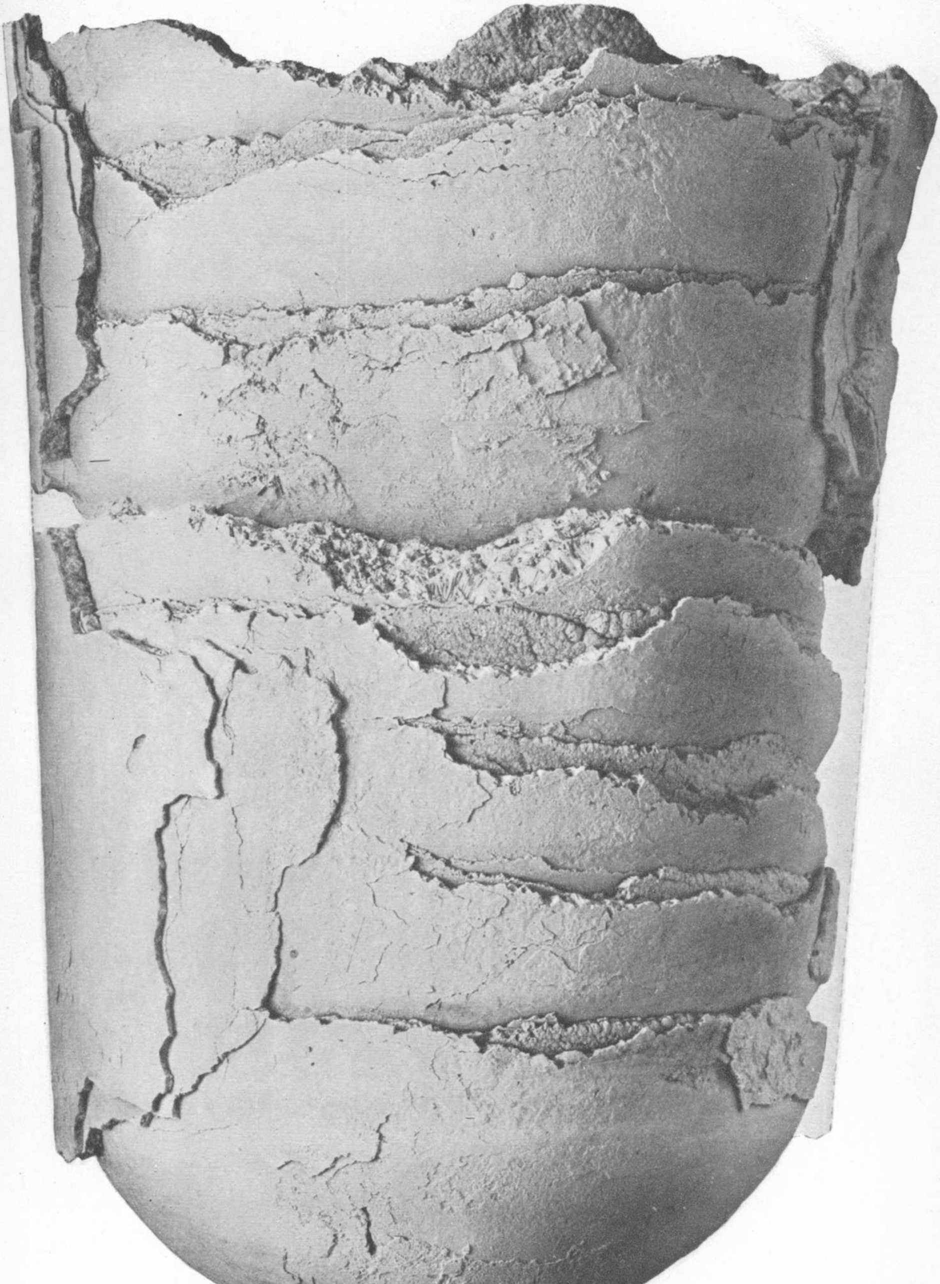
PLATE VII.

PLATE VII.

ACTINOCERAS VAUGHANIANUM n. sp. (p. 48).

FIGURE 1. The typical specimen, crushed and eroded on one side. (See also Pl. VIII.)

Original of figure 1 from station 2080.



FAUNA OF THE CANEY SHALE

PLATE VIII.

PLATE VIII.

ACTINOCERAS VAUGHANIANUM n. sp. (p. 48).

FIGURE 1. Opposite side of the type specimen illustrated on Plate VII
Original of figure 1 from station 2080.

FAUNA OF THE CANEY SHALE

PLATE IX.

PLATE IX.

ACTINOCERAS VAUGHANIANUM n. sp. (p. 48).

FIGURE 1. Another specimen probably belonging to this species. The rate of enlargement appears to be more rapid than in the type, but this is probably due to differential weathering and erosion. This specimen is preserved as a chert mold, worn halfway through upon one side. Side view.

1a. Opposite, weathered, side.

Original of figure 1 from point near Tishomingo.

1

1a

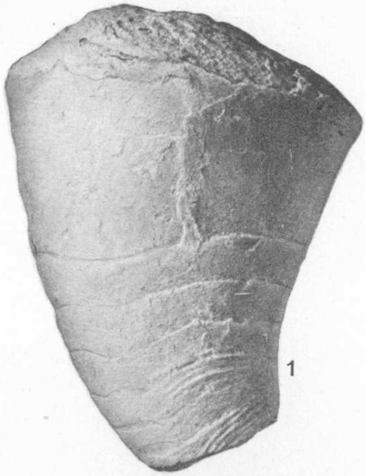
FAUNA OF THE CANEY SHALE

PLATE X.

PLATE X.

CYRTORIZOCERAS? HYATTIANUM n. sp. (p. 49).

FIGURE 1. Side view of the only specimen found.
1a. Dorsal view.
1b. Ventral view.
Original of figure 1 from station 2082.



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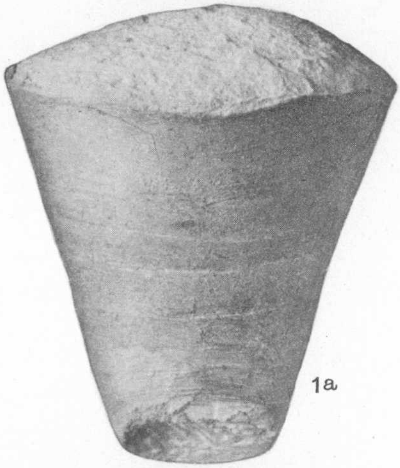


1a

1b

FAUNA OF THE CANEY SHALE

PLATE XI.

PLATE XI.

Gastrioceras richardsonianum n. sp. (p. 54).

Figure 1. A specimen of the average or a little less than the average size. Side view.
1a. Ventral view.
2. Part of the surface, × 4, showing the transverse sublamellose liræ. Taken from a mature specimen having a diameter of 27 mm.
3. Ventral view of a young specimen showing transversely corrugated surface, × 4.
3a. Side view of same, natural size.
4. Suture of a mature specimen having a diameter of 24 mm.
5. Side view of a young specimen, which has a large umbilicus.
6. Side view of a young specimen.
6a. Ventral view of same.
6b. Suture of same, × 2.
7. Internal suture of a small specimen having a diameter of 6 mm., × 2.
8. Ventral view of a young specimen, × 2.
8a. Side view of same, × 2.
9. Side view of a very young specimen, × 4.
9a. Ventral view of same, × 4.
10. Side view of a very young specimen, × 4.
11. Side view of a very young specimen showing sculpture, × 8.

Originals of figures 1–11 from station 2082 except that of figure 5, which is from station 2091, and that of figure 10, which is from station 2079.

Trizonoceras typicale n. sp. (p. 70).

Figure 12. Side view of an imperfect specimen taken as the type, × 2.
12a. Suture of same, × 3.
12b. Ventral view of same.

Original of figure 12 from station 3948.

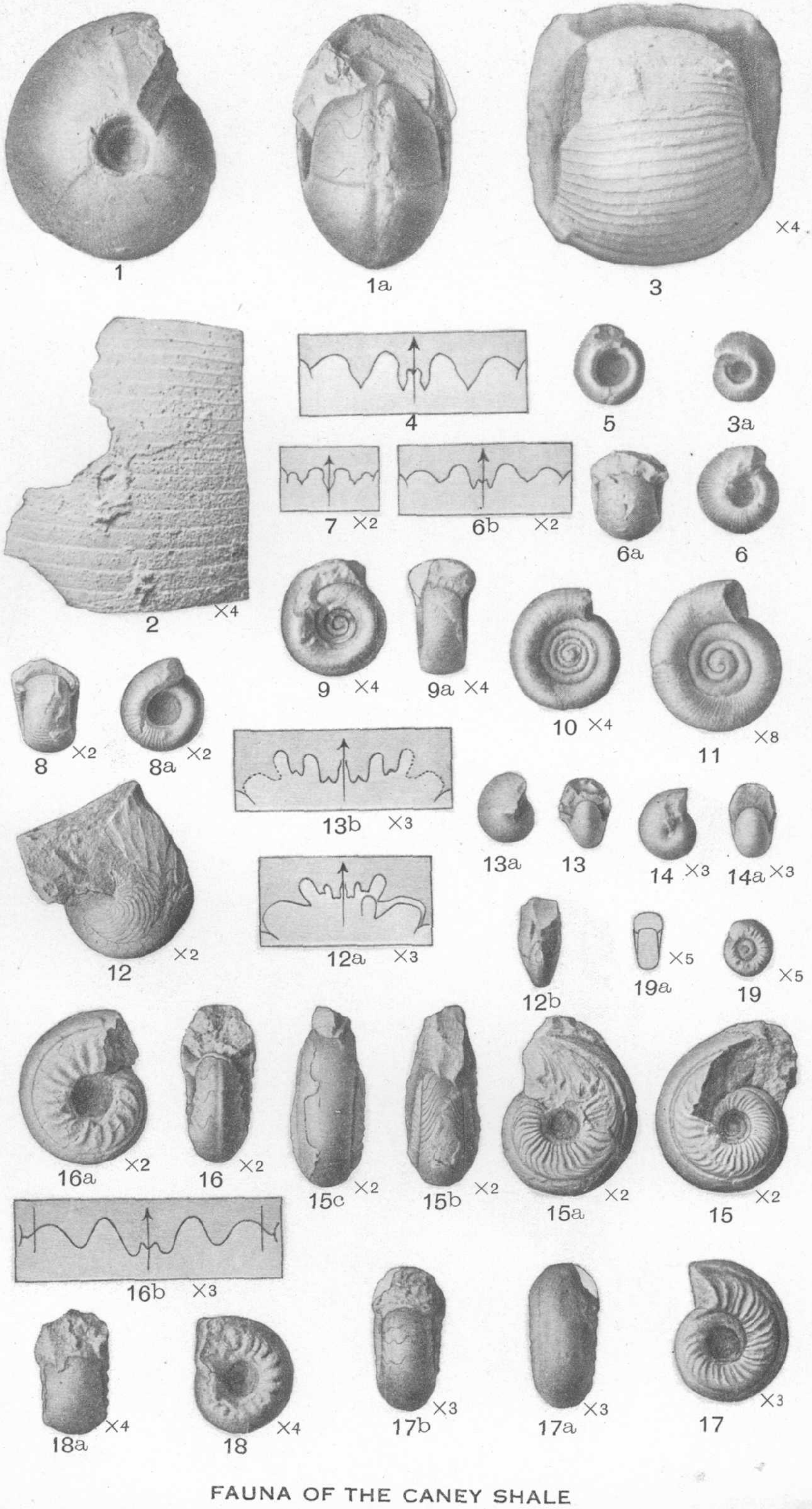
Trizonoceras lepidum n. sp. (p. 71).

Figure 13. Ventral view of the type specimen.
13a. Side view of same.
13b. Suture of same, × 3, somewhat restored at the sides.

Original of figure 13 from station 2078.

14. A young specimen of rather common type, supposed to belong to this species. Side view, × 3.
14a. Ventral view of same, × 3.

Original of figure 14 from station 2091.



FAUNA OF THE CANEY SHALE

EUMORPHOCERAS BISULCATUM n. sp. (p. 68).

FIGURE 15. Side view of typical specimen, × 2.
15a. Opposite side of same, showing the shape of the aperture, × 2.
15b. Ventral view of same, × 2.
15c. Ventral view opposite to 15b, showing hyponomic sinus much foreshortened, × 2.
16. Ventral view of an exfoliated specimen, × 2.
16a. Side view of same, × 2.
16b. Suture of same, × 3.
17. Side view of young specimen, × 3.
17a. Ventral view of same, × 3.
17b. Ventral view of same showing aperture, × 3.
18. Side view of a very young specimen, × 4.
18a. Ventral view of same, × 4.
19. Side view of a larval specimen, × 5.
19a. Ventral view of same in outline, × 5.

Original of figures 15–19 from station 2082 except that of figure 16, which is from station 2075.

PLATE XII.

PLATE XII.

Girtyoceras
~~ADELPHOCERAS~~ MESLERIANUM n. sp. (p. 66).

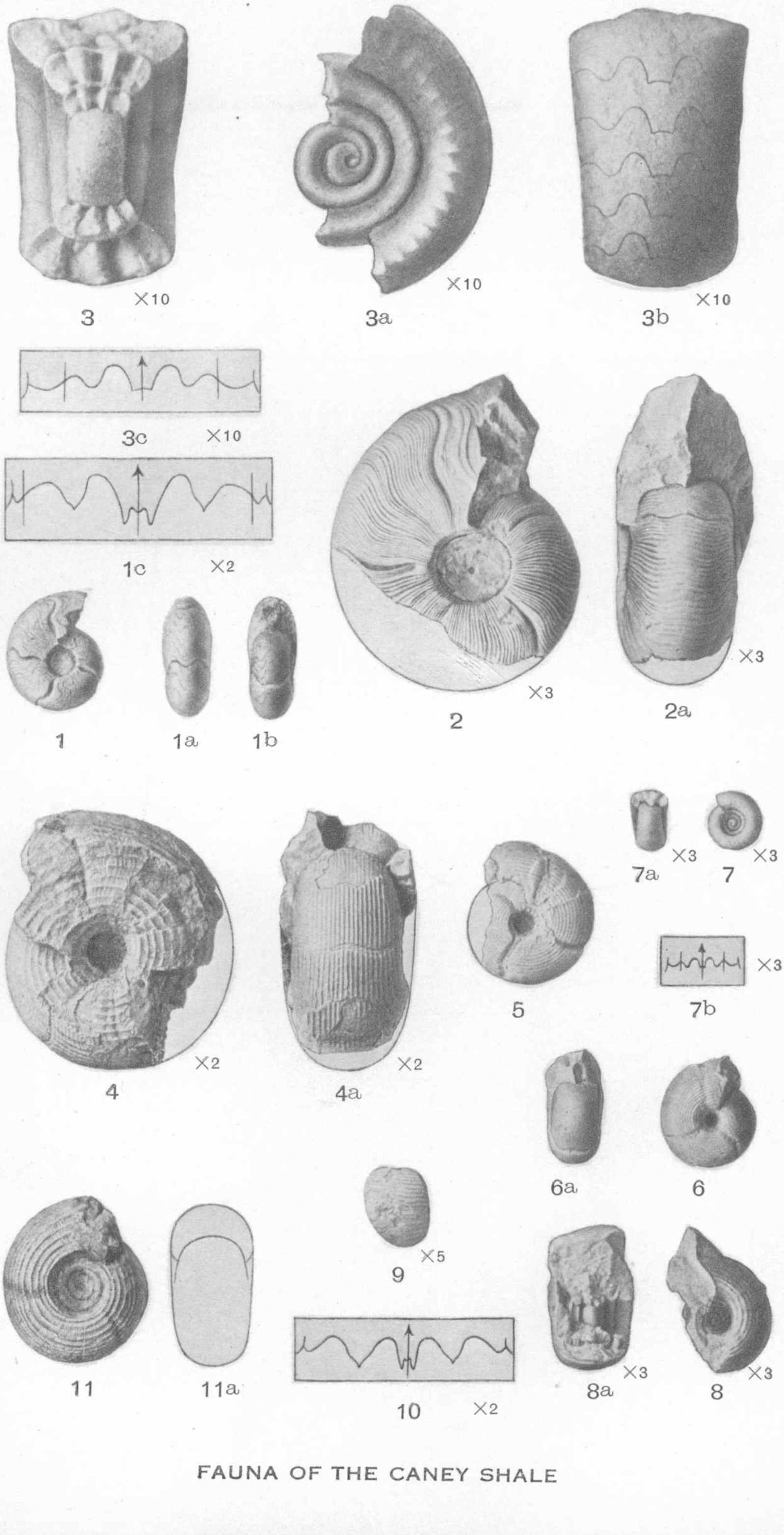
FIGURE 1. Side view of the typical specimen which is an internal mold.
1a. Ventral view of same.
1b. Ventral view of same, showing aperture.
1c. Suture of same, × 2.
2. Side view of an imperfect testiferous specimen showing sculpture, × 3.
2a. Ventral view of same, × 3. The ventral surface is marked medially by revolving striæ, too delicate to be shown by the figure.
3. A broken specimen showing larval stages, × 10. The very transverse shape of the cross-section is in strong contrast to that of the mature form.
3a. Side view of same, × 10.
3b. Ventral view of same, × 10.
3c. Suture of same, × 10.
Originals of figures 1–3 are from station 2083.

GASTRIOCERAS CANEYANUM n. sp. (p. 57).

FIGURE 4. Side view of a specimen with well-preserved surface, × 2.
4a. Ventral view of same, × 2.
5. Side view of a rather large but imperfect specimen.
6. Side view of a medium-sized specimen.
6a. Ventral view of same.
7. Side view of a very young specimen, × 3.
7a. Ventral view of same, × 3.
7b. Suture of same, × 3.
8. Side view of a broken specimen showing larval stages, × 3. The very rapid expansion is well shown.
8a. Ventral view of same, × 3.
9. A fragment showing the sculpture at an early stage, very different from that at maturity, × 5.
10. Suture of a mature specimen, × 2.
Originals of figures 4–10 from station 2078.

GONIATITES NEWSOMI Smith (p. 62).

FIGURE 11. A specimen referred to this species with some doubt. It resembles *Gastrioceras caneyanum*, but differs in having somewhat coarser striæ and wider umbilicus. Side view.
11a. Ventral view of same in outline.
Original of figure 11 from station 2041.



FAUNA OF THE CANEY SHALE

PLATE XIII.

PLATE XIII.

GONIATITES CHOCTAWENSIS Shumard (p. 59).

FIGURE 1. A narrow specimen of rather large size, without constrictions. Side view.

1a. Ventral view of same.

1b. Suture of same.

2. Side view of a small specimen with constrictions.

2a. Ventral view of same.

2b. Suture of same.

3. Side view of a young specimen.

3a. Ventral view of same.

3b. Suture of same, × 2.

4. Ventral view in outline of a very young specimen.

4a. Side view of same, in outline.

4b. Suture of same, × 5.

5. Suture about half a turn from the aperture of a mature specimen having a diameter of 25 mm.

6. Side view of a small testiferous specimen.

6a. Ventral view of same, showing the constrictions only where exfoliated, × 3.

6b. Ventral view showing aperture, in outline.

6c. Portion of the surface of the same.

7. Sculpture from the ventral surface of a specimen having a diameter of 12 mm. The crenulations show very faintly, but more than in figure 6c, where they do not show at all, × 5.

7a. Sculpture of same, near the umbilicus and about half a turn nearer the aperture, × 5.

8. Sculpture across the ventral surface of a specimen having a diameter of 6 mm. Constrictions show faintly upon the outside and are further indicated by intermittance of the sculpture. This figure may be compared with 6c, but the specimens are viewed in opposite directions, × 5.

9. Portion of the surface taken on the side of the shell of a specimen having a diameter of 18 mm., × 5.

10. Portion of a mature or possibly gerontic specimen, × 5.

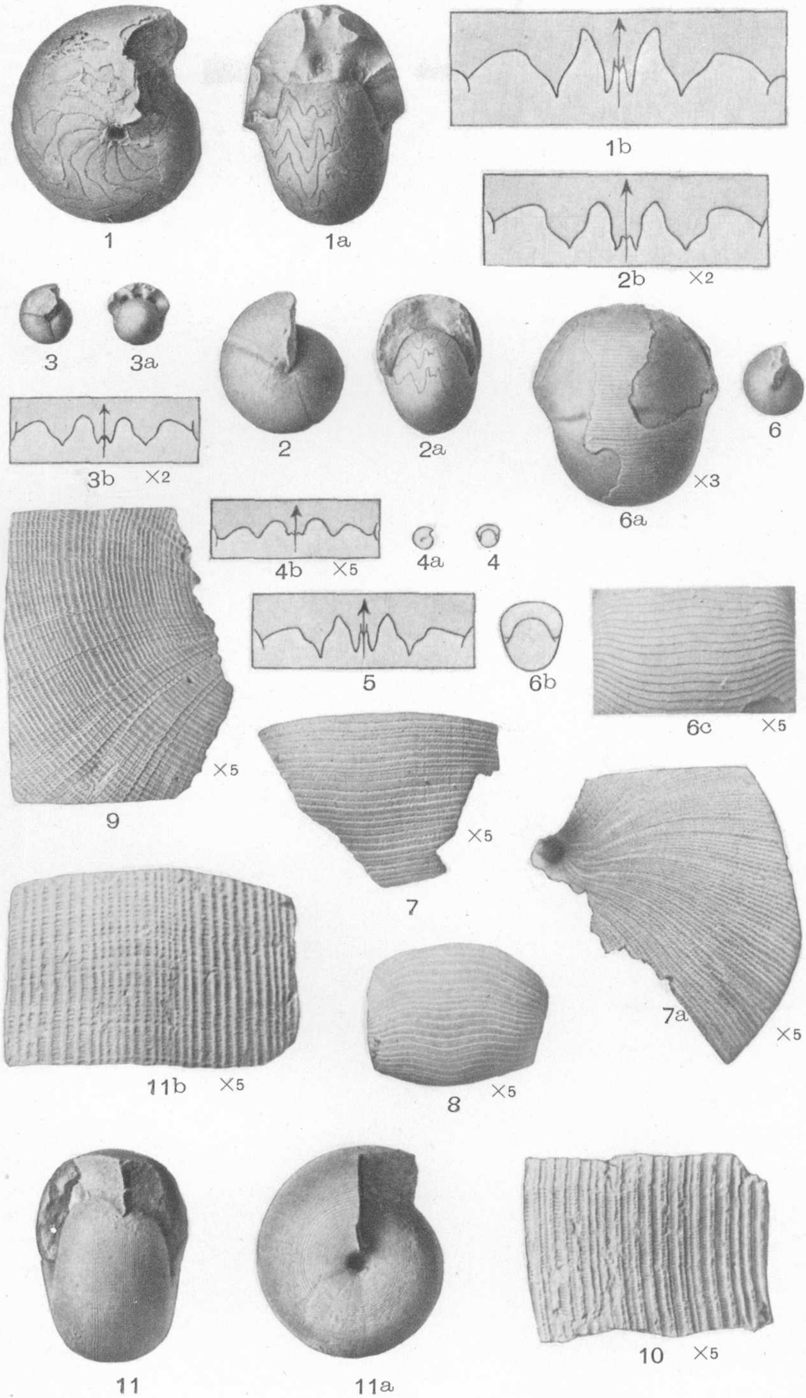
Originals of figures 1–10 from station 2083.

11. Ventral view of a specimen having a somewhat different expression and from a different locality from the foregoing. The difference in shape from figure 1a is not so marked in all cases. (See 2a.)

11a. Side view of same.

11b. Sculpture of ventral surface near the aperture.

Original of figure 11 from station 2047.



FAUNA OF THE CANEY SHALE

INDEX.

Names in *italic* are synonyms; figures in **black face** denote descriptions; figures in *italic* refer to illustrations.

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