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Cherokee Nautiloids of the Northern Mid-Continent Region

by

A. K. Miller
and
John Britts Owen

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PREFACE

Although cephalopods are abundant in the Pennsylvanian strata of Oklahoma and Texas, they are relatively rare in equivalent beds to the north of there. The numerous well-preserved specimens described in this report represent the fruits of more than eleven years of diligent collecting on the part of the junior author, and it is very doubtful if a comparable assemblage will ever be got together again. A surprisingly large variety of ammonoids was found in association with these nautiloids, and a study of them will be undertaken in the near future.

An extensive discussion of the morphology and terminology of the nautiloid shell has recently been published by the senior author, in conjunction with Professors C. O. Dunbar and G. E. Condra, in Bulletin 9 of the Nebraska Geological Survey. In that volume most of the genera of Pennsylvania nautiloid cephalopods are diagnosed and the species referable to each are listed. There is, of course, no need for that work to be duplicated here, and the reader is referred to the Nebraska bulletin for a more detailed explanation of nautiloid terminology and nomenclature than is given in the present study.

The authors are under obligation to Professor C. O. Dunbar of Yale University, Professor H. G. Walter of Utah State Agricultural College, and Mr. Joe Harner of Nevada, Missouri, for the loan of specimens studied during the preparation of this report.

A. K. M.
J. B. O.

Iowa City, Iowa
and
Clinton, Missouri
April 25, 1934

Cherokee Nautiloids of the Northern Mid-Continent Region

INTRODUCTION

In the northern part of the Mid-Continent region, that is, in Iowa, Missouri, and Kansas, the strata which are called Cherokee are more or less of a stratigraphic unit and are generally regarded as constituting a formation. However, in the southern part of the Mid-Continent region chronologically equivalent strata have been divided into several formations, and the term Cherokee is applied to the group. In this paper we will confine our attention largely to the nautiloids of the Cherokee formation and will discuss only incidentally those that occur in equivalent beds to the south.

THE CHEROKEE FORMATION

The Cherokee is the lowest formation in the Pennsylvanian system in the northern portion of the Mid-Continent region. It outcrops in a long, relatively narrow belt extending from southeastern Iowa in a southwesterly direction across Missouri to southeastern Kansas and northeastern Oklahoma as far as the Arkansas River. Its thickness varies greatly but in general it thins to the northeast; locally in Oklahoma it is well over 1000 feet thick, in southeastern Kansas and in Missouri it has an average thickness of about 300 or 400 feet, but in southeastern Iowa it averages only about 200 feet. Lithologically the formation consists largely of shale but there is considerable variation both vertically and laterally within it; it contains considerable quantities of sandstone and limestone, and coal beds are scattered throughout its entire vertical and horizontal extent. In all but the lower portions of the formation, the limestone and the coal members are fairly continuous over large areas and they are therefore good horizon markers. The coal beds are of very great economic importance, and in southeastern Kansas and adjacent portions of Oklahoma, the more or less irregular beds of sandstone in the Cherokee have yielded considerable quantities of oil and gas.

Since most of the cephalopods described in this report came from Henry County, Missouri, the following generalized section of the Cherokee formation in that county will be helpful:

GENERALIZED SECTION OF THE CHEROKEE SHALE IN HENRY COUNTY, MISSOURI
(After Hinds and Greene[1])

		Feet
1.	Shale, light at top, black and slaty at base; bears large concretions	4
2.	Coal (Lexington)	1
3.	Clay and shale	9
4.	Limestone	2
5.	Shale and sandstone; with thin and irregular coal bed at base; 25 to 50 feet thick	35
6.	Limestone, gray; weathers rough on top; in places a foot or more of blue limestone at base; absent in places, 15 feet thick in others	8
7.	Shale, slaty	4½
8.	Coal (Mulky), absent in places	1
9.	Shale, blue	30
10.	Coal (Bevier), absent in places	1½
11.	Clay, shale, and sandstone; 3 to 12 feet thick	8
12.	Limestone, variable; absent in places, 6 feet thick in others	3
13.	Shale, light at top, black and slaty below; locally with large concretions; absent in places	5
14.	Coal (Tebo), absent in places	2
15.	Shale and sandstone, with basins of coal distributed irregularly both stratigraphically and geographically, including the Mammoth coal bed 40 feet below the Tebo horizon, and the Jordan coal, 70-100 feet below the same horizon	80-230
16.	Mississippian limestone	—

THE FAUNA OF THE CHEROKEE FORMATION

The Cherokee is not as abundantly fossiliferous as are some of the divisions of the Pennsylvanian system in the Mid-Continent region but it has yielded quite an assemblage of foraminifera, brachiopods, bryozoans, mollusks, and ostracodes, and a few corals, crinoids, trilobites, etc. Cephalopods are not as abundant in the northern part of the Mid-Continent region as they are farther south, and the large collection which we are studying represents the results of more than eleven years of patient, intensive collecting

[1] Henry Hinds and F. C. Greene: The stratigraphy of the Pennsylvanian series in Missouri. Missouri Bur. Geol. and Mines, vol. 13, ser. 2, 1915, p. 47.

in west-central Missouri in and around the numerous strip pits which are dug to obtain coal—only a very few of the specimens came from natural exposures. Most of them came from large black calcareous nodules or concretions which occur in the shales that immediately overlie the Tebo and the Lexington coals; the shales which surround these concretions are also fossiliferous but the fossils in them are so fragile that it is rarely possible to collect large specimens. We have one specimen (*Temnocheilus* cf. *T. harneri*) from a dark-gray calcareous concretion immediately above an unnamed local coal which occurs some 15 feet below the Lexington coal, two specimens (*Metacoceras* spp.) from brownish-black ferruginous lenses immediately above the Jordan coal, and representatives of seven species from a local blue-to-drab jointed limestone, some 3½ feet thick, which occurs about 10-15 feet below the Jordan coal and immediately overlies an unnamed local coal. Also, through the courtesy of Mr. Joe Harner of Nevada, Missouri, we are able to study two specimens from immediately above the Rich Hill coal (near the middle of the Cherokee) in Vernon County, Missouri; and in 1891 Hyatt[2] described a small collection of nautiloids from immediately above the Lexington coal near Oswego, Kansas—we are bringing together in this report all of the available information in regard to these Cherokee specimens described by Hyatt. The known stratigraphic distribution of nautiloids within the Cherokee formation is portrayed clearly by the accompanying table (page 194).

So many of these species are known from only one specimen that we must regard our knowledge of the distribution of nautiloids within the Cherokee as very imperfect, and after a detailed study of all of the available material we are of the opinion that at least as far as nautiloids are concerned, the fauna of the Cherokee should be considered as a unit and not as a number of separate faunules each of which is indicative of a limited horizon within the formation. Nevertheless, our collections indicate rather strongly that *Brachycycloceras longulum* and *Metacoceras biseriatum* probably do not occur in the lower part of the Cherokee, that is, below the Tebo coal horizon, and *Parametacoceras bellatulum* probably does not occur below the uppermost portion of the Cherokee, that is, below the Lexington coal horizon. Some of the species that occur in the

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[2] Alpheus Hyatt: Carboniferous cephalopods. Texas Geol. Survey Ann. Rep. 2, 1891, pp. 327-356.

TABLE SHOWING KNOWN STRATIGRAPHIC RANGE AND DISTRIBUTION OF NAUTILOID SPECIES WITHIN THE CHEROKEE FORMATION

	Exact horizon uncertain	10-15 feet below Jordan coal	Jordan coal horizon	Tebo coal horizon	Rich Hill coal horizon	15 feet below Lexington coal	Lexington coal horizon
Pseudorthoceras knoxense				x			
Poterioceras bransoni				x			x
Poterioceras mehli							x
Mooreoceras normale		x		x			x
Mooreoceras normale uniconstrictum				x			
Bactrites? cherokeensis		x					
Brachycycloceras longulum				x			x
Ephippioceras ferratum		x		x			
Megaglossoceras pristinum		x					
Coloceras missouriense	x						
Coloceras sp.				x			
Coloceras sp.							x
Knightoceras missouriense				x			
Temnocheilus harneri				x	x		
Temnocheilus cf. T. harneri						x	
Temnocheilus sp.							x
Metacoceras mutabile		x		x			x
Metacoceras biseriatum				x			x
Metacoceras sp.				x			
Metacoceras 2 sp.			x				
Parametacoceras bellatulum							x
Parametacoceras? crassum							x
Endolobus depressus							x
Endolobus sp.				x			
Domatoceras umbilicatum							x
Domatoceras williamsi		x		x	x		
Solenochilus capax	x						
Solenochilus newloni							x
Solenochilus peculiare		x					

Cherokee, for example, *Pseudorthoceras knoxense*, *Mooreoceras normale*, and *Ephippioceras ferratum*, are known to range throughout much of the Pennsylvania system.

COMPARISON WITH OTHER FAUNAS

Although several of the formations in Oklahoma, Arkansas, and Texas that are stratigraphically equivalent to the Cherokee formation have yielded a few fragmentary nautiloids, no nautiloid fauna is known from the southern part of the Mid-Continent region that is comparable to the one described in this report, and none of the faunas known from the lower Pennsylvanian of Illinois or the eastern part of the United States contain many similar nautiloids. However, Tzwetaev[3] has described a nautiloid fauna from the Upper Carboniferous of central Russia that contains striking counterparts of several of the representatives of the Cherokee species. This Russian fauna was collected largely from the oölite near the village of Dewiatowo (province of Moscow), the Fusulina limestone near the village of Miatschkowo (province of Moscow), and the Fusulina limestone near the Matkosersky Canal (province of Olonets); according to Tzwetaev all three of these represent the same stratigraphic horizon and most of the species described by her are known to occur in at least two of these three localities. Almost all of the nautiloid genera represented in this Russian fauna are represented also in the Cherokee fauna we are studying, and the following specific similarities are worthy of note:

SPECIES FROM THE CHEROKEE OF MISSOURI	CORRESPONDING SPECIES FROM THE UPPER CARBONIFEROUS OF CENTRAL RUSSIA[4]
Mooreoceras normale	*Mooreoceras laterale?*
Ephippioceras ferratum	*Ephippioceras bilobatum?*
Coloceras sp.	*Coloceras globatum?*
Knightoceras missouriense	*Knightoceras subcariniferum*
Temnocheilus harneri	*Temnocheilus acanthicus*
Parametacoceras bellatulum	*Parametacoceras nikitini*
Endolobus sp.	*Endolobus? atuberculatus*
Domatoceras williamsi	*Domatoceras mosquense*

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[3] Marie Tzwetaev: Cephalopodes de la section supérieure du calcaire carbonifère de la Russie centrale. Mém. du Comité Géol., vol. 5, no. 3, 1888, pp. 1-58, pls. 1-6.

[4] *Parametacoceras nikitini* is known from only the Upper Carboniferous limestone near the village of Gjél (province of Moscow). All of the other Russian species listed except *Temnocheilus acanthicus* are known to occur in the Dewiatowo oölite. *Mooreoceras laterale?*, *Ephippioceras bilobatum?*, and *Domatoceras mosquense* occur also with *Temnocheilus acanthicus* in the Fusulina limestone near Miatschkowo; and *Ephippioceras bilobatum?*, *Temnocheilus acanthicus*, and *Domatoceras mosquense* occur also in the Fusulina limestone near the Matkosersky Canal.

we are figuring (plate VIII, figure 6), which is the only one that we are positively identifying as *P. knoxense*, came from immediately above the Tebo coal member of the Cherokee in the Owen strip pits (sec. 29, T. 42 N., R. 26 W.), Henry County, Missouri.

Repository.—The specimen we are figuring is in the private collection of John Britts Owen, Clinton, Missouri, where it is numbered 518.

Genus Poterioceras M'Coy 1844

The type of this genus is *Orthocera fusiformis* Sowerby of the Lower Carboniferous of England and Ireland. Relatively recently Foerste[12] studied representatives of this species in the paleontological collections of the Museum of Comparative Zoölogy at Harvard University, and on the basis of them and the figures and descriptions that have been published he drew up the following up-to-date diagnosis of the genus:

"Conch a breviconic cyrtoceracone with circular cross-section, or slightly compressed laterally, with the ventral outline convex and the dorsal outline concave along the lower [adapical] part of the phragmacone and the upper [adoral] part of the living chamber, but convexly gibbous along the upper part of the phragmacone and the lower part of the living chamber. The living chamber is contracted toward the aperture and the outline of this aperture is slightly elliptical or circular, with no indication of a hyponomic sinus. If a trace of the latter is present, it has not been observed so far in any described species. The sutures of the septa are directly transverse along the greater part of the length of the phragmacone, but toward the living chamber these sutures rise distinctly from the ventral toward the dorsal side of the conch. The siphuncle is located a short distance ventrad of the center of the conch. According to Foord, it is marginal on the ventral side of the conch in the young, but recedes a little toward the center in the adult. Its segments present elongate elliptical outlines. No converging vertical [longitudinal] lamellae are present. [The type species has been described] from St. Doulagh's, [county of] Dublin, Ireland [and from England]; in the Lower Carboniferous limestone."

The forms described below coincide fairly well with this generic

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[12] Aug. F. Foerste: Actinosiphonate, trochoceroid and other cephalopods. Denison Univ. Bull., Jour. Sci. Lab., vol. 21, 1926, pp. 330-331.

diagnosis and they almost certainly should be referred to this genus. However, there is a slight but very distinct hyponomic sinus in the aperture of at least one of them, the adoral suture in both is very unusual, and the structure of the siphuncle is unfortunately not known. The Devonian and the Lower Carboniferous of both Europe and North America have yielded numerous forms that apparently represent this genus but none has heretofore been described from the Pennsylvanian.

Poterioceras bransoni Miller and Owen, n. sp.

Plate VIII, figures 7-9; Plate IX, figure 1

Conch large, breviconic, cyrtoceraconic, subovoid, and subcircular in cross section. The holotype (plate IX, figure 1) is a nearly complete mature individual but it is not entirely removed from the matrix, the extreme adapical part of the conch is not preserved, and the extreme adoral part is not visible. The specimen is at least 270 mm. long and it attains a maximum diameter of at least 125 mm. The adapical portion of the phragmacone is curved exogastrically but the rest of the conch is nearly straight. The curved adapical portion of the conch is very rapidly expanded orad, but the rate of expansion of the conch gradually decreases adorally and in mature specimens the adoral half of the living chamber is contracted so that the maximum diameter of the conch is attained near the midlength of the living chamber—the living chamber is approximately as long as the phragmacone. The nature of the aperture is not ascertainable from the type material.

The extreme adapical portion of the conch is marked by very prominent transverse growth-lines or small lirae (plate VIII, figures 8, 9) but there is no indication of such on the other portions of any of the types. The internal mold is essentially smooth but along the venter there is a very small inconspicuous rounded ridge, and traces of fine longitudinal markings parallel to this ridge are discernible on the holotype. Also, on the adapical third of the living chamber of the holotype there appears to be a broad shallow rounded transverse dorso-lateral constriction comparable to that of *Poterioceras mehli*, described below; however, the dorsal and dorsolateral parts of the holotype are not well exposed and none of the paratypes represents the portion of the conch that would bear this constriction.

On the adapical portion of the phragmacone the sutures are straight and are directly transverse to the long axis of the conch but throughout most of the length of the phragmacone of large mature specimens like the holotype the sutures slope orad from the venter. The camerae are about one-sixth as long as wide but the adoral camerae of the holotype are much shorter than the preceding ones, indicating that this specimen represents a mature individual. The adoral suture of the holotype is very unusual; along the venter it is close and parallel to the preceding suture but a short distance (some 10 mm.) dorsad of there the adoral suture curves orad and along the ventro-lateral zone of the conch the adoral camera is about five times as long as it is along the venter—dorsad of there the adoral suture curves less strongly orad and it gradually approaches the preceding suture so that along the dorsum the adoral camera apparently is only about as long as it is along the venter.

The siphuncle is very small and is ventral but not marginal in position—unfortunately its structure can not be ascertained from the type material. At the adoral end of the phragmacone of one of the paratypes, a large mature specimen, where the conch is about 100 mm. in diameter, the siphuncle is about 18 mm. from the venter and is only about 3 mm. in diameter at its passage through a septum.

Remarks.—The peculiar shape of the adoral suture of mature representatives of this species differentiates them from all other described forms except *Poterioceras mehli,* described below, and presumably these two species are very closely related. They can be differentiated by the larger size, the contracted aperture, and the subovoid (rather than subconical) conch of the species described above. It is possible that some (or even all) of the small specimens that we are referring to this species may represent *P. mehli.* The fact that these two closely related forms are found associated together suggests the possibility that the difference between them may be due solely to sexual dimorphism. We have three mature representatives of *P. mehli* and they are all of essentially the same size, and we have two mature representatives of *P. bransoni* and they are also essentially equisized but they are much larger than *P. mehli.*

The specific name is given in honor of Professor E. B. Branson who has contributed extensively to our knowledge of the paleontology and stratigraphy of Missouri, as well as other regions.

Occurrence.—All of the types of this species came from the Cherokee of Missouri, and all but one of them, which came from Lafayette County (SE¼NW¼ sec. 15, T. 49 N., R. 25 W.), came from Henry County; all but two of them, which came from immediately above the Tebo coal, came from immediately above the Lexington coal. The specimens from the Tebo coal horizon came from the Borum strip pit (sec. 21, T. 41 N., R. 27 W.), and from the Carroll strip pits (sec. 9, T. 42 N., R. 25 W.); the specimen from the Borum pit is represented by figure 7 on plate VIII. The holotype and one of the paratypes came from the Lear strip pit (sec. 15, T. 43 N., R. 28 W.). The other four paratypes (including the specimens represented by figures 8 and 9 on plate VIII) came from the Ewing strip pits (sec. 36, T. 43 N., R. 28 W.).

Repository.—Private collection of John Britts Owen, Clinton, Missouri, Nos. 547 (holotype), 549 (pl. VIII, fig. 7), 550, 552, 554 (pl. VIII, fig. 8), 555 (pl. VIII, fig. 9), 556, 557.

Poterioceras mehli Miller and Owen, n. sp.

Plate X, figures 1, 2

Conch moderately large, breviconic, subconical, and subcircular in cross section. This species is being based on three approximately equisized mature specimens, all of which represent most of the living chamber but only the adoral portion of the phragmacone. All three of the types are nearly straight but it seems probable that the adapical portion of the phragmacone of this species is comparable to that of *Poterioceras bransoni*, described above, and is therefore curved exogastrically. In mature specimens like the holotype (plate X, figures 1, 2) the living chamber is about 65 mm. long (measured along the lateral side of the conch), and it attains a maximum diameter near the aperture of about 90 mm.—the phragmacone was probably somewhat longer than the living chamber and apparently was rapidly expanded orad. The ventral side of the living chamber is slightly flattened—in longitudinal profile the ventral side of the living chamber is slightly convex whereas the dorsal side is slightly concave. At least the adoral portion of the phragmacone is conical in shape.

The aperture is oblique to the long axis of the conch—it slopes apicad from the venter and the dorsal side of the living chamber is therefore very much shorter than the ventral side (see plate X,

figure 1). On the broad ventral side of the conch the aperture is nearly straight but is slightly concave as it is marked medianly by a very broad and shallow but nevertheless very distinct hyponomic sinus (see plate X, figure 2).

On the living chamber of large mature individuals the test is about 2 mm. thick and is marked externally by numerous very fine transverse growth-lines. The internal mold is essentially smooth but along the venter there is a very small rounded indistinct ridge and on either side of it there are traces of fine parallel markings. On the dorso-lateral portions of the internal mold of the living chamber there is a very prominent broad rounded transverse constriction which is about 20-25 mm. wide and about 3 mm. deep on large mature specimens like the holotype. This constriction becomes broader and shallower ventrally and it gradually disappears along the lateral sides of the conch. Dorsally it becomes shallower (but not broader) but it apparently continues across the dorsum. This constriction is not visible on specimens which retain the test and it apparently represents an internal thickening of the test.

At least on the adoral portion of the phragmacone the sutures are oblique to the long axis of the conch and slope orad from the venter. The camerae are about one-fifth or one-sixth as long as wide but in the adoral portion of the phragmacone of mature individuals the camerae are very short. As in *Poterioceras bransoni,* described above, the adoral suture of mature specimens is very unusual; along the ventral side of the conch it is straight and is parallel to the preceding suture, but about 10 mm. dorsad of the venter it curves abruptly orad and then gradually swings back apicad as it crosses the lateral and dorso-lateral sides of the conch—along the ventro-lateral zone of the conch the adoral camera is almost twice as long as it is along the venter, but along the dorsum it is slightly shorter than it is along the venter.

The siphuncle is small and is ventral but not marginal in position —unfortunately its structure can not be ascertained from any of the three type specimens. At the adoral end of the phragmacone of one of the paratypes, where the conch is about 80 mm. in diameter, the siphuncle is about 16 mm. from the venter and is about 2 mm. in diameter at its passage through a septum.

Remarks.—This species can be differentiated from all known forms except *Poterioceras bransoni,* described above, by the peculiar shape of its adoral suture and by the prominent transverse con-

strictions on the dorso-lateral portions of the living chamber. It differs from *P. bransoni* in that it is smaller and its conch is subconical rather than subovoid in shape as its living chamber is not contracted adorally.

The specific name is given in honor of our friend Professor M. G. Mehl—the senior author first became interested in paleontology in Professor Mehl's classroom.

Occurrence.—All three of the type specimens are from immediately above the Lexington coal member of the Cherokee, Henry County, Missouri. The holotype and one of the paratypes came from the Lear strip pit (sec. 15, T. 43 N., R. 28 W.); the other paratype came from the Bohler strip pit (sec. 22, T. 43 N., R. 28 W.).

Repository.—Private collection of John Britts Owen, Clinton, Missouri, Nos. 548 (holotype), 551, 553.

Genus Mooreoceras Miller, Dunbar, and Condra 1933

Mooreoceras normale Miller, Dunbar, and Condra

Plate XI, figures 1-6

(?) 1892. *Orthoceras colletti* S. A. Miller, Indiana Dept. Geology and Nat. Resources Ann. Rep. 18, *Advance sheets,* pp. 67-68, pl. 10, fig. 1.

(?) 1894. *Orthoceras colletti* S. A. Miller, Indiana Dept. Geology and Nat. Resources Ann. Rep. 18, pp. 321-322, pl. 10, fig. 1.

1931. *Orthoceras colletti* Morse, Kentucky Geol. Survey, ser. 6, vol. 36, pp. 300, 325-326, pl. 54, figs. 1, 2.

1933. *Mooreoceras normale* Miller, Dunbar, and Condra, Nebraska Geol. Survey Bull. 9, ser. 2, pp. 87-89, pl. 2, figs. 5-7.

This species is abundant in the Cherokee of Missouri and the collection we are studying contains more than twenty-five representatives of it. However, since it was recently described in detail by Miller, Dunbar, and Condra, and since our specimens are in all respects typical, a study of them has yielded little that is new.

Our collection contains several exceptionally large specimens; one of them (plate XI, figure 1) is about 40 cm. long but it is not complete apicad or orad and as it is septate throughout it represents only part of the phragmacone—it is about 52 mm. in diameter at its adoral end. Another specimen, which is somewhat fragmentary, presumably was much longer for it attains a maximum diameter of about 80 mm.—this specimen represents a gerontic individual for

the adoral camerae of its phragmacone are very short. The adoral 75 mm. of this large specimen represent living chamber, but the specimen is not complete adorally and no portion of the aperture is retained. The rate of adoral expansion is constant throughout the entire length of all of the specimens we are referring to this species. On the adoral portion of the large specimen mentioned last the test apparently was about 4 mm. thick and was smooth externally. However, one small fragmentary specimen about 11 mm. in diameter, that we are tentatively referring to this species but which probably represents a distinct variety (or species), retains a small portion of the test and it is marked by prominent transverse lirae whereas the internal mold is smooth.

Occurrence.—This species is widely distributed in the Pennsylvanian system of the United States. Stratigraphically it is known to range from the Cherokee to the Wabaunsee. It has been found as far east as Kentucky, as far west as Colorado, as far north as Michigan, and as far south as Kansas. All of the specimens we are studying came from the Cherokee of Henry County, Missouri. Most of them came from immediately above the Tebo coal but some came from immediately above the Lexington coal and one specimen came from 10-15 feet below the Jordan coal immediately above an unnamed local coal.

Repository.—Private collection of John Britts Owen, Clinton, Missouri, Nos. 521-546. The figured specimens are numbered 521 (pl. XI, fig. 2), 522 (pl. XI, fig. 1), and 523 (pl XI, figs. 3-6); the large gerontic specimen mentioned above is numbered 545; and the small specimen with a lirate test is numbered 546.

MOOREOCERAS NORMALE UNICONSTRICTUM Miller and Owen, n. var.

Plate XI, figures 7, 8

We have two small specimens which are very similar to typical *M. normale* but differ from it in that they are small, although mature, and there is a very distinct transverse constriction on the living chamber of one of them—the living chamber of the other is not preserved. The specimen bearing the constriction is an internal mold representing much of the living chamber and the phragmacone, and we are designating it as the holotype of the new variety. It is about 41 mm. long but it is not complete adorally or adapically.

It is circular (or nearly so) in cross section and its diameter increases from a little more than 5 mm. near its adapical end to about 10 mm. near its adoral end. The internal mold is smooth but about 15 mm. orad of the junction of the phragmacone and the living chamber there is a very distinct broad shallow broadly rounded transverse constriction which is about 5 mm. wide and ½ mm. deep. The sutures are directly transverse and almost straight, but as in typical *M. normale* they are very slightly sinuous and on the holotype they form very slight ventral lobes. The length of the camerae is equal to about one-fourth the diameter of the conch but in both type specimens the adoral camera is slightly but distinctly shorter than the preceding one, which indicates that these specimens represent mature individuals.

The siphuncle is located about midway between the center and the venter. We have not been able to ascertain the structure of the siphuncle of the holotype, but that of the paratype is cyrtochoanitic in structure and its segments, though more or less pyriform, are nearly straight-sided throughout much of their length and in some cases they are very slightly concave laterally and resemble somewhat those of *Euloxoceras greenei* M., D., and C.[13]

Remarks.—This form differs from typical *M. normale* in that it is much smaller at maturity, there is a distinct transverse constriction near the adoral end of its living chamber, and its siphuncular segments are differently shaped. It is not improbable that this form should be regarded as a distinct species rather than as a variety of *M. normale.*

Occurrence.—Both types came from calcareous concretions immediately above the Tebo coal member of the Cherokee formation in the Shaw strip pit (sec. 23, T. 42 N., R. 26 W.), Henry County, Missouri.

Repository.—Private collection of John Britts Owen, Clinton, Missouri, No. 520 (holotype and paratype).

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[13] A. K. Miller, C. O. Dunbar, and G. E. Condra: The nautiloid cephalopods of the Pennsylvanian system in the Mid-Continent region. Nebraska Geol. Survey Bull. 9, ser. 2, 1933, pl. 1, fig. 14.

Genus Bactrites Sandberger 1843

Bactrites? cherokeensis Miller and Owen, n. sp.

Plate VIII, figure 5; Plate X, figure 3

Conch long, slender, straight, gradually expanded orad, and broadly elliptical in cross section as it is slightly compressed laterally. The holotype and only known representative of this species is an internal mold of four (and a part of a fifth) camerae of the phragmacone; it is about 85 mm. long and at its adapical end its two diameters measure about 30 mm. and 27 mm. (estimated), whereas at its adoral end these two diameters measure about 41 mm. and 37 mm., respectively.

Surface of holotype is marked by traces of growth-lines which are parallel to the sutures and by faint traces of longitudinal lirae. Camerae long and their length is equal to about one-half the longer (dorso-ventral) diameter of the conch. Sutures of holotype are not quite perpendicular to the long axis of the conch but this is probably due to a slight amount of distortion that the specimen has obviously undergone during preservation. The ventral portion (siphuncular side) of the holotype is not well preserved and it is therefore impossible to tell whether or not there is a small ventral lobe in the sutures, but on the ventro-lateral, lateral, dorso-lateral, and dorsal sides of the conch the sutures are straight. Septa moderately convex apicad. Siphuncle small in size and ventral and marginal in position—it was in contact with the wall of the phragmacone or very nearly so. Segments of siphuncle are essentially cylindrical in shape and siphuncle is orthochoanitic in structure. At adapical end of holotype siphuncle is about 3 mm. in diameter.

Remarks.—We are very uncertain about the generic affinities of this form. Long straight cephalopods with nearly straight sutures and small marginal siphuncles first appear in the Lower Ordovician of Bohemia—these early forms are referred to the genus *Eobactrites.* No similar forms are known from the Silurian but a variety of forms has been described from the Devonian of both Europe and North America and referred to the genus *Bactrites.* The Mississippian of Arkansas and Oklahoma, the Pennsylvanian of Texas and Peru, and the Permian of Sicily and Mexico has yielded comparable forms—these have been regarded as nautiloids by some authors and referred to the genus *Orthoceras,* whereas other authors have re-

garded them as ammonoids and referred them to the genus *Bactrites*. In 1909 Girty[14] called attention to the uncertainty in regard to the generic affinities of these Carboniferous forms, and in 1928 Thomas[15] referred to *Orthoceras* one of them that had heretofore always been referred to *Bactrites*—two years later Miller[16] referred it back to *Bactrites*. Recently Schindewolf[17] has expressed uncertainty in regard to the generic affinities of the Carboniferous forms under consideration, and Spath[18] has gone so far as to refer to the Nautiloidea all of the species, Ordovician, Devonian, and Carboniferous, that have been referred to *Bactrites* except those that had been removed to *Lobobactrites*. The form described above certainly seems to us to be a nautiloid and not an ammonoid, but we are very uncertain in regard to its relation to *Bactrites subconicus* Sandberger of the Wissenbach shale (Middle Devonian) of Germany, which is the genotype of *Bactrites*—if our species is not congeneric with that form, it represents an unnamed genus for it is not closely related to the genotype of either *Orthoceras* or *Orthoceratites*. It is however closely related to *Bactrites? carbonarius* Smith of the Mississippian of Arkansas and possibly the Upper Carboniferous of Peru, *B.? quadrilineatus* Girty of the Mississippian of Oklahoma, *B.? smithianus* Girty of the Mississippian of Arkansas and Oklahoma, *B.? postremus* Miller of the Pennsylvanian of western Texas, and *B.? adrianense* Gemmellaro and *B.? paternoi* Gemmellaro of the Permian of Sicily—its large size and elliptical conch and the relative length of its camerae serve to distinguish it from these forms.

Occurrence.—Holotype and only known representative of this species came from an unnamed limestone member of the Cherokee formation, 10-15 feet below the Jordan coal, England strip pit (sec. 17, T. 41 N., R. 25 W.), Henry County, Missouri.

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14 G. H. Girty: The fauna of the Caney shale of Oklahoma. U. S. Geol. Survey Bull. 377, 1909, p. 52.

15 H. Dighton Thomas: An Upper Carboniferous fauna from the Amotape Mountains, north-western Peru. Geological Magazine, vol. 65, 1928, p. 290.

16 A. K. Miller: A new ammonoid fauna of Late Paleozoic age from western Texas. Jour. Pal., vol. 4, 1930, p. 389.

17 O. H. Schindewolf: Vergleichende Morphologie und Phylogenie der Anfangskammern tetrabranchiater Cephalopoden. Preuss. geol. Landesanstalt Abhandl., N. F., Heft 148, 1933, pp. 69, 73.

18 L. F. Spath: The evolution of the Cephalopoda. Biological Reviews, vol. 8, no. 4, 1933, pp. 445-447, 459.

synonymy—there is of course no need for us to duplicate this work. However, the collection we are studying contains ten representatives of this species and although they are not entirely complete they are well preserved and a detailed study of them has yielded exact data in regard to the surface ornamentation of the conch and the nature of the internal sutures, which heretofore were known in only a general way.

Two of the small specimens, early mature individuals, retain portions of the test and fortunately they are exceptionally well preserved. The exterior of the conch is marked by numerous fine transverse growth-lines and by much finer and more numerous longitudinal lirae which give it a finely reticulate surface. Each growth-line forms a broad shallow broadly rounded salient on the lateral sides of the conch and a similar but more narrowly rounded sinus on the ventral side. Certain of the growth-lines are more prominent than the others and these prominent growth-lines are somewhat regularly spaced, but their spacing is not nearly as regular as it is stated to be by Sayre[20] on conspecific specimens from the Westerville limestone (Kansas City group) of Kansas City, Missouri, and Turner, Kansas. The longitudinal lirae, though in general straight, are very finely sinuous.

One of the specimens we are studying has been prepared in such a way that its internal as well as its external sutures are visible. As indicated by the accompanying diagram (text figure 1A, page 213), each external suture consists of a broad deep narrowly rounded depressed-V-shaped ventral saddle and on either side of it a very broad shallow broadly rounded asymmetrical lateral lobe and a smaller rounded dorso-lateral saddle which centers on the umbilical shoulder and is followed by a broad very shallow broadly rounded lobe on the umbilical wall. Each internal suture consists of a broad broadly rounded dorsal saddle and on either side of it a similar but narrower lateral lobe and a small angular saddle that centers on the umbilical seam and is followed by the lobe on the umbilical wall. In general the septa are moderately convex adapically but they are marked medianly by a prominent dorso-ventral fold.

Occurrence.—This species is widely distributed in the Pennsyl-

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[20] A. N. Sayre: The fauna of the Drum limestone of Kansas and western Missouri. Univ. of Kansas Sci. Bull., vol. 19, pt. 2, 1930, p. 154. Reprinted as Kansas Geol. Survey Bull. 17, 1930.

vanian of North America; it is known to range from Kentucky on the east to Nebraska on the west, and stratigraphically from the base of the Cherokee to the top of the Lansing. The collection we are studying contains ten representatives of this species all of which came from the Cherokee of Henry County, Missouri; nine of them came from immediately above the Tebo coal, whereas the tenth came from an unnamed limestone 10-15 feet below the Jordan coal. The smaller of the figured specimens (plate XII, figure 3), came from the Russell strip pit (sec. 32, T. 42 N., R. 26 W.); the larger of the figured specimens (plate XII, figure 4; text figures 1A, 1B) and one of the specimens which retain the surface marking of the test came from the Tillman strip pit (NE¼NE¼ sec. 23, T. 42 N., R. 26 W.); the other specimen which retains the surface markings of the test came from the Vansant strip pits (sec. 22, T. 41 N., R. 27 W.); one of the other specimens came from the Carroll strip pits (sec. 9, T. 42 N., R. 25 W.); three of the remaining specimens came from the Bradley strip pits (sec. 17, T. 43 N., R. 24 W.); the other specimen from above the Tebo coal came from the J. H. Britts strip pit (sec. 29, T. 42 N., R. 26 W.); and the single specimen from below the Jordan coal came from the England strip pit (sec. 17, T. 41 N., R. 25 W.).

Repository.—All of the specimens being studied by us are in the private collection of John Britts Owen, Clinton, Missouri, where they are numbered 501-506 and 509, 510. The figured specimens are numbered 501 (plate XII; figure 3) and 502 (plate XII, figure 4; text figures 1A, 1B); the specimens retaining surface markings of the test are numbered 503 (Tillman strip pit) and 504 (Vansant pits); the single specimen from below the Jordan coal is numbered 510.

Genus Megaglossoceras Miller, Dunbar, and Condra 1933

Only four species have heretofore been referred to this genus; these are *Megaglossoceras montgomeryense* (Worthen) of the McLeansboro formation of Illinois (the genotype), *M. magnum* M., D., and C. of the lower Fort Scott limestone (basal Marmaton) of Kansas[21], *M. rectilaterale* M., D., and C. of the Argentine limestone

[21] The exact horizon and locality from which the holotype of this species, which was originally referred to *Ephippioceras divisum* (White and St. John), came are given by Beede and Rogers in Kansas University Science Bulletin, vol. 2, 1904, pp. 463, 465.

(Lansing) of Nebraska, and *M. johnsoni* M., D., and C. of the Lower Pennsylvanian of Colorado. We are describing below an additional species, *M. pristinum,* from the Cherokee of Missouri, and also it seems to us that *Nautilus gilpini* Swallow may represent this genus. The type specimen of *N. gilpini,* which was only briefly described, was never figured, and was lost in the fire at the University of Missouri in 1892, came from Wayne City, an abandoned town located on the Missouri River in Jackson County, Missouri, about four miles north of Independence, Missouri[22]—presumably the specimen came from the Kansas City group but it may have come from the Bronson.

A detailed study of the specimen described below as *Megaglossoceras pristinum,* n. sp., has yielded the first reliable information in regard to the internal structures of the conch in this genus that has been available. Furthermore, since this specimen is a very primitive representative of the genus and is more or less intermediate between typical *Ephippioceras* and typical *Megaglossoceras,* it enables us to get a clearer concept of the relation between these two genera.

The septa in this genus are moderately convex adapically but they are marked medianly by a prominent dorso-ventral fold. Each complete suture consists of a total of six saddles and six lobes (see text figure 1C). Each external suture consists of a very prominent rounded more or less tongue-shaped ventral saddle and on either side of it a broad shallow rounded asymmetrical lateral lobe and a broad very shallow narrowly rounded or subangular dorso-lateral saddle which centers on the umbilical shoulder and which is followed by a broad very shallow broadly rounded lobe on the umbilical wall. Each internal suture consists of a broad rounded prominent dorsal saddle and on either side of it a similar but smaller and shallower lateral lobe and a low broad angular saddle that centers on the umbilical seam and is followed by the lobe on the umbilical wall.

The siphuncle is subcentral in position, moderately small in size, and orthochoanitic in structure—its segments are not expanded appreciably within the camerae and, though slightly curved, are essentially cylindrical in shape.

Miller, Dunbar, and Condra[23] state that *Megaglossoceras* and

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[22] This information in regard to Wayne City was furnished us by Mr. Floyd C. Shoemaker, Secretary of the State Historical Society of Missouri.

[23] Op. cit., p. 119.

Ephippioceras probably descended from a common ancestor. This view was based on the assumption that *Megaglossoceras magnum* M., D., and C. of the lower Fort Scott limestone (basal Marmaton) of Kansas is an exceedingly primitive representative of the genus and that it developed from a nautiloid with straight sutures by the formation of a broad shallow broadly rounded ventral saddle in its sutures. The specimen described below as *M. pristinum* also appears to be a very primitive representative of this genus—its umbilical shoulders, like those of *M. magnum*, are rounded rather than angular, as is typical for this genus, and the ventral saddle in its sutures is not nearly as straight sided as it is in *M. johnsoni* M., D., and C., for example. The form of its conch and the shape of its sutures (with the exception of the ventral saddle) are so strikingly similar to those of typical representatives of *Ephippioceras* (see text figures 1A-1D) that it seems very probable that this form developed from some representative of the genus *Ephippioceras* by a broadening and deepening of the ventral saddles of the sutures—although in so far as is now known, *Ephippioceras* is limited to the

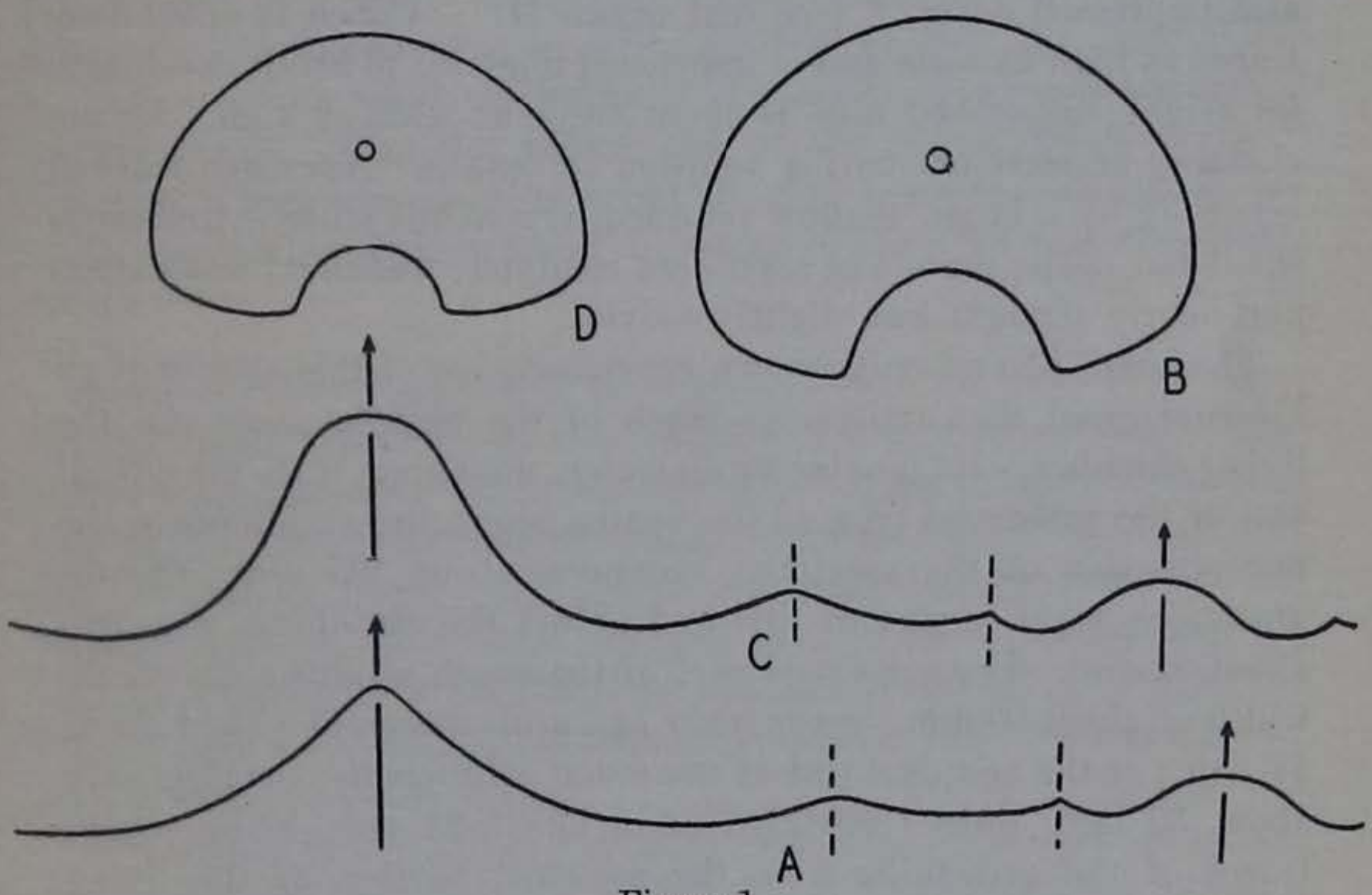

Figure 1

Figure 1.—Diagrammatic representations of
A,B—suture and cross section of conch of an early mature representative of *Ephippioceras ferratum* (Cox), x 2;
C,D—suture and cross section of conch of holotype of *Megaglossoceras pristinum*, n. sp., x 1.

Pennsylvanian in North America, in Europe it is well represented in the Lower Carboniferous, so as far as chronology is concerned this phylogeny is possible. If this view is correct, then *M. magnum* is either a degenerate form (for the ventral saddle in its sutures is shallower than is that of typical *Ephippioceras*, and the cross section of the conch is considerably different), or it represents an independent development and is therefore not closely related to *M. pristinum*—at present we are inclined to favor the latter view but more representatives of this group will have to be collected and studied before any reliable conclusions as to its phylogenetic development can be reached.

MEGAGLOSSOCERAS PRISTINUM Miller and Owen, n. sp.

Plate XII, figures 1, 2; Text figures 1C, 1D

Form subglobose. Conch nautiliconic, rapidly expanded orad, and apparently consists of about two or three volutions. Whorls reniform in cross section, depressed dorso-ventrally, broadly rounded ventrally and laterally, rather narrowly rounded dorso-laterally, and impressed dorsally (see text figure 1D). Conch is about two-thirds as high as wide and is impressed dorsally to about one-fourth its height; impressed zone is about twice as wide as high. Living chamber at least one-half a volution in length. Aperture marked ventrally by a broad shallow rounded hyponomic sinus. Umbilicus small but deep; umbilical shoulders rounded; umbilical walls steep and nearly straight but slightly convex.

The holotype and only known representative of this species is an internal mold that represents much of the phragmacone and the living chamber. Its maximum diameter, measured from the adoral end of the preserved part of the venter across the umbilicus to the opposite side of the specimen, measures about 105 mm.; the diameter at right angles to this and across the umbilicus measures about 82 mm. The preserved part of the conch attains a maximum width of about 90 mm. (estimated) and a maximum height of about 57 mm.; at the adapical end of the outer volution the conch is only about 32 mm. wide (estimated) and about 21 mm. high. Faint traces of the growth-lines on the adapical portion of the living chamber of the holotype indicate that the hyponomic sinus there was about 15 mm. deep. The umbilicus appears to have attained a maximum diameter of about 20 mm.

The surface of the internal mold is essentially smooth and there

is no trace of low broad transverse annulations which occur in some other representatives of this genus. There is, however, a small rounded ridge or raised line along the venter—this of course represents a stria on the inside of the conch. Each external suture consists of a very prominent rounded more or less tongue-shaped ventral saddle and on either side of it a broad shallow broadly rounded asymmetrical lateral lobe and a broad very shallow rather narrowly rounded dorso-lateral saddle which centers on the umbilical shoulder and which is followed by a broad very shallow broadly rounded lobe on the umbilical wall (see text figure 1C). Each internal suture consists of a broad rounded prominent dorsal saddle and on either side of it a similar but smaller and shallower lateral lobe and a low broad angular saddle that centers on the umbilical seam and is followed by the lobe on the umbilical wall. The septa are moderately convex adapically but they are marked medianly by a prominent dorso-ventral fold.

The siphuncle is subcentral and is rather small. Its segments are not expanded appreciably within the camerae and, though slightly curved, are essentially cylindrical—these facts indicate that the siphuncle is orthochoanitic in structure but we have not been able to determine the relative lengths of the septal necks and the connecting rings. Near the adoral end of the phragmacone of the holotype, where the conch is about 30 mm. high, the siphuncle is about 3½ mm. in diameter and its center is about 13 mm. from the venter.

Remarks.—This species is so distinct from all previously described forms that detailed comparisons would be superfluous. Its rounded umbilical shoulders serve to differentiate it from all known representatives of the genus *Megaglossoceras* except *M. magnum* M., D., and C. of the basal Marmaton near Oswego, Kansas. In that form the conch is large, low, and broad; the impressed zone is relatively shallow and its junctions with the dorsal side of the conch are broadly rounded rather than subangular; and there is a concave zone along the venter.

With the possible exception of *M. magnum, M. pristinum* is the most primitive representative of the genus *Megaglossoceras* known, and it is more or less intermediate between typical *Ephippioceras* and typical *Megaglossoceras;* however, the broadly rounded more or less tongue-shaped ventral saddles in its sutures indicate clearly

that its affinities are with *Megaglossoceras* rather than with *Ephippioceras*.

Occurrence.—Holotype and only known representative of this species came from an unnamed limestone member of the Cherokee formation 10-15 feet below the Jordan coal, England strip pit, sec. 17, T. 41 N., R. 25 W., Henry County, Missouri.

Repository.—Private collection of John Britts Owen, Clinton, Missouri, No. 507.

Genus Coloceras Hyatt 1893

Coloceras missouriense (Swallow)

1858. *Nautilus Missouriensis* Swallow, St. Louis Acad. Sci. Trans., vol. 1, p. 198.
(?) 1884. *Nautilus Missouriensis?* C. A. White, Indiana Dept. Geol. and Nat. History, Ann. Rep. 13, pt. 2, p. 166, pl. 35, figs. 1, 2.
(?) 1893. *Nautilus [Coloceras?] missouriensis* Hyatt, Texas Geol. Survey Ann. Rep. 4, p. 453.
(?) 1894. *Nautilus missouriensis* Keyes, Missouri Geol. Survey, vol. 5 (Paleontology of Missouri, Part 2), p. 224, pl. 56, fig. 3.
(?) 1896. *Endolobus (Nautilus) missouriensis* J. P. Smith, Amer. Phil. Soc. Proc., vol. 35, pp. 252-253, pl. 21, figs. 1-3d. [Reprinted as Contributions to Biology from the Hopkins Seaside Laboratory, 9, 1896 (1897).]
1898. *Endolobus missouriensis* [part ?] Weller, U. S. Geol. Survey Bull. 153, p. 246.
(?) 1910. *Endobolus missouriensis* Raymond, Carnegie Museum Annals, vol. 7, p. 156.
1933. *Coloceras missouriense* Miller, Dunbar, and Condra, Nebraska Geol. Survey Bull. 9, ser. 2, pp. 131, 195.

This species was originally described by Swallow as follows:

"*Shell* small, gibbous, smooth, somewhat flattened on the dorsal [ventral ?] margin; *aperture* reniform, transverse, slightly modified by the preceding whorl; *septa* sparingly concave, margin curved a little forward towards the inner border of the shell; *siphuncle* sub-central, a little nearer the ventral margin; *umbilicus* deep, partially closed.

"Diameter, 0.65;[24] thickness of last whorl, 0.54; diameter of last whorl, 0.38.

"State collection, from the Hydraulic Limestone, near the base of the Coal Measures in Boone County, where it is asso-

[24] The measurements in this paper are in inches.

ciated with *Productus splendens, P. Wabashensis, Chonetes mesoloba, Spirifer cameratus, S. lineatus* and *Naticopsis Pricei.''*

This description is entirely inadequate, it is not accompanied by an illustration, and the type specimen was lost in the fire at the University of Missouri in 1892. It is therefore very doubtful if the species can ever be recognized with certainty and even its generic affinities are somewhat in doubt. The specimens that C. A. White and J. P. Smith referred to this species are probably not all conspecific and, as recognized by both of these authors, it is very doubtful if any of their specimens represent Swallow's species. Keyes apparently referred to Swallow's specimen but he reproduced one of White's illustrations. Hyatt referred to White's illustrations. The collection we are studying contains two fragmentary representatives of *Coloceras* from the Cherokee of Missouri (which also yielded Swallow's type specimen) but in view of what has been said above it is not possible to determine whether or not either of these specimens represents Swallow's species.

Occurrence.—The holotype of this species came from the Cherokee of Boone County, Missouri. The specimen which C. A. White referred to this species came from the Pennsylvanian of Silverwood, Fountain County, Indiana, and the specimens which J. P. Smith referred to it came from the Lower Pennsylvanian (Atoka formation) of the center of N½ sec. 17, T. 5 N., R. 16 W., Conway County, Arkansas. Raymond lists this species from the Allegheny (Vanport limestone) of western Pennsylvania.

Coloceras spp.

Plate XVI, figure 3

The collection we are studying contains two specimens which apparently represent the genus *Coloceras* but which are so fragmentary that their specific affinities can not be determined satisfactorily. The sutures of both of these specimens are very slightly sinuous and they form very slight ventral and lateral lobes and similar ventro-lateral saddles; it is therefore quite possible that these specimens should be referred to the genus *Stearoceras* rather than to *Coloceras*—until more information is available in regard to *Coloceras hyatti* Miller, Dunbar, and Condra, the genotype of

Coloceras, it will not be possible to differentiate clearly between *Coloceras* and *Stearoceras.*

The conchs of both of our specimens are nautiliconic in their mode of growth, rapidly expanded orad, and therefore subglobular in shape. The internal mold is smooth with the exception of a very small indistinct ridge along the venter. The smaller of our specimens retains part of the test (or a replacement of it) and it is marked externally by numerous very fine growth-lines which indicate that the conch was marked ventrally by a broad deep rounded hyponomic sinus. The sutures of this specimen are more strongly sinuous than are those of the larger of our specimens (the figured specimen) and therefore it seems likely that we are dealing with two distinct species.

Occurrence.—Both of the specimens we are studying came from the Cherokee of Henry County, Missouri. The figured specimen came from immediately above the Tebo coal in the J. G. Turk strip pit (sec. 10, T. 41 N., R. 27 W.), whereas the other specimen came from immediately above the Lexington coal in the Ewing strip pit (sec. 36, T. 43 N., R. 28 W.).

Repository.—Private collection of John Britts Owen, Clinton, Missouri, Nos. 560 (figured specimen) and 561.

Genus KNIGHTOCERAS Miller and Owen, n. gen.

We have a single well-preserved specimen from the Cherokee of Missouri that apparently is not referable to any described genus and we here propose the generic name *Knightoceras* for it. This name is given in honor of Dr. J. Brookes Knight, in recognition of his excellent work on Missouri Pennsylvanian ostracodes and gastropods.

The new genus can be characterized as follows: Conch nautiliconic, subglobular, and rapidly expanded orad. Whorls strongly depressed dorso-ventrally and sublenticular in cross section as they are very broadly rounded ventrally and dorsally and are subangular laterally—the impressed zone along the dorsum is small and inconspicuous. Umbilicus very broad and deep. Prominent growth-lines indicate the presence of a broad deep rounded hyponomic sinus. Subangular lateral sides of conch (but not internal mold) projected to form a low and blunt but rather prominent carina. Each suture forms a very broad shallow broadly rounded

ventral lobe and on either side of it a shallow subangular lateral saddle which centers on the subangular lateral zone of the conch; on the broad dorso-lateral sides of the conch (the umbilical walls) the sutures are essentially straight but each forms a rather prominent rounded lobe as it crosses the dorsal impressed zone. Siphuncle small, subcentral in position, and orthochoanitic in structure.

Apparently *Nautilus subcariniferus* Tzwetaev of the Lower Pennsylvanian (Dewiatowo oölite) of central Russia in congeneric with *Knightoceras missouriense*, our genotype, but on the dorso-lateral sides of its conch (the umbilical walls) its sutures form broad shallow lobes. Tzwetaev[25] believed this Russian species to be closely related to *Nautilus cariniferus* J. de C. Sowerby of the Lower Carboniferous of Ireland and England, but in that form the dorso-lateral sides of the conch are concave rather than convex and the broad ventral side of the conch is marked by two longitudinal ridges.

This genus appears to be more closely related to *Vestinautilus* Ryckholt (of which *Coelonautilus* Foord is a synonym) than to any other described genus and it should be associated with it in the Triboloceratidae. The genotype of *Vestinautilus* is *Nautilus koninckii* d'Orbigny of the lower Mississippian (Tournacian) of Belgium; there are prominent longitudinal ridges on the ventro-lateral and dorso-lateral sides of its conch, and these, together with its sinuous sutures and concave venter, differentiate it from the genotype of *Knightoceras*. In *Planetoceras* the sutures form lateral lobes rather than saddles and the conch is evolute, and in *Temnocheilus* the conch bears prominent ventro-lateral nodes.

KNIGHTOCERAS MISSOURIENSE Miller and Owen, n. sp.

Plate XV, figures 6-8

Conch moderately small, subglobular, nautiliconic, and rapidly expanded orad. Whorls strongly depressed dorso-ventrally, almost twice as wide as high, and sublenticular in cross section; they are very broadly rounded ventrally and dorsally and are subangular laterally—the dorsal impressed zone is very shallow and not very wide and it is therefore rather inconspicuous. The dorsal side of

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25 Marie Tzwetaev: Cephalopodes de la section supérieure du calcaire carbonifère de la Russie centrale. Mém. du Comité Géol., vol. 5, no. 3, 1888, pp. 15, 50.

the conch is more highly arched than is the ventral. The holotype and only known representative of this species is a well-preserved specimen representing most of the living chamber and a small portion of the penultimate volution of the conch, which is septate. This specimen is not complete orad and it is bounded apicad by an impression of the adoral septum of the phragmacone; the ventral portions of two camerae of the penultimate volution of the conch adhere to the dorsal side (impressed zone) of the living chamber. The holotype is about 34 mm. long but it apparently represents only about one-fourth of a volution of the conch; at its adapical end it is about 20 mm. wide and 11 mm. high whereas at its adoral end it is about 27 mm. wide. At the adapical end of the holotype the dorsal impressed zone is about 3 mm. wide and is less than ½ mm. deep, but near the mid-length of this specimen it is about 5½ mm. wide and 1 mm. deep.

Aperture not preserved but growth-lines indicate that it was marked ventrally by a broad deep rounded hyponomic sinus which was more or less depressed-U-shaped but had curved sides—near the mid-length of the holotype the sinus formed by the numerous fine growth-lines as they cross the broad ventral side of the conch is about 7 mm. deep. On the broad dorso-lateral sides of the conch (the umbilical walls) the growth-lines are nearly straight. The test is rather thick (averaging almost ½ mm. on the ventral side of the holotype), and along the narrow subangular lateral zones of the conch its thickness is more than trebled and a low and blunt but rather prominent keel or carina is thereby formed. Since this keel results from a thickening of the test no trace of it is discernible on the internal mold. The surface of the internal mold is smooth with the exception of a very small but distinct ridge along the venter.

On the penultimate volution of the holotype the camerae apparently are about one-third as long as wide. Each suture forms a very broad shallow broadly rounded ventral lobe and on either side of it a shallow subangular lateral saddle which centers on the subangular lateral zone of the conch; on the broad dorso-lateral sides of the conch (the umbilical walls) the sutures are nearly straight, but each forms a rather prominent rounded lobe as it crosses the dorsal impressed zone.

The siphuncle is small, is located distinctly nearer the venter than the dorsum, and is orthochoanitic in structure. At the

adapical end of the holotype the siphuncle is slightly more than 1 mm. in diameter and its center is about 4 mm. from the venter. The septal necks are straight but their length can not be determined from the holotype.

Remarks.—Only one species, *K. subcariniferum* (Tzwetaev) of the Lower Pennsylvanian of central Russia, is known that is congeneric with this form; it is much larger and its sutures are different particularly in that they form distinct lobes on the dorsolateral zones (umbilical walls) of the conch. *Planetoceras bellilineatum* Miller, Dunbar, and Condra of the Kendrick shale (upper Pottsville) of Kentucky is somewhat similar but its sinuous sutures as well as the form of its conch indicate clearly that the resemblance is superficial and that it is not closely related to the form under consideration.

Occurrence.—Immediately above the Tebo coal member of the Cherokee formation in the Edwards strip pit (sec. 23, T. 42 N., R. 26 W.), Henry County, Missouri.

Repository.—Private collection of John Britts Owen, Clinton, Missouri, No. 562.

Genus Temnocheilus M'Coy 1844

The genera *Temnocheilus, Metacoceras,* and *Domatoceras* are very closely related and it is becoming increasingly difficult to distinguish clearly between them as more and more non-typical, more or less intermediate forms are being discovered. The characteristics of each of these genera must, of course, be determined largely from its genotype. The genotype of *Temnocheilus* is *Nautilus coronatus* M'Coy of the Lower Carboniferous of Ireland and England; the genotype of *Metacoceras* is *Nautilus sangamonensis* Meek and Worthen of the Pennsylvanian (McLeansboro formation) of Illinois; and the genotype of *Domatoceras* is *D. umbilicatum* Hyatt of the Pennsylvanian (upper Cherokee) of Kansas. In so far as we have been able to ascertain from a study of the published illustrations and descriptions of these genotypes and closely related forms, the conchs of all of them are similarly coiled and are marked externally by a row of prominent ventro-lateral nodes, and there is no material difference in their sutures or their siphuncles. However, they do differ materially in cross section (see text figure 2); in *Temnocheilus*

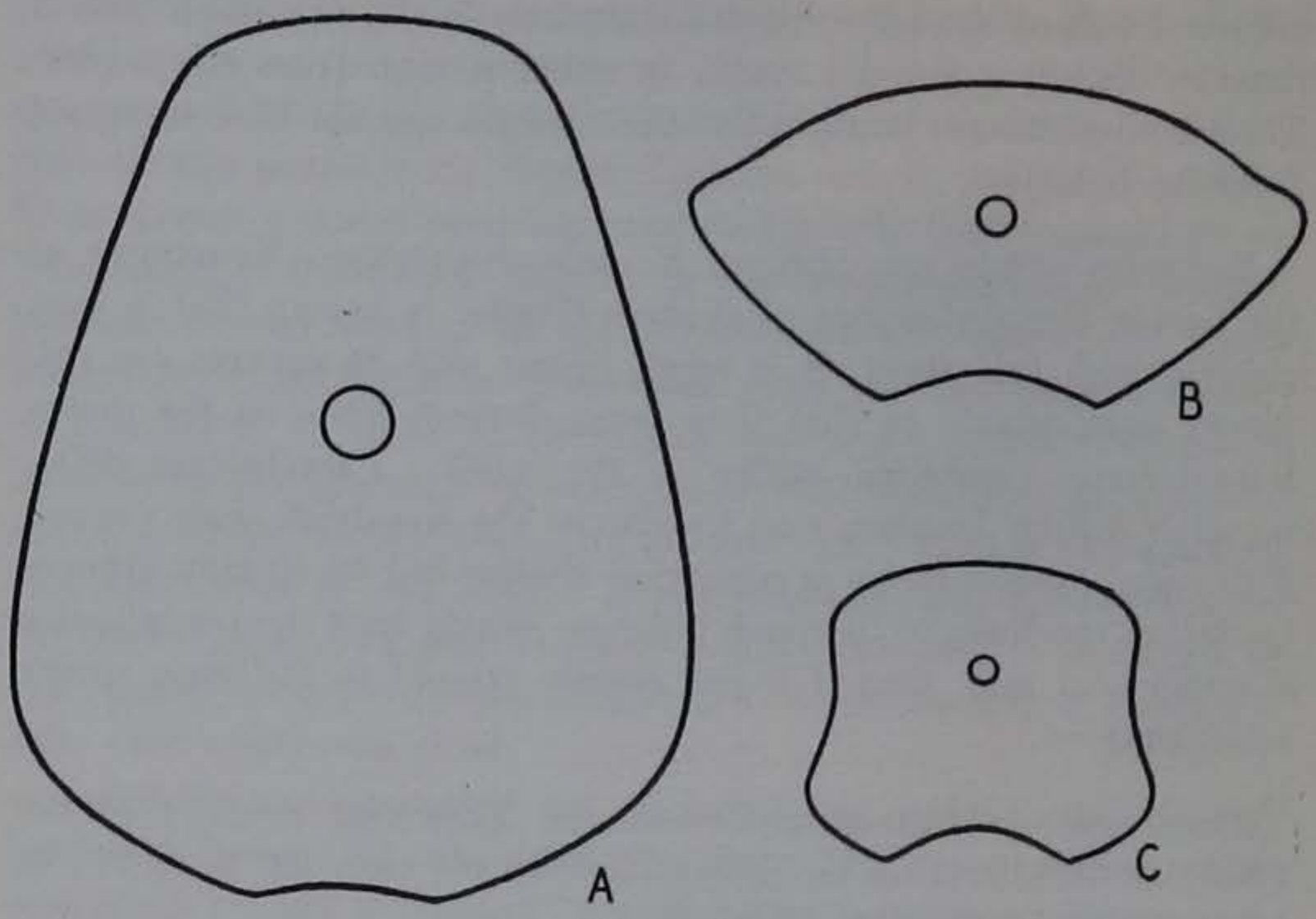

Figure 2

Figure 2.—Diagrammatic cross sections of the conchs of typical representatives of *Domatoceras*, *Temnocheilus*, and *Metacoceras*, based on
A—the holotype of *Domatoceras umbilicatum* Hyatt, the genotype of *Domatoceras*, x 1 (after Hyatt);
B—a typical representative of *Temnocheilus*, an unnamed species, from the Mingus shale (Strawn), near Millsap, Texas, x 1—this specimen is in the Yale Peabody Museum—; and
C—a topotype of *Metacoceras sangamonense* (Meek and Worthen), the genotype of *Metacoceras*, x 2.

the conch is strongly depressed dorso-ventrally and its lateral sides converge dorsally; in *Domatoceras* the conch is compressed laterally and its lateral sides converge ventrally; in *Metacoceras* the cross section of the conch is more or less intermediate in shape between that of *Temnocheilus* and *Domatoceras*. Furthermore, in *Temnocheilus* the ventro-lateral nodes are typically confluent whereas those of *Metacoceras* and *Domatoceras* are not, and in *Domatoceras* the ventro-lateral nodes represent merely thickenings of the test and therefore not more than a faint trace of them is retained on the internal mold whereas in both *Metacoceras* and *Temnocheilus* subdued replicas of the ventro-lateral nodes are present on the internal mold.

TEMNOCHEILUS HARNERI Miller and Owen, n. sp.

Plate XIII, figure 1; Plate XIV, figure 1

We are basing this species on two large specimens which are rather fragmentary but which supplement each other exceptionally well—one of them represents the lateral portion of the conch whereas the other represents the ventral portion. Both specimens retain the test, or rather a replacement of it, and therefore the nature of the sutures can not be ascertained.

Conch large, nautiliconic, fairly rapidly expanded orad, and subglobular in shape. Whorls are depressed dorso-ventrally, very broadly rounded ventrally, rather narrowly rounded ventro-laterally, very broadly rounded laterally, and slightly impressed dorsally; the lateral sides of the conch converge dorsally and the dorsal side is therefore very much narrower than the ventral side. The holotype (plate XIII, figure 1) shows that the conch consists of at least three volutions and attains a maximum diameter (measured from the adoral end of the venter across the umbilicus to the opposite side of the specimen) of at least 135 mm., and the paratype (plate XIV figure 1) shows that it attained a maximum width of at least 90 mm.

The narrowly rounded ventro-lateral zone of the conch bears a single row of very prominent narrowly rounded nodes which are nearly circular in cross section but are slightly elongate in a direction parallel to the long axis of the conch. On the adoral portions of the type specimens these nodes are about 10 mm. high and about 15 mm. in diameter; there are about thirteen of them to the volution. These nodes are not confluent as are those of most of the known representatives of this genus, and they project ventro-laterally rather than laterally as do those of the genotype. The extreme adapical portion of the holotype, which is not well preserved, apapparently is non-nodose, but it bears prominent longitudinal lirae on its lateral sides.

The growth-lines are numerous and very fine; they appear to be nearly straight on the lateral zones of the conch but on the broad ventral side they curve first gradually and then abruptly apicad and form a broad deep broadly rounded almost U-shaped sinus as they cross the venter; presumably these growth-lines indicate the shape of the aperture. The median third of the ventral side of the conch is essentially flat, or very slightly concave, and the borders

of this flattened zone are sharp and are rather prominent; on the adoral portion of the paratype this zone is about 30 mm. wide.

Unfortunately no information in regard to the internal structures of the conch can be gleaned from the type material.

Remarks.—This form is not closely similar to the genotype of *Temnocheilus, T. coronatus* (M'Coy) of the Lower Carboniferous of Ireland and England, but it appears to be very closely related to *T. winslowi* Meek and Worthen and *T. latus* M. and W. of the Lower Pennsylvanian of Illinois and *T. johnsoni* Miller, Dunbar, and Condra of the Lower Pennsylvanian of Colorado. In *T. latus* and *T. winslowi* the ventro-lateral nodes are more or less confluent and in *T. johnsoni* they are distinctly elongate in a direction parallel to the long axis of the conch. *T. subrectangularis* M., D., and C. of the Lower Pennsylvanian of Kentucky differs in that its conch is subrectangular in cross section and its ventro-lateral nodes are confluent—the ventro-lateral nodes of *T. subrectangularis* resemble those of the genotype, *T. coronatus,* more closely than do those of any of the species mentioned above, but the conchs of these two forms apparently are quite different in cross section.

The John Britts Owen Collection contains a small specimen (No. 559) which may represent this species but which is so incomplete that its affinities can not be determined with certainty and a satisfactory illustration of it can not be secured. This specimen is about 17 mm. long but it is not complete adorally or adapically and it apparently represents only about one-third of a volution of a coiled conch. It is depressed dorso-ventrally and its lateral sides converge dorsally as do those of *T. harneri,* but except on its adoral portion its lateral and ventral sides bear prominent longitudinal lirae but no ventro-lateral nodes are present. However, on the adoral portion of this specimen two very prominent ventro-lateral nodes are developed and the longitudinal lirae become much less prominent—they are entirely obsolete on the adoral portion of the ventral side of the conch. Tzwetaev[26] has described a representative of the genus *Temocheilus, T. acanthicus,* from the Lower Pennsylvanian of central Russia in which the adapical portion of the conch is preserved and it is longitudinally lirate but non-nodose, and a trace of similar ornamentation is discernible on the adapical portion of the holotype of *T. harneri.* It is quite possible that the specimen

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[26] Op. cit., pp. 6-7, 45-46, pl. 1, fig. 2.

under consideration represents merely the adapical portion of the conch of a representative of *T. harneri*—it is septate throughout. This specimen came from immediately above an unnamed local coal, some 15 feet below the Lexington coal, in the Fowler strip pit (sec. 10, T. 43 N., R. 28 W.), Henry County, Missouri.

The species described above is named in honor of Mr. Joe Harner of Nevada, Missouri, who collected the paratype and kindly loaned it to us for study.

Occurrence.—Both of the types of this species came from the Cherokee of Missouri. The holotype came from immediately above the Tebo coal in the Tillman strip pit (NE¼NE¼ sec. 23, T. 42 N., R. 26 W.), Henry County, Missouri. The paratype came from a reddish limestone lens immediately above the Rich Hill coal (near the middle of the Cherokee), about 1½ miles northeast of Arthur, Missouri, that is, from a strip pit located in NW¼NW¼ sec. 4, T. 37 N., R. 31 W.

Repository.—Private collection of John Britts Owen, Clinton, Missouri, No. 558 (holotype); and private collection of Joe Harner, Nevada, Missouri (paratype).

Temnocheilus sp.

1891. *Temnocheilus latus* Hyatt, Texas Geol. Survey Ann. Rep. 2, pp. 330-331. [Probably not *Nautilus* (*Temnocheilus*) *latus* Meek and Worthen 1870.]
1904. *Temnocheilus latus* Beede and Rogers, Kansas Univ. Sci. Bull., vol. 2, no. 15, pp. 461, 463.

In 1891 Hyatt referred a specimen from Oswego, Kansas, in the collections of the U. S. National Museum, to *Temnocheilus latus* Meek and Worthen, but he published only the following information in regard to it:

> "This is a much compressed and distorted fossil in shaly limestone, having a line of huge tubercles and an aspect similar to that of *Temnocheilus latus* or *Winslowi.* This in common with a number of others here described from this locality were collected and presented by Dr. W. S. Newlon."

According to Beede and Rogers, this specimen came from a strip pit one and one-half miles southeast of Oswego, Kansas, and Professor R. C. Moore[27] has recently written us that this "is doubtless

[27] Personal communication, dated February 3, 1934.

the horizon of the Lexington coal, which occurs immediately below the lower Fort Scott and we should place it in the very top of the Cherokee shale.'' Since the type specimen of *Temnocheilus latus* came from the stratigraphic equivalent of the basal portion of the Cherokee (''Roof of Coal No. 1'')[28] at Carbon Cliff, Rock Island County, Illinois, it is doubtful if the specimen from near Oswego is conspecific with it, but we have not had an opportunity to examine either specimen. It is of course quite possible that this Cherokee specimen represents the species described above as *Temnocheilus harneri.*

Genus METACOCERAS Hyatt 1883

METACOCERAS MUTABILE Miller and Owen, n. sp.

Plate XVI, figures 1, 2

Conch at maturity consists of at least two and one-half volutions, is moderate in size, subdiscoidal in form, and tarphyceraconic in its mode of growth. Whorls are slightly depressed dorso-ventrally and all volutions except the first which is elliptical in cross section are irregularly hexagonal in cross section as the conch is flattened ventrally, laterally, dorso-laterally, and dorsally; and the ventro-lateral shoulders, the umbilical shoulders, and the junctions of the dorso-lateral and the dorsal sides of the conch are very narrowly rounded or subangular. The dorsal side of the conch is slightly concave as it is impressed by the ventral side of the preceding volution. On the adoral portion of the holotype the ventral side of the conch is very slightly concave along the median zone, and the lateral sides are slightly convex; the dorso-lateral sides (the umbilical walls), however, are neither concave nor convex and they are inclined to the lateral sides at an angle of about 75 degrees. The lateral sides of the conch converge very slightly ventrad. The maximum diameter (measured from the adoral end of the venter across the umbilicus to the opposite side of the specimen) attained by the holotype, a typical mature specimen, is about 45 mm.; the diameter at right angles to this and across the umbilicus measures about 37 mm. Near the adoral end of this specimen the conch is about 20 mm. wide and about 15 mm. high; its ventral side is about 18 mm.

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[28] Savage (Jour. Geol., vol. 32, 1924, p. 580) gives the horizon of this species as the McLeansboro formation, which includes the Pennsylvanian strata of Illinois above the top of Coal No. 6; it seems likely that he was referring to *T. winslowi* and not to *T. latus.*

wide; its lateral sides are about 13 mm. wide; its dorso-lateral sides (umbilical walls) are about 6 mm. wide; and its dorsal side is about 8 mm. (calculated) wide.

The umbilicus is large (but not large for this genus), moderately deep and perforate; its width is equal to almost one-half that of the specimen and the umbilicus of the holotype attains a maximum diameter of a little more than 20 mm. Since the conch is only slightly involute essentially all of the lateral sides of the earlier volutions are exposed in the umbilicus. The umbilical perforation is oval in shape and that of the holotype is about 4½ mm. long and almost 3½ mm. wide.

The surface ornamentation of the conch varies markedly during the ontogenetic development and the specific name is given to refer to this characteristic. On the extreme adapical portion of the conch (the first half-volution) the ornamentation consists of only prominent transverse lirae which are slightly sinuous. Orad of there a row of small narrowly rounded nodes is developed on each of the ventro-lateral and the dorso-lateral shoulders of the conch. Those on the dorso-lateral shoulders (the umbilical shoulders) gradually decrease in prominence on the adoral volution of the conch and on the adoral half-volution of the holotype they are entirely obsolete. The nodes on the ventro-lateral shoulders of the conch gradually increases in prominence adorally. Greatly subdued replicas of these nodes are present on the internal mold. On the adoral portion of the holotype the umbilical shoulders are very sharp and the test is thick there; on the internal mold, however, these shoulders are rounded. The surface of the test (but not the internal mold) is marked also by rather prominent growth-lines. These form very slight salients as they cross the dorso-lateral sides of the conch (the umbilical walls); they are slightly sigmoidal as they cross the lateral sides; and they form broad deep rounded more or less U-shaped sinuses as they cross the broad ventral side of the conch. The growth-lines seem to be particularly prominent on the subangular umbilical and ventro-lateral shoulders of the conch. On the internal mold (but not the exterior of the test) there is a small rounded ridge or raised line along the venter. One of the paratypes (the one represented by figure 2 on plate XVI) retains an impression of part of the apertural margins; they are of course shaped like the growth-lines and there is a small rounded lateral crest and a deep rounded hyponomic sinus. These apertural

margins are slightly depressed indicating that the test was somewhat thickened immediately adjacent to the aperture.

About three camerae (four sutures) occur in a length (measured along the venter) equal to the height of the conch. On the mature portion of the conch the sutures form a broad shallow rounded lobe on the ventral side of the conch and a similar rounded lobe on the lateral and the dorsal sides of the conch, and these are separated by subacute saddles. The part of the suture forming the dorsal side of the lateral lobe continues to curve orad across the umbilical wall and the subacute dorso-lateral saddle centers on the umbilical seam rather than on the umbilical shoulder; there is however a decrease in the amount of the adoral curvature of the sutures on the umbilical shoulder.

The siphuncle is small, subcentral in position but distinctly nearer the ventral than the dorsal side of the conch, and presumably orthochoanitic in structure. Where the conch of one of the paratypes is about 10 mm. high and about 12½ mm. wide the siphuncle is considerably less than 1 mm. in diameter and is located about 3½ mm. from the venter.

Remarks.—This species is similar to *Metacoceras angulatum* Sayre of the Westerville limestone (Kansas City) of Missouri but in that form the nodes on the umbilical shoulders do not become obsolete on the adoral portion of the conch. In *M. biseriatum,* described below, the conch is more strongly depressed dorso-ventrally and the nodes on the umbilical shoulders do not become obsolete on the adoral portion of the conch.

The collection we are studying contains numerous small representatives of *Metacoceras* some of which probably represent this species but we have not been able to differentiate satisfactorily adolescent specimens of this species from those of other congeneric forms.

Occurence.—All of the specimens we are referring to this species came from the Cherokee of Henry County, Missouri. The holotype came from immediately above the Tebo coal member of the Cherokee in the Tillman strip pits (NE¼NE¼ sec. 23, T. 42 N., R. 26 W.); the figured paratype (plate XVI, figure 2) came from the same horizon in the West Missouri Power Company strip pits (sec. 23, T. 42 N., R. 26 W.); the paratype showing the siphuncle came from the same horizon about ¼ mile north of Montrose; other specimens

which apparently represent this species came from immediately above the Lexington coal in the George Howell strip pit (sec. 19, T. 42 N., R. 25 W.), and from immediately above an unnamed local coal 10-15 feet below the Jordan coal in the England pit (sec. 17, T. 41 N., R. 25 W.).

Repository.—Private collection of John Britts Owen, Clinton, Missouri, Nos. 583-587; the holotype is numbered 583, the figured paratype 584, the paratype showing the siphuncle 585, the specimen from the Lexington coal horizon 586, and the specimens from below the Jordan coal 587.

METACOCERAS BISERIATUM Miller and Owen, n. sp.

Plate XVI, figures 5-7

Conch moderate in size and tarphyceraconic in its mode of growth. Whorls are depressed dorso-ventrally and are irregularly hexagonal in cross section; their height is equal to about two-thirds their width. On the mature portion of the conch the ventral side, though in general slightly convex, is slightly concave along the median zone. The lateral sides are neither concave nor convex. The dorso-lateral sides are slightly convex. The dorsal side is slightly concave as it is impressed by the ventral portion of the preceding volution. The ventro-lateral shoulders of the conch are rounded, but the umbilical shoulders are subangular—on the internal mold however they are rounded. The junctions of the dorso-lateral and the dorsal sides of the conch are subangular. The lateral sides of the conch converge slightly ventrad.

The holotype is an internal mold of the living chamber to which fragments of the test adhere. Also, much of the phragmacone of this specimen is available for study but it is very fragmentary and poorly preserved. The living chamber is at least one-third of a volution in length and that of the holotype was at least 45 mm. long (measured along the venter). At the adapical end of the living chamber of the holotype, a mature specimen, the internal mold of the conch is about 18 mm. wide and 12 mm. high, the ventral side is about 16 mm. wide, the lateral sides are each about 7 mm. wide, the dorso-lateral sides are each about 5 mm. wide, the dorsal side is about 8 mm. wide, and the impressed zone is about 1 mm. deep.

Umbilicus large and apparently perforate. Nearly all of the

lateral sides of the earlier volutions of the conch are exposed in the umbilicus. Umbilical walls steep and inclined to the lateral sides of the conch at about 65 degrees.

Both the ventro-lateral shoulders and the umbilical shoulders of the conch bear a single row of rather prominent, round, fairly sharp nodes; those on the ventro-lateral shoulders are much larger than are those on the umbilical shoulders. There are about 20-25 (estimated) ventro-lateral nodes to each volution, and there appears to be an umbilical node opposite each ventro-lateral node. Subdued replicas of the ventro-lateral nodes are present on the internal mold, but not more than a trace of the umbilical nodes is discernible on the internal mold. The exterior of the test is marked also by growth-lines; these are nearly straight on the lateral sides of the conch, but immediately ventrad of the narrowly rounded ventro-lateral zones of the conch they curve strongly apicad and they form broad deep rounded sinuses as they cross the ventral side of the conch—presumably they indicate the shape of the aperture.

Camerae short. Each suture forms a broad shallow broadly rounded ventral lobe, a shallow narrowly rounded ventro-lateral saddle, a broad shallow lateral lobe which extends from the ventro-lateral shoulder of the conch to the umbilical seam, a shallow subangular dorso-lateral saddle which centers on the umbilical seam, and a deeper (but nevertheless rather shallow) rounded dorsal lobe. The part of the suture which forms the dorsal side of the lateral lobe continues to curve orad as it crosses the dorso-lateral side of the conch but there is a marked decrease in the amount of adoral curvature beyond (dorsad of) the umbilical shoulder.

Siphuncle small, central (or nearly so) in position, and orthochoanitic in structure. At the adapical end of the living chamber of the holotype the siphuncle is about 1½ mm. in diameter. The septal necks are straight but short; their length is only about one-fourth that of the cylindrical connecting rings. In the adapical volution of the holotype the siphuncle is much nearer the venter than the dorsum. Also, the extreme adapical portion of the conch (the first volution) is not impressed dorsally and is subelliptical in cross section.

Remarks.—This species is similar to *Metacoceras mutabile,* described above, of the Cherokee of Missouri and to *M. angulatum* Sayre of the Westerville limestone (Kansas City) of Missouri.

However, its conch is more strongly depressed than are the conchs of either of those species and its siphuncle is central in position. Also, on the adoral portion of the conch of mature representatives of *M. mutabile* the nodes on the umbilical shoulders become obsolete whereas those in the species under consideration do not. The collection we are studying contains numerous small representatives of *Metacoceras* some of which probably represent this species but we have not been able to differentiate satisfactorily adolescent specimens of this species from those of other congeneric forms.

Occurrence.—The holotype and the three paratypes of this species all came from the Cherokee of Missouri. The holotype came from immediately above the Lexington coal in the Old Overby strip pit (NE¼NE¼ sec. 21, T. 43 N., R. 28 W.); two of the paratypes came from immediately above the Tebo coal in the Carroll pits (sec. 9, T. 42 N., R. 25 W.); the other paratype came from immediately above the Lexington coal in the Geo. Howell pit (sec. 19, T. 42 N., R. 25 W.)

Repository.—Private collection of John Britts Owen, Clinton, Missouri, Nos. 599 (holotype) and 600, 601 (paratypes).

METACOCERAS sp.

Plate XVI, figures 8, 9

The collection we are studying contains a single large fragment (an internal mold) of a large representative of the genus *Metacoceras* that apparently is not referable to any described species but is too incomplete to serve as the type of a new species. The lateral sides of this specimen converge dorsally rather than ventrally as is typical for this genus, and the maximum width of the conch is therefore attained at the ventro-lateral shoulders. The narrowly rounded ventro-lateral zones of the specimen bear a single row of large prominent rounded nodes, but the umbilical shoulders are rounded and are non-nodose. There is a small rounded ridge or raised line along the venter. About five camerae occur in a length (measured along the venter) equal to the maximum width of the conch. Each suture forms a very broad shallow broadly rounded ventral lobe and a similar lateral lobe, and these are separated by a shallow rather narrowly rounded ventro-lateral saddle. The siphuncle is small and is central or nearly so in position; presumably it is orthochoanitic in structure.

Occurrence.—Immediately above the Tebo coal member of the Cherokee in the Carroll strip pits (sec. 9, T. 42 N., R. 25 W.), Henry County, Missouri.

Repository.—Private collection of John Britts Owen, Clinton, Missouri, No. 605.

Genus Parametacoceras Miller and Owen, n. gen.

The collection we are studying contains numerous representatives of a species which, though somewhat similar to the type of *Metacoceras*, is generically distinct from it and is not referable to any described genus; we are proposing the generic name *Parametacoceras* for this and congeneric forms. Tzwetaev[29] has described a closely related species, *Nautilus nikitini*, from the Upper Carboniferous of central Russia; Miller[30] has described a form, *Endolobus schucherti*, from the Pennsylvanian of New Mexico that probably is congeneric; Hyatt[31] has described a species, *Temnocheilus crassus*, from the Cherokee of Kansas that may represent this genus; and the John Britts Owen collection contains a specimen (number 619) from the Lower Pennsylvanian near Danville, Kentucky, that represents an undescribed species closely similar to the genotype. These forms differ from typical *Metacoceras* particularly in that the ventro-lateral shoulders of their conchs do not bear a row of prominent nodes and their lateral sides are ornamented by transverse ribs. The new genus can be briefly characterized as follows:

Conch tarphyceraconic and typically slightly evolute. Whorls subquadrate in cross section. Umbilicus large and perforate. Aperture marked ventrally by a broad deep rounded hyponomic sinus. On mature portion of conch lateral sides of whorls bear short transverse ribs. Each suture forms very shallow broadly rounded ventral, lateral, and dorsal lobes and these are separated by similar but more narrowly rounded ventro-lateral and dorso-lateral saddles. Siphuncle small, subcentral or subventral in position, and orthochoanitic in structure. Genotype *Parametacoceras bellatulum* Miller and Owen, described below.

As indicated by the generic name this genus is closely related to

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[29] Op. Cit., 10-11, 47-48, pl. 1, figs. 5.

[30] A. K. Miller: A Pennsylvanian cephalopod fauna from south-central New Mexico. Jour. Paleontology, vol. 6, 1932, pp. 64-66, pl. 12, figs. 12, 13.

[31] Alpheus Hyatt: Carboniferous cephalopods. Texas Geol. Survey, Ann. Rep. 2, 1891, p. 333, text figs. 27-29.

Metacoceras and occurs in association with it; it should be placed in the *Tainoceratidae* next to *Metacoceras*. It differs from *Endolobus* and *Diodoceras* in that its conch is not strongly depressed dorso-ventrally and is subquadrate rather than subelliptical in cross section. It lacks the prominent ventro-lateral nodes which are so characteristic of *Metacoceras*, *Temnocheilus*, and *Tainoceras*.

Parametacoceras bellatulum Miller and Owen, n. sp.

Plate XV, figures 1-5

Conch moderately small and tarphyceraconic, and at maturity consists of about two and one-fourth volutions. First volution of conch is subelliptical in cross section—its dorsal side is more strongly arched than its ventral—but orad of there the conch is impressed dorsally and its ventral, lateral, and dorso-lateral sides are gradually flattened so that the adoral portion of the second volution is irregularly hexagonal in cross section—the ventro-lateral zones of the conch are narrowly rounded; the umbilical shoulders and the junctions of the dorsal and dorso-lateral sides are subangular. Orad of the second volution the conch gradually becomes less strongly impressed dorsally and the extreme adoral portion of the conch is therefore subquadrate in cross section, or, as it is depressed dorso-ventrally, subrectangular. On the outer volution of the holotype all of the sides except the dorsal impressed zone are slightly convex but on the adoral portion of the conch the ventral side is nearly flat. The living chamber is about one-third of a volution in length.

The holotype (plate XV, figures 1-3) is a typical mature specimen; its maximum diameter, measured from the adoral end of the venter across the umbilicus to the opposite side of the specimen, is about 31 mm.; the diameter at right angles to this and across the umbilicus measures about 26 mm. At the adoral end of the holotype, which is essentially complete, the conch is about 21 mm. wide and about 14 mm. high; at the adapical end of the outer volution the conch is only about 9 mm. wide and 6 mm. high.

The umbilicus is wide and perforate. Its width is equal to about two-fifths the diameter of the specimen and that of the holotype attains a maximum diameter of about 12½ mm. The umbilical walls are steep and are inclined to the nearly flat lateral sides of the conch at some 80 degrees. The umbilical perforation is oval in shape and that of the holotype is about 3 mm. long and 2 mm. wide.

On the adoral half-volution of mature specimens the umbilical shoulders are subangular but apicad of there they are narrowly rounded, and on the internal mold they are rounded throughout their entire length.

The first half-volution of the conch is marked externally by rather prominent transverse lirae which are slightly sinuous, but orad of there these lirae disappear and small low rounded transverse ribs are developed on the lateral sides of the conch. There are about twenty-five (estimated) of these ribs to the volution. They end rather abruptly in small rounded nodes on the ventral portion of the lateral sides but on the dorsal portion of those sides these ribs die out gradually (see figure 5 on plate XV). On the adoral fourth of the outer volution of mature specimens the ribs become obsolete. Subdued replicas of these ribs are discernible on the internal mold. The exterior of the test but not the internal mold is marked also by rather prominent growth-lines. These form very slight salients as they cross the umbilical walls and are very slightly sinuous on the lateral sides of the conch, but immediately ventrad of the ventro-lateral shoulders, they curve strongly apicad and form very broad deep rounded sinuses as they cross the broad ventral side of the conch. These growth-lines of course indicate the shape of the aperture, and on some of the type specimens where portions of the apertural margins are preserved the growth-lines are parallel to them.

The camerae are moderate in length and along the venter the distance between successive sutures is equal to about one-third the width of the conch. On the adapical portion of the conch the sutures are straight but on the outer volutions each suture forms a shallow rounded lobe as it crosses the ventral side of the conch, a similar ventro-lateral saddle, a similar but broader lateral lobe, a low narrowly rounded dorso-lateral saddle which centers on the umbilical seam, and a deep rounded dorsal lobe as it crosses the impressed zone. On the adoral portion of mature specimens, where the conch is irregularly hexagonal in cross section, the part of the suture which forms the dorsal side of the lateral lobe continues to curve orad as it crosses the umbilical wall but there is a marked decrease in the amount of its adoral curvature dorsad of the umbilical shoulders. There is a small rounded pit or depression in each septum next to the dorsum. On the adoral portion of the internal

mold of some of the types there is a small rounded ridge or raised line along the venter.

The siphuncle is small in size, subcentral in position but distinctly nearer the venter than the dorsum, and orthochoanitic in structure. The septal necks are about one-third as long as the cylindrical connecting rings. In one of the figured paratypes (plate XV, figure 4), where the internal mold is about 11 mm. wide and 7½ mm. high, the siphuncle is slightly less than 1 mm. in diameter and its center is about 2½ mm. from the venter.

Remarks.—This species is more closely similar to *Parametacoceras nikitini* (Tzwetaev) of the Upper Carboniferous of central Russia than to any other described species, but it is readily differentiated from that form by the subrectangular (rather than elliptical) cross section of its conch, and by the fact that its siphuncle is nearer the venter than the dorsum (rather than central in position). In *Parametacoceras schucherti* (Miller) of the Pennsylvanian of New Mexico the cross section of the conch and the shape of the lateral ribs are different, and in *P.? crassus* (Hyatt) of the Cherokee of Kansas the conch is less rapidly expanded orad and is compressed rather than depressed.

Occurrence.—All of the specimens that we are referring to this species came from immediately above the Lexington coal member of the Cherokee in Henry and Lafayette counties, Missouri. The holotype and eleven of the paratypes came from the Ewing strip pit (sec. 36, T. 43 N., R. 28 W.), Henry County; seven of the other paratypes (including the one represented by figure 5 on plate XV) came from the Lear pit (sec 15, T. 43 N., R. 28 W.), Henry County; the other figured paratype (plate XV, figure 4), and an unfigured one, came from the SE¼NW¼ sec. 15, T. 49 N., R. 25 W., Lafayette County; another paratype came from the Old Overby strip pit (sec. 21, T. 43 N., R. 28 W.), Henry County; and the other paratype came from the Old Gooch strip pit (sec. 15, T. 43 N., R. 28 W.), Henry County.

Repository.—Private collection of John Britts Owen, Clinton, Missouri, Nos. 606 (holotype), 607 (figured paratype, figure 5 on plate XV), 608 (figured paratype, figure 4 on plate XV), and 609-612 (unfigured paratypes).

Parametacoceras? crassum (Hyatt)

Text figures 3a-3c

1891. *Temnocheilus crassus* Hyatt, Texas Geol. Survey Ann. Rep. 2, p. 333, text figs. 27-29.

1893. *Temnocheilus crassus* Hay, Kansas Acad. Sci. Trans., vol. 13, pp. 38-39, text figs. 3-5.

1904. *Temnocheilus crassus* Beede and Rogers, Kansas Univ. Sci. Bull., vol. 2, no. 15, pp. 461, 463.

1933. *Metacoceras crassum* Miller, Dunbar, and Condra, Nebraska Geol. Survey Bull. 9, ser. 2, pp. 168, 195.

No representative of this unique species other than the holotype has ever been found. Since Hyatt's illustrations and description are not readily available to most paleontologists, we are reproducing them.

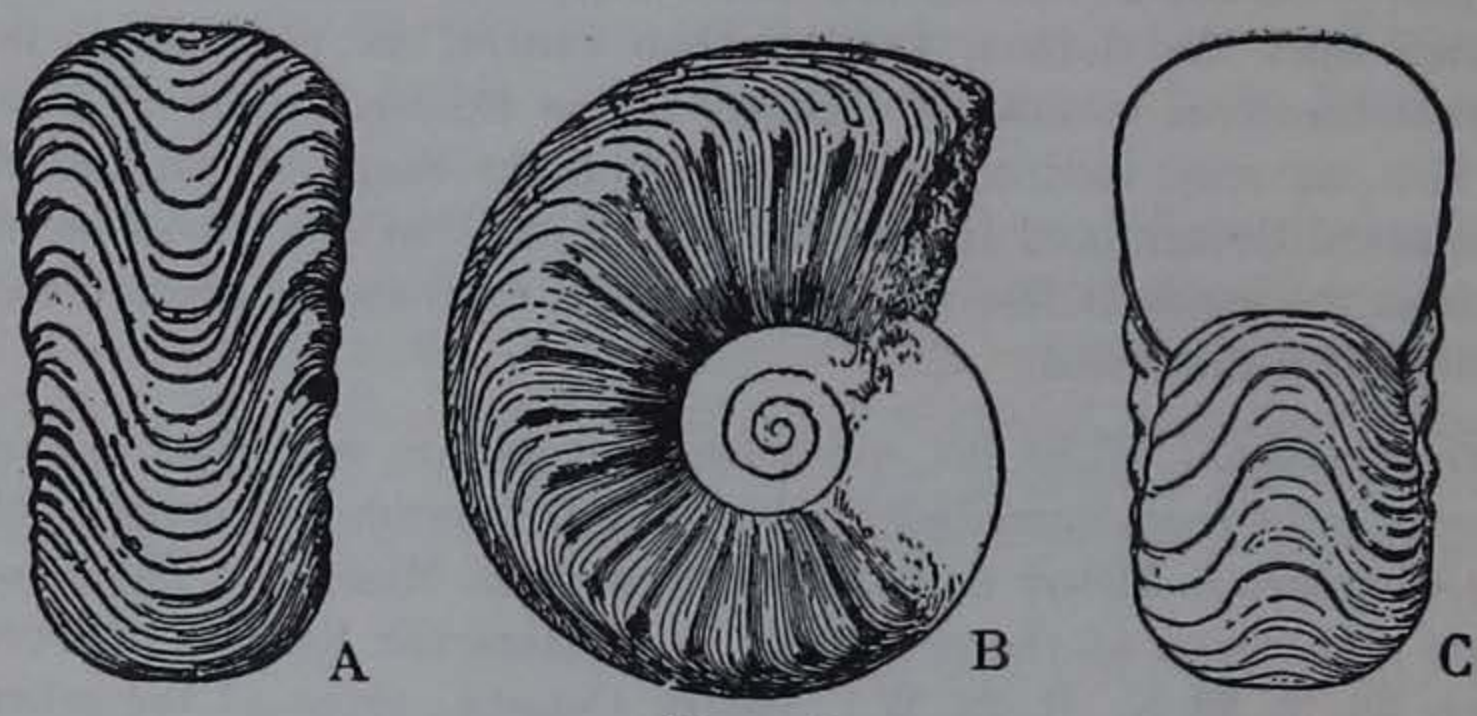

Figure 3

Figure 3.—Three views of the holotype of *Parametacoceras? crassum* (Hyatt), x 1⅓; from immediately above the Lexington coal (Cherokee), near Oswego, Kansas. Figure C is in part a restoration. After Hyatt.

"This species is represented only by a fragment, but the characteristics are so peculiar that there is apparently little doubt of its being the representative of a distinct form.

"The sides are convex and do not converge towards the umbilici so abruptly as in most forms of this genus. They are covered by numerous well defined straight pilae, terminating in small nodes at the edges of the abdomen. The abdomen is convex, with a narrow slightly depressed zone along the centre. The shell is ornamented by prominent striae of growth, and at regular intervals one of these is more prominent than the neighboring striations, showing frequent short arrests of growth. These striae are straight upon the sides,

but upon the abdomen bend suddenly posteriorly, forming wide sinuses of great depth; doubtless the aperture was similar. The sutures are almost straight on the sides and have a very broad and slight ventral lobe. Siphuncle unknown.

"This shell is very similar to *Nautilus falcatus*, L. [J.] de C. Sowerby[32], in so far as they both have ribs. The Coalbrookdale specimen, however, has no tubercles, or at least none are given, and the sides of the whorl are figured as concave. *Naut. Nikitini*, Tzwetaev[33], is also very similar, but the ribs are less numerous and the sutures quite different. *Nikitini* has saddles and lobes as in *Tainoceras*. Living chambers were not observed. Position of siphuncle is unknown."

Remarks.—We are very uncertain in regard to the generic affinities of this form. The lateral ornamentation of its conch is strikingly similar to that of *Parametacoceras bellatulum*, the genotype of *Parametacoceras*, but the shape of its conch and the nature of its umbilicus are quite different from those of that form. Nevertheless, this species appears to be more closely related to *Parametacoceras bellatulum* than to any other genotype, and we are accordingly placing it with question in *Parametacoceras*. It is so distinct from all described species that specific comparisons would be superfluous.

Occurrence.—Hyatt states only that the holotype came from the Carboniferous near Oswego, Kansas. However, Beede and Rogers state that it came from a strip pit one and one-half miles southeast of Oswego, and Professor R. C. Moore[34] has recently written us that "this is doubtless the horizon of the Lexington coal, which occurs immediately below the lower Fort Scott and we should place it in the very top of the Cherokee shale."

Repository.—According to Hyatt the holotype is in the U. S. National Museum.

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[32] Joseph Prestwich, Jun.: On the geology of Coalbrook Dale. Geol. Soc. London Trans., ser. 2, vol. 5, 1840, pl. 40, fig. 9.

[33] Op. cit., pl. 1, fig. 5.

[34] Personal communication, dated February 3, 1934.

Genus ENDOLOBUS Meek and Worthen, 1865

ENDOLOBUS DEPRESSUS (Hyatt)

Text figures 4a, 4b

1891. *Temnocheilus depressus* Hyatt, Texas Geol. Survey Ann. Rep. 2, pp. 331-332, text figs. 25, 26.

1904. *Temnocheilus depressus* Beede and Rogers, Kansas Univ. Sci. Bull., vol. 2, no. 15, pp. 461-463.

1933. *Endolobus depressus* Miller, Dunbar, and Condra, Nebraska Geol. Survey Bull. 9, ser. 2, p. 194.

Only one representative of this species, the holotype, has been found. It was described by Hyatt as follows:

"The young of this fossil was not visible, the whole umbilical area being concealed on both sides by matrix. The sides are very narrow, convex, and very abruptly convergent to the umbilici. Their junctions with the abdomen are subangular, with a row of obscure elongated nodes, which are more marked on the shell than on the cast, and better marked on one side than on the other. The shell has fine striae of growth almost straight or only slightly concave on the sides and bending backwards on the abdomen to form broad and apparently deep sinuses. These sinuses are, however, much broader in proportion and not as deep apparently as those in the striae on the abdomen of *Tem. crassus*.

"The sutures are only slightly concave on the sides and have very broad and extremely slight lobes on the abdomen. They are numerous, and the interspaces of the air chambers quite narrow. The tubercles are more obscure than in other species on the cast and also less prominent on the shell; the air chambers are also narrower than usual in species of similar proportions. It is similar to *T. conchiferus* in the slight character of the nodes and transverse section of whorl, but the increase by growth is less, in *T. conchiferus* the nodes extend internally across the longitudinal axis of the whorl, whereas in this species they extend parallel with that axis, and the shell is thicker in *conchiferus*.

"It is closely similar to *Temnocheilus coronatus* as figured by De Koninck[35] in his Calcaire Carbonifere; but our species has an abdomen somewhat more depressed and very much broader in proportion to the abdominal and dorsal diameter at the same age, and

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[35] L.-G. de Koninck: Faune du calcaire carbonifère de la Belgique; première partie, poissons et genre nautile. Musée Royal d'Histoire Naturelle de Belgique, tome 2, 1878, pl. 24, fig. 2.

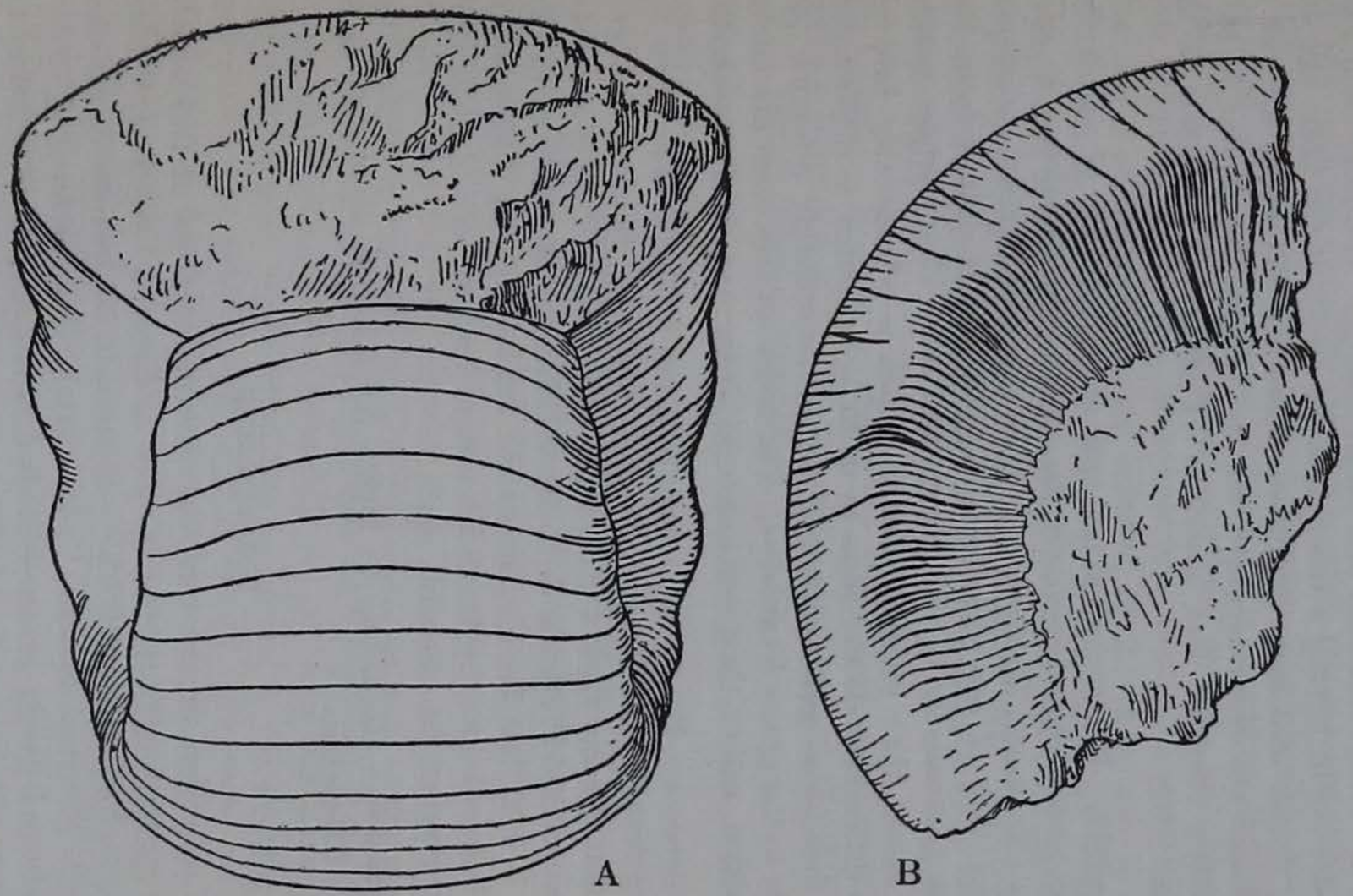

Figure 4.—Two views of the holotype of *Endolobus depressus* (Hyatt), x 1; from immediately above the Lexington coal (Cherokee), near Oswego, Kansas. Figure A is in part a restoration. After Hyatt.

the nodes are less prominent. It is similar to *Tem. latus* and *Winslowi* in the transverse section of the whorls and umbilici, but the nodes are more numerous and much smaller. It differs from *Tem. Forbesianus* in having a much broader whorl at the same age and much deeper and more funnel-like umbilici, the nodes are not so heavy and are closer together, but the sutures are similar in both. No living chamber was observed. Position of siphuncle is unknown.''

Remarks.—In general shape and ornamentation of conch this species resembles rather closely the genotype of *Endolobus, E. spectabilis* (Meek and Worthen) [= *Nautilus* (*Endolobus*) *peramplus* M. and W.] of the Chester of Illinois, but it differs from that species particularly in that its sutures form very shallow ventral lobes rather than saddles—also its conch is considerably broader. These differences do not seem to us to be sufficient to differentiate these two forms generically and we are accordingly referring this species to the genus *Endolobus.* The nodes on this form are lateral in position, rather than ventro-lateral as they are in *Temnocheilus.*

Occurrence.—Hyatt states only that the holotype came from the Carboniferous, near Oswego, Kansas. However, Beede and Rogers state that it came from a strip pit one and one-half miles southeast of Oswego, and Professor R. C. Moore[36] has recently written us that ''this is doubtless the horizon of the Lexington coal, which occurs immediately below the lower Fort Scott and we should place it in the very top of the Cherokee shale.''

Repository.—According to Hyatt the holotype is in the U. S. National Museum.

Endolobus sp.

The collection we are studying contains portions of two whorls of a large specimen (at least 125 mm. in diameter) which represents the genus *Endolobus* and which appears to be specifically distinct from all described forms. Unfortunately this specimen is so incomplete and poorly preserved that a satisfactory illustration of it can not be obtained and it should not be made the type of a species. In general form and ornamentation this specimen resembles *Endolobus depressus* (Hyatt), described above, but its conch is consider-

[36] Personal communication, dated February 3, 1934.

ably narrower and the nodes on the lateral sides of it are much less prominent. The sutures are nearly straight (very slightly convex apicad) on the umbilical walls, but immediately ventrad of the narrowly rounded lateral zones of the conch the sutures curve distinctly apicad and apparently each forms a broad shallow ventral lobe. The siphuncle is small, subcentral in position, and orthochoanitic in structure. The septal necks are straight and they are about one-third as long as the connecting rings. At least the internal mold of the penultimate volution of this specimen is nonnodose, and it resembles somewhat the figured type of *Nautilus* [*Endolobus?*] *atuberculatus* Tzwetaev[37] of the Upper Carboniferous (Dewiatowo oölite) of central Russia, but in that form the siphuncle is subventral in position and the sutures form definite lobes on the umbilical walls.

Occurrence.—Imediately above the Tebo coal member of the Cherokee formation in the Bradley strip pits (sec. 17, T. 43 N., R. 24 W.), Henry County, Missouri.

Repository.—Private collection of John Britts Owen, Clinton, Missouri, No. 616.

Genus Domatoceras Hyatt 1891

Recently Miller, Dunbar, and Condra[38] proposed the generic term *Pseudometacoceras* [genotype, *Metacoceras sculptile* Girty] for forms which they recognized are closely related to *Domatoceras* but which they believed differed from the type of that genus in that at maturity they develop a row of nodes on each of the ventrolateral shoulders of the conch and therefore mimicked *Metacoceras* in surficial features. The collection we are studying contains a number of internal molds which are so similar to the genotype of *Domatoceras* (*D. umbilicatum* Hyatt, known only from internal molds) that at first we believed them to be conspecific with it—certainly they are congeneric. Some of our specimens retain portions of the test and it (but not the internal mold) bears ventrolateral nodes on its mature portions. After carefully comparing these specimens with the published illustrations and description of the cotypes of "*Metacoceras*" *sculptile* we have concluded that our specimens may not differ specifically from them. Since the geno-

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[37] Op. cit., pl. 1, fig. 6.

[38] Op. cit., p. 224.

types of *Pseudometacoceras* and *Domatoceras* are so similar that it is not easy to differentiate them specifically they should not be differentiated generically and the generic name *Pseudometacoceras* is therefore to be suppressed as a synonym of *Domatoceras.* The close relationship between the genotypes of *Domatoceras* and *Pseudometacoceras* was not suspected heretofore as one of them is based on specimens retaining the test whereas the other is based on internal molds.

Domatoceras umbilicatum Hyatt

Text Figures 2A, 5A, 5B

1891. *Domatoceras umbilicatum* Hyatt, Texas Geol. Survey Ann. Rep. 2, pp. 343-345, text figs. 45-47.
1891. *Koninckioceras umbilicatum* Hyatt, Texas Geol. Survey Ann. Rep. 2, p. 344.
1893. *Domatoceras umbilicatum* Hay, Kansas Acad. Sci. Trans., vol. 13, pp. 42-43, text fig. 12.
1893. *Domatoceras umbilicatum* Hyatt, Texas Geol. Survey Ann. Rep. 4, p. 441.
1904. *Domatoceras umbilicatus* Beede and Rogers, Kansas Univ. Sci. Bull., vol. 2, no. 15, pp. 461, 463.
1933. *Domatoceras umbilicatum* Miller, Dunbar, and Condra, Nebraska Geol. Survey Bull. 9, ser. 2, pp. 217-218.

This species is more than ordinarily important for it is the genotype of *Domatoceras.* It was originally described by Hyatt as follows:

"This species reaches a considerable size, the specimen here described being about 217 mm. in diameter.

"The living chamber is incomplete, and is a trifle over one-fourth of a volution in length. The narrowing of the abdomen with increase of age is very marked on the living chamber in this specimen. It measures 192 mm. in length along the abdomen, 73 mm. in the abdomino-dorsal diameter at the last septum, and about 52 mm. in the transverse diameter at the umbilical shoulders, and 34 mm. near the venter. The sides of the whorls are flattened and converge outwardly, so that the abdomen is considerably less in breadth than the dorsum in the large full grown stage. There is a shallow impressed zone upon the dorsum, which occupies about one-third of its width and is due to the slight rotundity of the abdomen and the small amount of involution in the coiling of the whorls. The umbilical shoulders stand out abrupt and broad, giv-

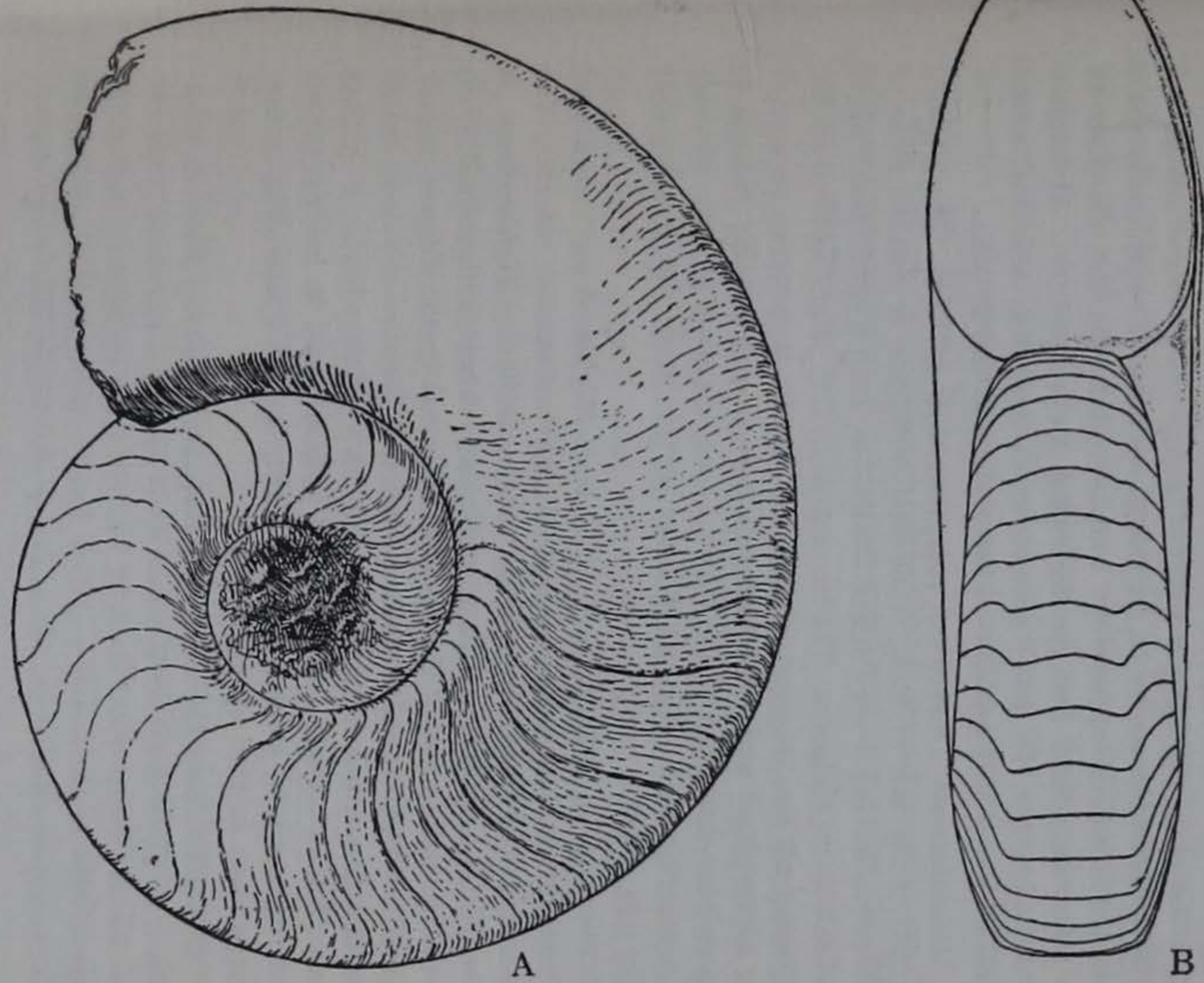

Figure 5.—Two views of the holotype of *Domatoceras umbilicatum* (Hyatt), x ½; from immediately above the Lexington coal (Cherokee), near Oswego, Kansas. Figure B is in part a restoration. After Hyatt. (See also text figure 2A.)

ing a depth to the wide umbilicus which is a marked characteristic. The sutures have shallow ventral [and] lateral lobes. The saddles at the umbilical shoulders are broad and extend inwards to the edges of the impressed zone, and then the sutures bend toward the apex, forming a shallow dorsal lobe. There are no annular lobes in the centre of the dorsal sutures. The siphon is above the centre and is apparently nummuloidal. At the diameter of 95 mm. the whorl has the following measurements: Abdomino-dorsal diameter, 41 mm.; transverse through the umbilical shoulders, 32 mm.; and breadth of the abdomen was 25 mm.

"*Domatoceras* (*Nautilus*) *complanatum,* sp. Sow. Min. Conc., Pl. 261, from Isle of Man, from Carboniferous, is another form of this genus having a very slight involution, with a compressed whorl and sub-acute abdomen. The involution is very slight in this species, exposing all the internal whorls, but in the transverse section of the outer whorl and in the sutures it is unquestionably related to the species described above. The living chamber is over one-half of a volution in length, but it is not certain from the drawing that it is completed.

"The species differs from (*Discites*) *Highlandense,* Meek and Worthen,[39] in being much larger, in having stouter whorls. The sutures are, however, evidently very similar. *Highlandense* is described as having a narrow periphery, whereas this shell when about the same size as the specimen figured in the Illinois survey has an abdomen almost as broad as the dorsum and very much broader proportionately than in its own adult whorl. It differs from (*Naut.*) *planovolve,* Shumard[40], in size and in having whorls with more rapid growth, and probably a wider and deeper umbilicus than in that species.

"It differs from the nearest European congener, *Kon. infundibulum,* as figured by De Koninck[41], in having a narrower abdomen and a more compressed form of whorl in the adolescent and adult stages; also in the sutures, which have a more marked abdominal lobe. It differs from *Kon.* (*Nautilus*) *podolskense,* Marie Tzwetaev[42],

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[39] F. B. Meek and A. H. Worthen: Descriptions of invertebrates. Illinois Geol. Survey, vol. 6, 1875, p. 531, pl. 33, fig. 2.

[40] B. F. Shumard and G. C. Swallow: Descriptions of new fossils from the Coal Measures of Missouri and Kansas. St. Louis Acad. Sci. Trans., vol. 1, 1858, p. 198.

[41] Op. cit., 1878, pl. 24, figs. 1a, 1b.

[42] Op. cit., pl. 3.

in the young. This is similar to the adult in the proportions of the parts, but in *K. podolskense* the young whorl has an abdomen broader than the dorsum. The adult of this species also has a broader abdomen than the adult of our shell. The species evidently stands just between the genus represented by such species as *Kon. ingens, implicatum,* described by De Koninck, and *K. podolskense,* all of which have stout whorls with broad abdomens, and whorls similar to those of the young of *K. umbilicatum,* and those species of the same genus having more contracted abdomens, like *mosquensis* (sp. Tzwetaev), *planotergatum* as figured by De Koninck, and *Highlandense* (sp. M. and W.).

"The last whorl was considerably altered by compression on one side, and the drawings of the section and front view (Figs. 2A, 5B) are in a measure restorations."

Remarks.—In 1893 Hyatt pointed out that the next-to-the-last paragraph of this description "has unfortunately brought an element of confusion into the forms attributed to this genus [*Domatoceras*], owing to errors in the manuscript caused by the introduction of the new generic name, Domatoceras, after the text had been written. Thus *D. umbilicatum* is there referred to as *Kon. umbilicatum.*" He then referred *Nautilus podolskensis, N. inostranzwei, N. mosquensis,* and *N. lasallenis* to *Domatoceras* and stated that *N.* (*Discites*) *highlandensis, Domatoceras simplex,* and *D. militarium* may be congeneric; he referred *N. ingens, N. implicatus, N. subcariniferus,* and *Temnocheilus scottensis* to *Koninckioceras* and *N. infundibulus* and *N. planotergatus* to *Coelonautilus*; and he stated that *N. complanatus* could not be referred safely to any genus as Sowerby's figure of the type specimen of that species is inaccurate.

In 1933 Miller, Dunbar, and Condra[43] studied a representative of this species "in the collections of the Geological Survey of Kansas, which has been sectioned to show the siphuncle in the last volution. This specimen shows that the siphuncle is smaller than Hyatt inferred and that it is definitely orthochoanitic, the septal necks being rather short and straight. It has a diameter of only 2.5 mm. where the whorl has a height of 45 mm. Its position is a little below the center of the whorl, the distance from its center to the dorsum being 26 mm. and to the venter 18 mm."

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[43] This specimen was studied by C. O. Dunbar and neither of the authors of the present report has seen it.

Occurrence.—Hyatt states only that the holotype came from Oswego, Kansas. However, Beede and Rogers state that it came from a strip pit one and one-half miles southeast of Oswego, and Professor R. C. Moore[44] has recently written us that "this is doubtless the horizon of the Lexington coal, which occurs immediately below the lower Fort Scott and we should place it in the very top of the Cherokee shale." Miller, Dunbar, and Condra did not state where the specimen referred to by them was collected.

Repository.—According to Hyatt the holotype is in the U. S. National Museum, and the specimen discussed by Miller, Dunbar, and Condra is stated by them to be in the collections of the Kansas Geological Survey.

DOMATOCERAS WILLIAMSI Miller and Owen, n. sp.

Plate XVI, figure 4; Plate XVII, figures 1-4; Plate XVIII, figure 1

Conch, which at maturity consists of about three and one-half volutions, is large, tarphyceraconic in its mode of growth, gradually expanded orad, and subdiscoidal in shape. On the mature portion of the conch the whorls are compressed laterally and are irregularly hexagonal in cross section. The ventral and lateral sides are essentially straight, the dorso-lateral sides are slightly convex, and the dorsal side is slightly concave. The ventro-lateral shoulders of the conch are so abrupt as to appear subangular; the dorso-lateral shoulders also are abrupt but they are rounded; and the junctions of the dorso-lateral and dorsal sides are angular. The lateral sides are much larger than are the dorso-lateral and they converge ventrad; the dorso-lateral sides converge dorsad; and the maximum width of the conch is therefore attained at the junctions of the lateral and the dorso-lateral sides, that is, at the umbilical shoulders. The ventral side is wider than the dorsal.

The largest representative of this species that we have seen attains a maximum diameter, measured from the adoral end of the venter across the umbilicus to the opposite side of the specimen, of at least 150 mm., and it is not complete orad. The large figured specimen (plate XVIII, figure 1), an internal mold, attains a maximum diameter of about 130 mm., a maximum height of conch of about 43 mm., and a maximum width of conch of about 36 mm.; near the adoral end of this specimen the ventral side of the conch

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[44] Personal communication, dated February 3, 1934.

is about 20 mm. wide, the lateral sides about 30 mm. wide, the dorso-lateral sides about 15 mm. wide, and the dorsal side about 16 mm. wide. The impressed zone is very shallow and where the conch is about 25 mm. high the impressed zone is only about 1½ mm. deep.

Due to the rather loose coiling of the conch the umbilicus is wide and it is perforate. The umbilical perforation is oval in shape and that of one of the figured specimens (plate XVII, figure 2) is about 6¼ mm. long and 4 mm. wide. The diameter of the umbilicus is equal to slightly more than half the diameter of the specimen, and the maximum diameter attained by the umbilicus of the large figured specimen (plate XVIII, figure 1) measures about 70 mm. The umbilical shoulders though abrupt are rounded, and the umbilical walls are stepped but are not very steep.

None of the specimens available for study retains the apertural margins, but the growth-lines indicate that the aperture was marked ventrally by a broad deep depressed-U-shaped hyponomic sinus.

The extreme adapical portion of the conch is subcircular in cross section—there is of course no impressed zone on the first volution. At the adoral end of the first volution the lateral and ventral (but not the dorsal) sides of the conch are greatly flattened but the lateral sides do not converge ventrally and the conch is distinctly depressed dorso-ventrally. At the adoral end of the second volution the maximum width and height of the conch are approximately equal and the lateral sides of the conch converge ventrad slightly; orad of there the conch becomes progressively more strongly compressed laterally and as the lateral sides converge ventrally more and more strongly the ventral side becomes relatively narrow.

The surface of the test is marked by numerous fine growth-lines. On the dorso-lateral sides of the conch these are nearly straight. On the lateral sides they are sigmoidal as they form broad shallow sinuses on the dorsal half of these sides and similar salients on the ventral half. On the ventral side of the conch the growth-lines form deep rounded depressed-U-shaped sinuses. On the inner volutions of the conch there is a rather narrow shallow groove with definite borders just inside (ventrad of) each ventro-lateral shoulder of the conch but these grooves apparently do not exist on the outer volution. The growth-lines are continuous across these grooves and they appear to be more than ordinarily prominent as they cross the narrow subangular ventro-lateral shoulders of the conch. On the

outer volution of large mature specimens a row of blunt narrowly rounded rather prominent nodes is gradually developed on each of the ventro-lateral shoulders—these nodes first become discernible when the conch has attained a diameter of some 55 or 60 mm. and they rapidly increase in prominence adorally; they are longitudinally elongate and are more or less confluent. On the adoral portion of the outer volution of large mature specimens a row of low and rounded but rather prominent transversely elongate nodes or short ribs is developed on each of the dorso-lateral shoulders; these do not extend far dorsad but they extend at least halfway across the lateral sides; they first become discernible when the conch has attained a maximum diameter of some 65 or 70 mm. and they rapidly increase in prominence adorally. There does not appear to be any relation between the spacing of these nodes and those developed on the ventro-lateral shoulders but this needs verification. Both the ventro-lateral and the dorso-lateral nodes are formed by a thickening of the test and therefore not more than a trace of them is discernible on the internal mold. The internal mold is essentially smooth with the exception of a small rounded inconspicuous ridge or raised line along the venter.

The camerae are rather short and about four or four and one-half of them occur in a length equal to the height of the conch. On the extreme adapical portion of the conch the sutures are straight and form simple circles but orad of there they gradually become slightly sinuous, and on the mature portion of the conch each suture forms a broad shallow broadly rounded ventral lobe and on either side of it a subangular saddle which centers on the ventro-lateral shoulder of the conch, a very broad relatively shallow broadly rounded lateral lobe, and a low broad subangular dorso-lateral saddle which centers on the umbilical seam and extends to the broad shallow broadly rounded dorsal lobe on the impressed zone; each suture form a single broad lobe as it crosses the lateral and dorso-lateral sides of the conch but there is a marked decrease in

Figure 6.—Diagrammatic representation of a mature suture of *Domatoceras williamsi*, n. sp., x 1; based on a specimen from immediately above the Tebo coal (Cherokee), in Henry County, Missouri—this is the same specimen that is represented by figures 2-4 on plate XVII.

the amount of its adoral curvature as it crosses the umbilical shoulder and continues to the umbilical seam.

Siphuncle small, circular in cross section, located distinctly nearer the venter than the dorsum, and orthochoanitic in structure; the septal necks are short and straight—their length is equal to about one-eighth the length of the camerae—and the connecting rings are not expanded within the camerae so the segments of the siphuncle are cylindrical in shape (see plate XVI, figure 4). In one of the figured specimens (plate XVII, figure 4), where the conch is about 26 mm. high the siphuncle is slightly less than 2 mm. in diameter and is located about 10 mm. from the venter.

Remarks.—We have more than twenty representatives of this species, all of which came from the Cherokee of Missouri. The specific name is given in honor of Dr. James S. Williams of the U. S. Geological Survey.

It is quite possible that the type specimens of this species are conspecific with those of *Domatoceras umbilicatum* Hyatt of the Cherokee of Kansas, *D. mosquense* (Tzwetaev) of the Upper Carboniferous (Dewiatowo oölite) of central Russia, or *D. sculptile* (Girty) of the Wewoka formation (Marmaton) of Oklahoma. Unfortunately the precise relationship between the types of these four species can not be determined from the available material. Only internal molds of *D. umbilicatum* are known, and the only published illustrations of that species are not entirely satisfactory as they are in part restorations; if they are accurate, the conch of that species is relatively higher than that of the other three species under consideration—also the holotype of that species is much larger than any known representative of the other three species. The mature portions of the conch of *D. mosquense* are known from only the internal mold and therefore adequate comparisons are not possible; the internal mold of that form is very similar to that of *D. williamsi* but the exterior of the test may well be quite different. *D. sculptile* is known from only relatively small testaceous specimens, and whereas these are strikingly similar to equisized specimens of *D. williamsi*, there is no good reason to assume that the Wewoka form attains as large a size as does *D. williamsi* and that its adoral portions are precisely similar to those of *D. williamsi*. Any or all of these four forms may prove to be conspecific. *D. highlandense* (Worthen) of the McLeansboro of Illinois is also very similar to *D. williamsi* but it is so poorly known that adequate comparisons

are not possible; nevertheless, at least on the lateral sides of its conch the sutures of *D. highlandense* are less strongly curved than are those of *D. williamsi,* and these two forms are almost certainly not conspecific.

Mr. Harold Stoneman of Springfield, Missouri, has deposited in the John Britts Owen collection a poorly preserved specimen (number 618) from the Graydon Springs sandstone (Cherokee) near Springfield, Missouri, which is clearly referable to the genus *Domatoceras* and which may represent the species under consideration. Unfortunately this specimen is so poorly preserved and incomplete that its specific affinities can not be determined with any degree of certainty.

Occurrence.—All of the representatives of this species we are studying came from the Cherokee of Missouri; most of them (including all of the figured specimens) came from immediately above the Tebo coal in Henry County, but three of them came from immediately above an unnamed local coal 10-15 feet below the Jordan coal in the England strip pit (sec. 17, T. 41 N., R. 25 W.) in Henry County, and another came from immediately above the Rich Hill coal (near the middle of the Cherokee) about 1½ miles northeast of Arthur, Vernon County, Missouri, that is, from a strip pit located in the NW¼NW¼ sec. 4, T. 37 N., R. 31 W.

Repository.—All but one of the specimens we are studying (cotypes) are in the private collection of John Britts Owen, Clinton, Missouri, where they are numbered 563-581, inclusive; the other cotype (the one from above the Rich Hill coal in Vernon County, Missouri) is number 676 in the paleontological collections of the State University of Iowa. The figured specimens are numbered as follows: 563 (plate XVIII, figure 1), 564 (plate XVII, figures 2-4), 565 (plate XVII, figure 1), and 566 (plate XVI, figure 4). The two specimens from below the Jordan coal in Henry County, Missouri, are numbered 567.

Genus Solenochilus Meek and Worthen 1870

Solenochilus capax (Meek and Worthen)

1865. *Nautilus (Cryptoceras) capax* Meek and Worthen, Acad. Nat. Sci. Philadelphia Proc., p. 262.

1875. *Nautilus (Cryptoceras) capax* Worthen and Meek, Illinois Geol. Survey, vol. 6, p. 532, pl. 33, figs. 1, 1a.

1891. *Asymptoceras capax* Hyatt, Texas Geol. Survey Ann. Rep. 2, pp. 346, 347.
1893. *Solenocheilus capax* Hyatt, Texas Geol. Survey Ann. Rep. 4, p. 460.
1898. *Asymptoceras capax* Weller, U. S. Geol. Survey Bull. 153, p. 101.
1933. *Solenochilus capax* Miller, Dunbar, and Condra, Nebraska Geol. Survey Bull. 9, ser. 2, p. 230.

The holotype and only known representative of this species has been well described and illustrated by Worthen and Meek, and since their publication is readily available to most geologists there is no need for us to duplicate this work. The broad conch and the ventral siphuncle of this form clearly indicate that it should be referred to *Solenochilus*, the genotype of which is *S.* [*Nautilus* (*Cryptoceras*)] *springeri* (White and St. John) of the Upper Pennsylvanian of Adair County, Iowa. Meek and Worthen referred this species to *Cryptoceras* d'Orbigny 1850, but that name is invalid as it is a homonym of *Cryptoceras* Barrande 1846—it is to be supplanted by *Solenochilus* Meek and Worthen 1870.

In 1891 Hyatt referred this species to *Asymptoceras* Ryckholt 1852 and stated that he believed that *Solenochilus* should be suppressed as a synonym of *Asymptoceras*, the genotype of which is *A.* [*Nautilus*] *cyclostomum* (Phillips) of the Lower Carboniferous of England and Ireland and possibly Belgium and Russia. However, by 1893 Hyatt had become aware of the fact that the genotype of *Solenochilus* is not congeneric with that of *Asymptoceras*, and he therefore recognized the validity of both genera; this conclusion he expressed again in 1900 in the Zittel-Eastman *Text-book of Palaeontology* (p. 525), which was the last time he dealt with these genera. In 1893 he apparently believed that the species under consideration, *S. capax*, should be referred to the genus *Solenochilus*.

Occurrence.—Cherokee at Charboniere, Saint Louis County, Missouri.

Solenochilus newloni (Hyatt)

Text figures 7A, 7B

1891. *Asymptoceras Newloni* Hyatt, Texas Geol. Survey Ann. Rep. 2, pp. 346-347, text figures 48, 49.
1893. *Asymptoceras Newloni* Hay, Kansas Acad. Sci. Trans., vol. 13, p. 45.
1904. *Asymptoceras newloni* Beede and Rogers, Kansas Univ. Sci. Bull., vol. 2, no. 15, pp. 461, 463.

No representative of this species other than the holotype has ever been found. Hyatt described the holotype as follows:

"The species in hand is a fragment very similar to *As.* (*Cryptoceras*) *capax,* Meek and Worthen.[45] There are three air chambers incompletely preserved in the cast. The last two sutures are 17 mm. apart on the venter. The increase in size is very rapid, being as much as 46 mm. in the greatest transverse diameter to 68 mm., a difference of 22 mm. in a distance of only 51 mm., as measured along the centre of the venter, and only 35 mm. as measured along the side of the whorl.

"These measurements show a more rapid increase than in the whorl of *Asympt. capax.* The sutures are not only wider apart than in that species, but the form of the whorl also differs. In the figure of *As. capax* the greatest diameter of the living chamber is above or external to the umbilical shoulder, whereas in this species it is at the umbilical shoulder. The sides converge outwards from these shoulders and are not gibbous as in *capax,* and in the living chamber, which is evidently very nearly complete on one side, the whorl becomes flatter or more depressed on the abdomen than in *capax,* and the flaring of the aperture at the umbilical shoulders carries the lateral angles out with great rapidity. The diameter through the widest part of the whorl at the last suture is 68 mm., at a point about half way between this and the aperture about 82 mm., through the wings themselves not less than 120 mm., and perhaps a little more in perfect specimens.

"The sutures have a distinct but very shallow broad lobe on the venter, which is irregularly interrupted by the siphon, and there are also shallow lateral lobes. In some specimens the sutures are very likely continuous, as they are in the figure of *capax.* If the side view of the sutures in the figure of *capax* is correct, these differ decidedly from those of this species. This shell differs from *Asym. Springeri* in having less angular umbilical shoulders, a more depressed abdomen, and more convergent sides. In fact, *Springeri* and *capax* resemble each other more than either of them resemble this species.[46]

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[45] A. H. Worthen and F. B. Meek: Descriptions of invertebrates. Illinois Geol. Survey, vol. 6, 1875, p. 532, pl. 33, figs. 1, 1a.

[46] "The species has been dedicated to Dr. W. S. Newlon, of Oswego, who found and sent the specimen, with some others described in this paper, to the National Museum."

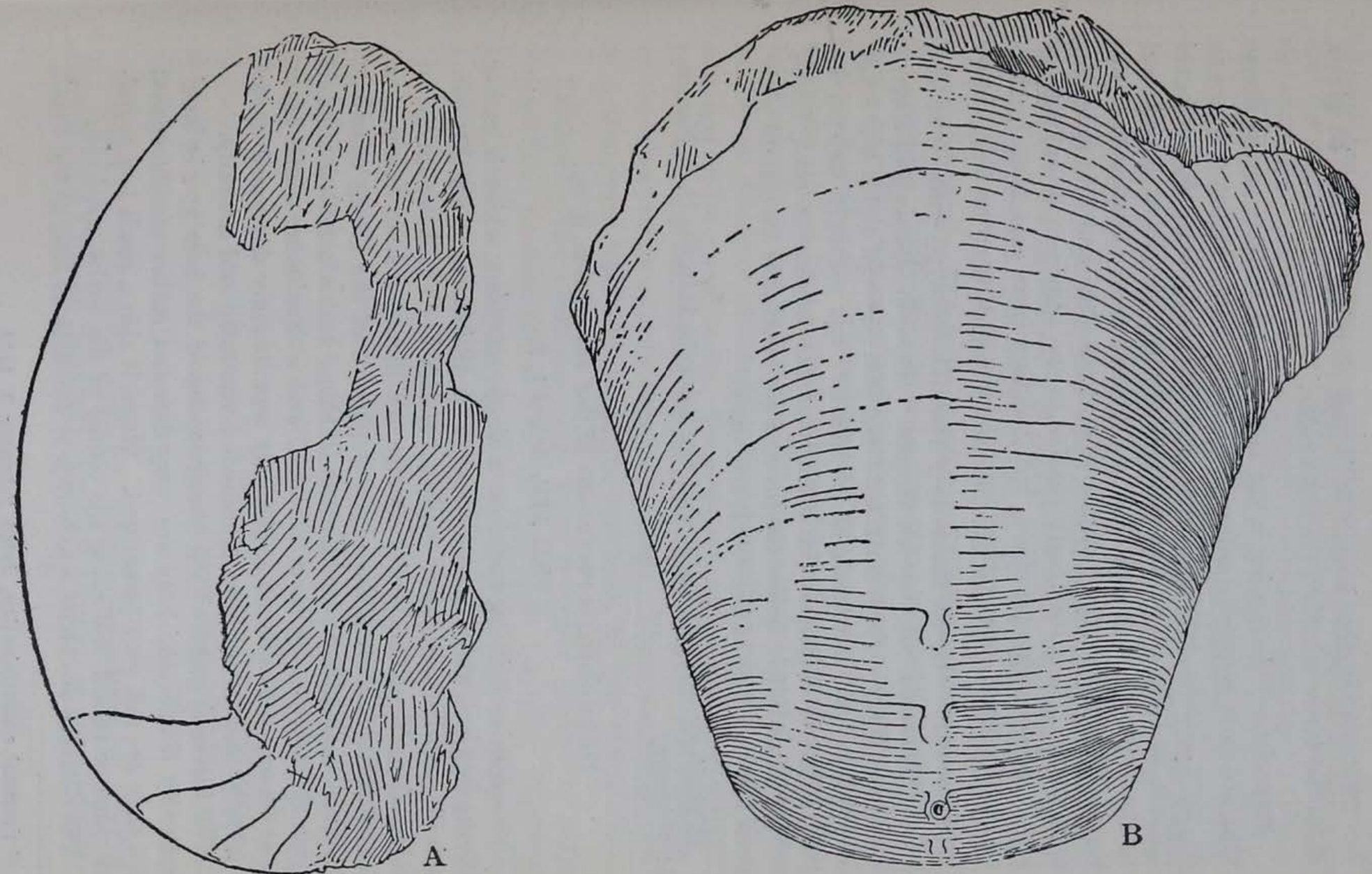

Figure 7.—Two views of the holotype of *Solenochilus newloni* (Hyatt), x 9/10; from immediately above the Lexington coal (Cherokee), near Oswego, Kansas. After Hyatt.

"The comparative length of living chamber can not be given, since the inner whorls were not visible."

Remarks.—This species is not very similar to most of the forms that are now generally referred to *Solenochilus*, but it appears to be more closely related to the type of that genus, *S. springeri* (White and St. John) of the Upper Pennsylvanian of Iowa, than to the type of *Asymptoceras, A. cyclostomum* (Phillips) of the Lower Carboniferous of England and possibly Ireland, Belgium, and Russia. It is strikingly similar to the specimen described below as *Solenochilus peculiare*, but it differs from that form in that its sutures form lobes rather than saddles as they cross the venter.

Occurrence.—Hyatt states only that the holotype came from the "Coal Measures" of Oswego, Kansas. However, Beede and Rogers state that it came from a strip pit one and one-half miles southeast of Oswego, and Professor R. C. Moore[47] has recently written us that "that is doubtless the horizon of the Lexington coal, which occurs immediately below the lower Fort Scott and we should place it in the very top of the Cherokee shale."

Repository.—Hyatt states that the holotype is in the U. S. National Museum.

Solenochilus peculiare Miller and Owen, n. sp.

Plate XIX, figures 1, 2

This species is being based on a single specimen which is rather incomplete but which is so distinct from all known forms that conspecific specimens can be readily identified. The holotype is an internal mold of the ventral portion of the adoral six camerae of the phragmacone and the adjacent portion of the living chamber. When complete, it was subglobose in shape and it attained a maximum diameter of at least 135 mm. and a maximum width of at least 85 mm. The conch apparently was strongly depressed dorsoventrally and it was broadly rounded ventrally and laterally.

The internal mold of the phragmacone of the holotype is longitudinally lirate—the lirae are very fine and rather closely spaced but they are not very prominent. There is also a small low rounded ridge or raised line along the venter of the entire specimen.

The camerae are about one-fourth or one-fifth as long as the conch

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[47] Personal communication, dated February 3, 1934.

is wide, but those of the holotype become progressively shorter orad and the extreme adoral camerae are very short—this indicates that the specimen represents a late mature or gerontic individual. Each suture forms a low broad shallow broadly rounded ventral saddle and on either side of it a similar lobe, a similar but slightly broader ventro-lateral saddle, and a broad very shallow scarcely recognizable lateral lobe which presumably is followed by a saddle on the umbilical shoulder.

The siphuncle is relatively small and it is ventral and marginal in position and apparently was in contact with the ventral wall of the phragmacone. The preservation of the siphuncle of the holotype is not all that could be desired, but apparently its structure is very unusual. The septal necks are about two-fifths as long as the camerae. They appear to be somewhat expanded a short distance apicad of the septa and then rather abruptly contracted near their adapical ends. The connecting rings appear to be pyriform in shape, that is, they appear to be contracted rather abruptly near their adoral end and rather gradually near their adapical end. The maximum diameter attained by the connecting rings exceeds that attained by the septal necks. The segments of the siphuncle appear to bear a sharp subangular transverse constriction at the junction of the septal necks and the connecting rings. There is a suggestion of a transverse partition across the siphuncle at this constriction.

Remarks.—The above-described form is closely similar to only *Solenochilus newloni* (Hyatt) of the uppermost Cherokee (Lexington coal horizon), near Oswego, Kansas. Hyatt's figures of the type specimen of that species show that at least the connecting rings of the siphuncle of *S. newloni* are strikingly similar to those of *S. peculiare*. The sutures of *S. newloni* form lobes rather than saddles as they cross the venter and this character serves to differentiate the two species. It may be that because of their relatively narrow conchs and peculiar siphuncles these two forms should not be placed in the same genus with most of the species that have been referred to *Solenochilus*, but it does not seem feasible to eliminate them from that genus at present, particularly when so little information is available in regard to the genotype.

Occurrence.—Holotype and only known representative of this species came from an unnamed limestone member of the Cherokee

formation, 10-15 feet below the Jordan coal, England strip pit (sec. 17, T. 41 N., R. 25 W.), Henry County, Missouri.

Repository.—Private collection of John Britts Owen, Clinton, Missouri, No. 508.

PLATES VIII-XIX

PLATE VIII

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Figures 1-4.—*Brachycycloceras longulum* Miller and Owen, n. sp. 208

1.—Lateral view (unretouched photograph) of the longest of the cotypes, x 2; from immediately above the Tebo coal (Cherokee), Henry County, Missouri.

2-4.—Lateral and septal views of another of the cotypes, x 2, and enlarged view (unretouched photograph, x 8) of the adoral median portion of the same specimen showing the details of the surface markings of the test; from immediately above the Lexington coal (Cherokee), Henry County, Missouri.

Figure 5.—*Bactrites? cherokeensis* Miller and Owen, n. sp. 206

Septal (apical) view of the holotype, x 1; from below the Jordan coal (Cherokee), Henry County, Missouri. See also figure 3 on plate X.)

Figure 6.—*Pseudorthoceras knoxense* (McChesney) 196

Lateral view (unretouched photograph, x 2) of a typical specimen showing the characteristic curvature of the extreme adapical portion of the conch; from immediately above the Tebo coal (Cherokee), Henry County, Missouri.

Figures 7-9.—*Poterioceras bransoni* Miller and Owen, n. sp. 199

7.—Ventro-lateral view of one of the paratypes, x 1; from immediately above the Tebo coal (Cherokee), Henry County, Missouri.

8.—Ventro-lateral view (unretouched photograph, x 2) of another of the paratypes, showing the transverse growth lines on a fragment of the test that adheres to the internal mold; from immediately above the Lexington coal (Cherokee), Henry County, Missouri.

9.—Lateral view (unretouched photograh, x 2) of a small specimen representing only the extreme adaptical portion of the conch; from immediately above the Lexington coal (Cherokee), Henry County, Missouri. (See also figure 1 on plate IX.)

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Miller and Owen, Cherokee Nautiloids

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Miller and Owen, Cherokee Nautiloids

PLATE IX

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Figure 1.—*Poterioceras bransoni* Miller and Owen, n. sp. 199
Ventro-lateral view (x 3/5) of the holotype—the venter is on the reader's left—from immediately above the Lexington coal (Cherokee), Henry County, Missouri. (See also figures 7-9 on plate VIII.)

PLATE X

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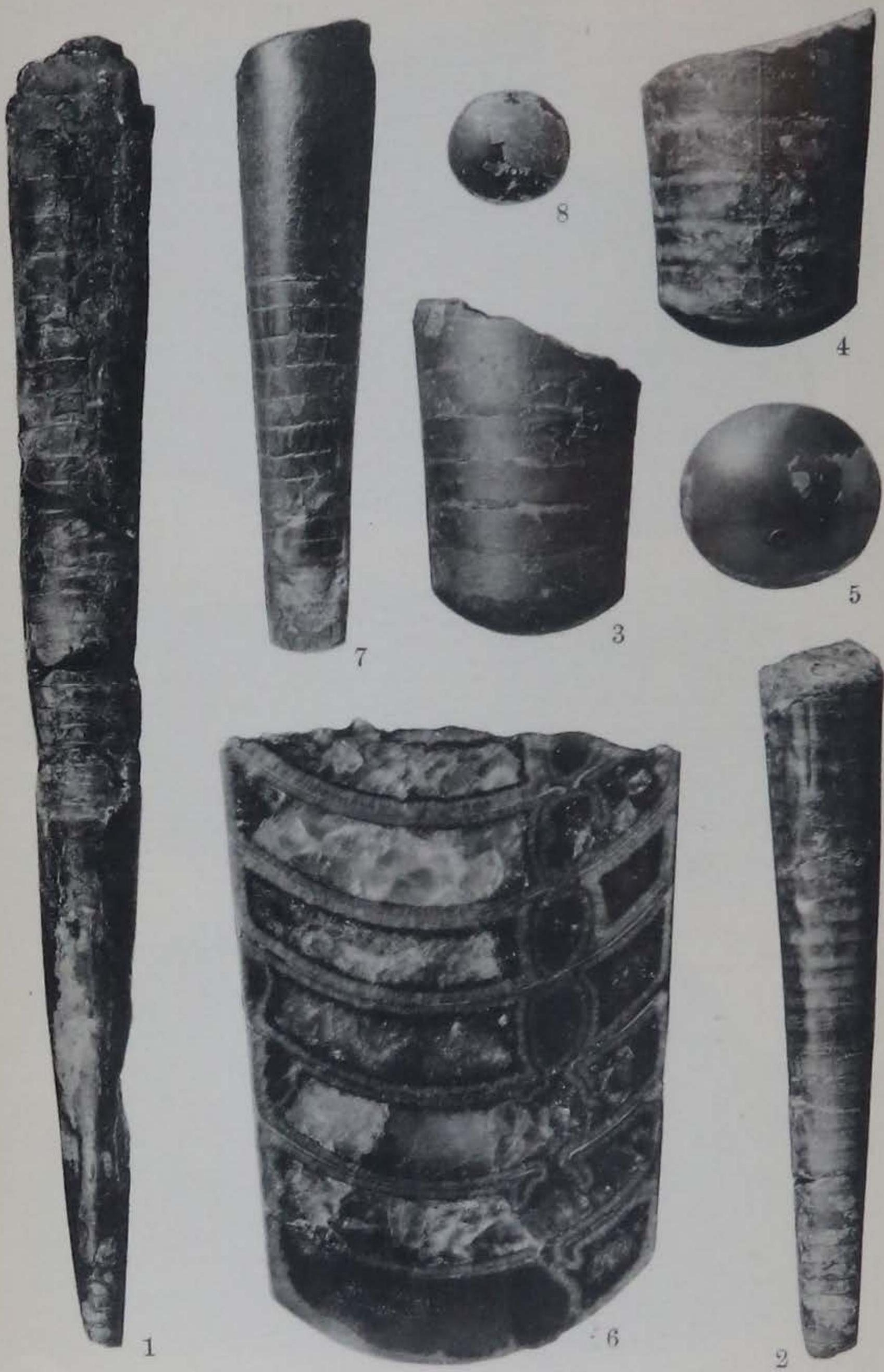
Figures 1,2.—*Posterioceras mehli* Miller and Owen, n. sp. 201

Lateral and ventral views of the holotype, x ¾; from immediately above the Lexington coal (Cherokee), Henry County, Missouri.

Figure 3.—*Bactrites? cherokeensis* Miller and Owen, n. sp. 206

Lateral view of the holotype, x 1; from below the Jordan coal (Cherokee), Henry County, Missouri. (See also figure 5 on plate VIII.)

Miller and Owen, Cherokee Nautiloids



Miller and Owen, Cherokee Nautiloids

PLATE XI

PLATE XII

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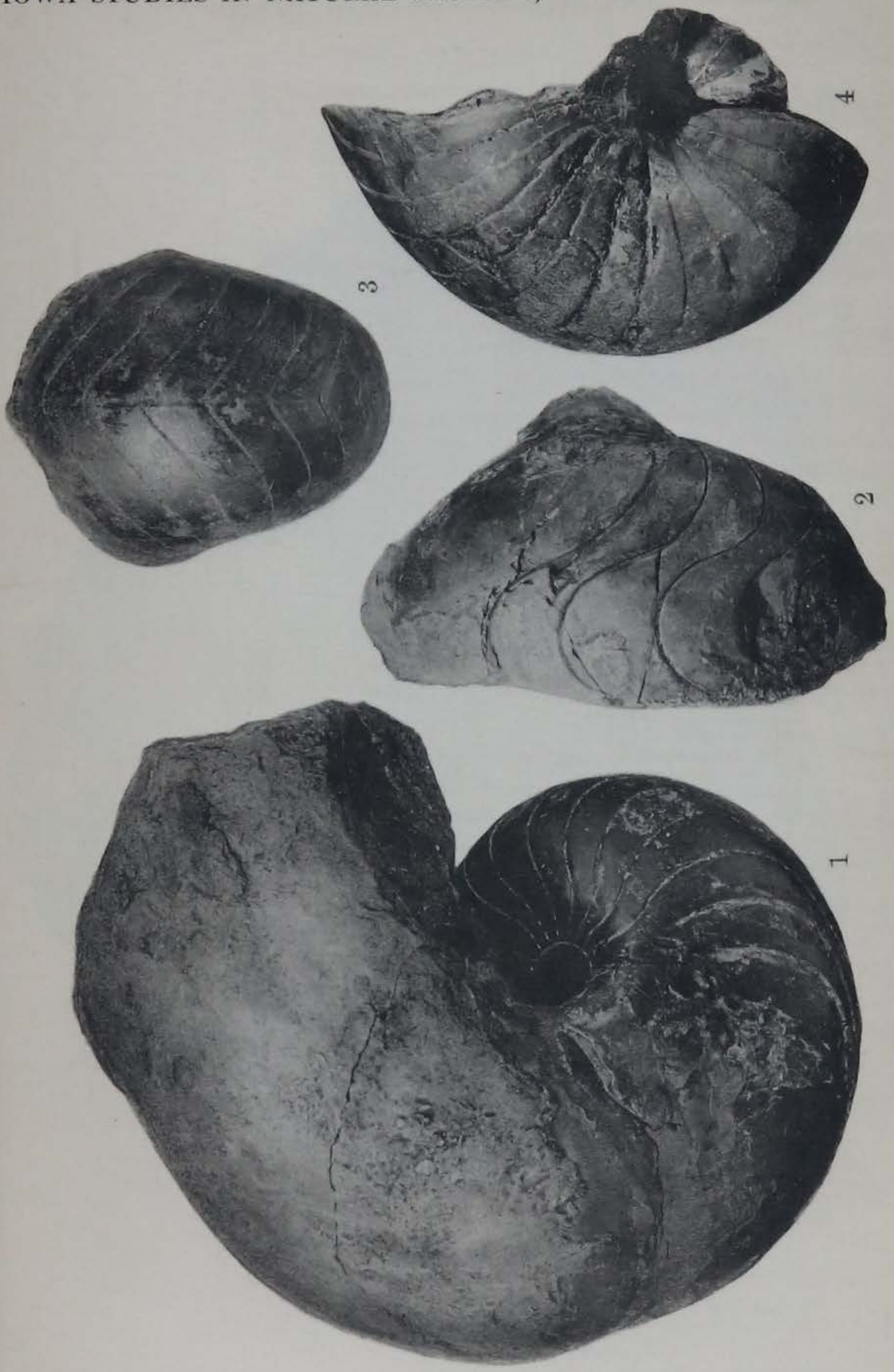
Figures 1,2.—*Megaglossoceras pristinum* Miller and Owen, n. sp. 214

Lateral view of holotype and ventral view of all but adoral portion of same, x 1; from below Jordan coal (Cherokee), Henry County, Missouri.

Figures 3,4.—*Ephippioceras ferratum* (Cox) 209

Ventral and lateral views, x 2, of two specimens from immediately above the Tebo coal (Cherokee), Henry County, Missouri.



Miller and Owen, Cherokee Nautiloids

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Miller and Owen, Cherokee Nautiloids

PLATE XIII

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Figure 1.—*Temnocheilus harneri* Miller and Owen, n. sp. 223

Lateral view (unretouched photograph) of the holotype, x 1; from immediately above the Tebo coal (Cherokee), Henry County, Missouri. (See also figure 1 on Plate XIV.)

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Miller and Owen, Cherokee Nautiloids

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Miller and Owen, Cherokee Nautiloids

PLATE XV

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Figures 1-5.—*Parametacoceras bellatulum* Miller and Owen, n. sp. 223

1-3.—Three views of the holotype, x 2; from immediately above the Lexington coal (Cherokee), Henry County, Missouri. Figures 2 and 3 are unretouched photographs.

4.—Septal view (unretouched photograph) of a paratype, an early mature specimen, x 2; from immediately above the Lexington coal (Cherokee), Lafayette County, Missouri.

5.—Lateral view (unretouched photograph) of another paratype showing the details of the surface ornamentation, x 2; from immediately above the Lexington coal (Cherokee), Henry County, Missouri.

Figures 6-8.—*Knightoceras missouriense* Miller and Owen, n. sp. 219

Ventral, lateral, and apical views of the holotype, x 2; from immediately above the Tebo coal (Cherokee), Henry County, Missouri. Figures 6 and 7 are unretouched photographs.

PLATE XVI

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Figures 1,2.—*Metacoceras mutabile* Miller and Owen, n. sp. 226

1.—Lateral view (unretouched photograph) of the holotype, slightly more than x 1; from immediately above the Tebo coal (Cherokee), Henry County, Missouri.

2.—Cross section of the living chamber of a paratype, x 1; from immediately above the Tebo coal (Cherokee), Henry County, Missouri.

Figure 3.—*Coloceras* sp. 217

Ventral view of a rather fragmentary specimen, x 2; from immediately above the Tebo coal (Cherokee), Henry County, Missouri.

Figure 4.—*Domatoceras williamsi* Miller and Owen, n. sp. 246

Mediam longitudinal dorso-ventral section (unretouched photograph) of part of two volutions of a typical specimen showing the structure of the siphuncle, x 2; from immediately above the Tebo coal (Cherokee), in the Tillman strip pits (NE¼NE¼ sec. 23, T. 42 N., R. 26 W.), Henry County, Missouri. The connecting rings are not preserved in the adoral camera of the outer volution but the septal necks are very distinct there. (See also figures 1-4 on plate XVII and figure 1 on plate XVIII.)

Figures 5-7.—*Metacoceras biseriatum* Miller and Owen, n. sp. 229

Ventral, apical, and lateral views (unretouched photographs) of the holotype, x 1; from immediately above the Lexington coal (Cherokee), Henry County, Missouri.

Figures 8,9.—*Metacoceras* sp. 231

Ventral and septal views (unretouched photographs) of a fragment of a large representative of the genus *Metacoceras*, x 1; from immediately above the Tebo coal (Cherokee), Henry County, Missouri.

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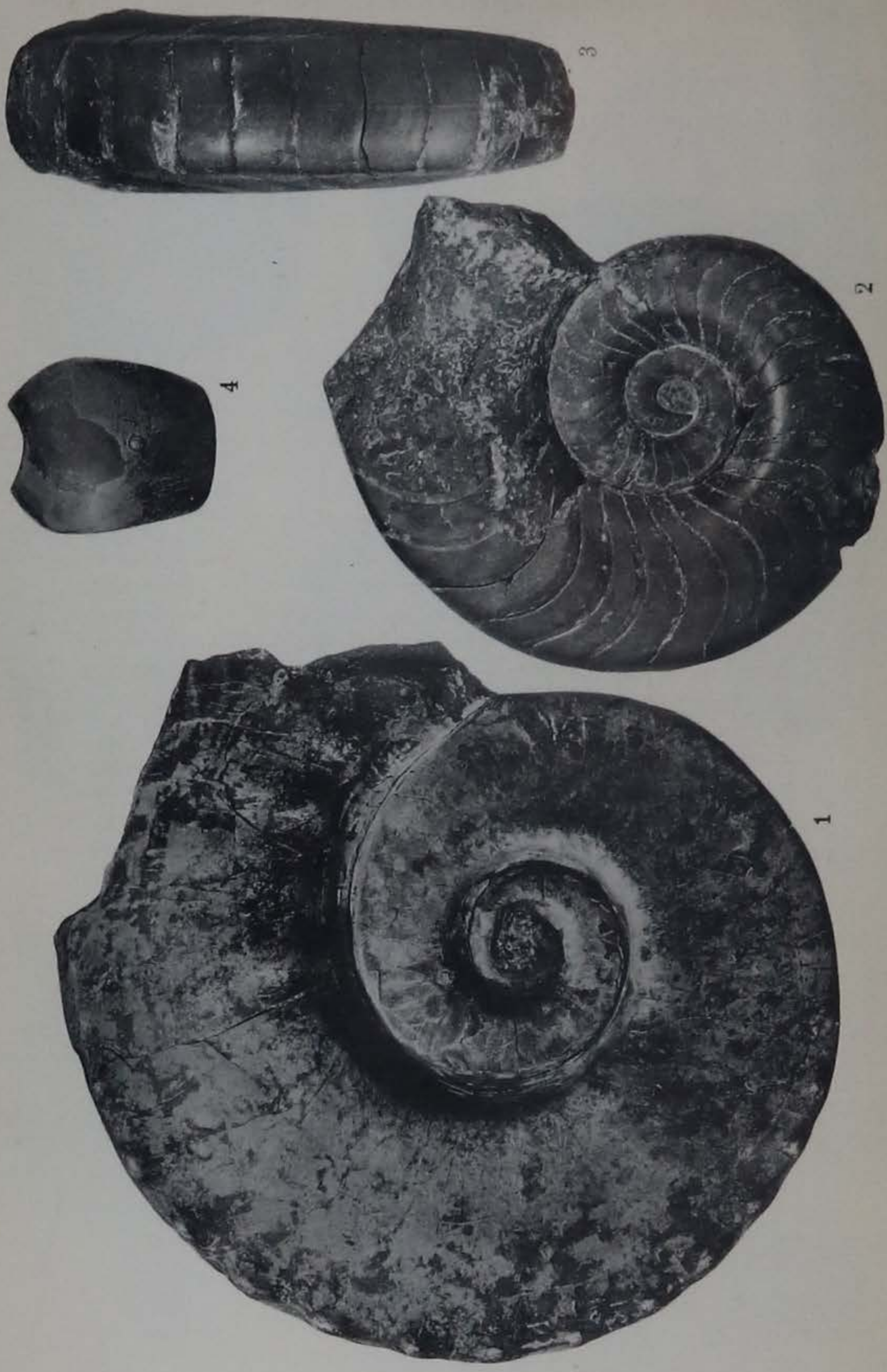
Miller and Owen, Cherokee Nautiloids



Miller and Owen, Cherokee Nautiloids

PLATE XVII

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Figures 1-4.—*Domatoceras williamsi* Miller and Owen, n. sp. 246

1.—Lateral view of one of the cotypes, a large testaceous specimen, showing the ventro-lateral nodes on the adoral half of the outer volution and the dorso-lateral nodes or short ribs on the adoral fourth of the outer volution, x 1; from imediately above the Tebo? coal (Cherokee), in the Bowens mine near Windsor, Henry County, Misouri.

2-4.—Lateral, ventral, and septal views of another of the cotypes, a well-preserved internal mold, x 1; from immediately above the Tebo coal (Cherokee) in the Vansant strip pit sec. 22, T. 41 N., R. 27 W.), Henry County, Missouri. Figures 2 and 3 are unretouched photographs. Figure 4 represents the antepenultimate septum. A diagramatic representation of one of the adoral sutures of this specimen is given as text figure 6 on page 248. (See also figure 4 on plate XVI and figure 1 on plate XVIII.)

PLATE XVIII

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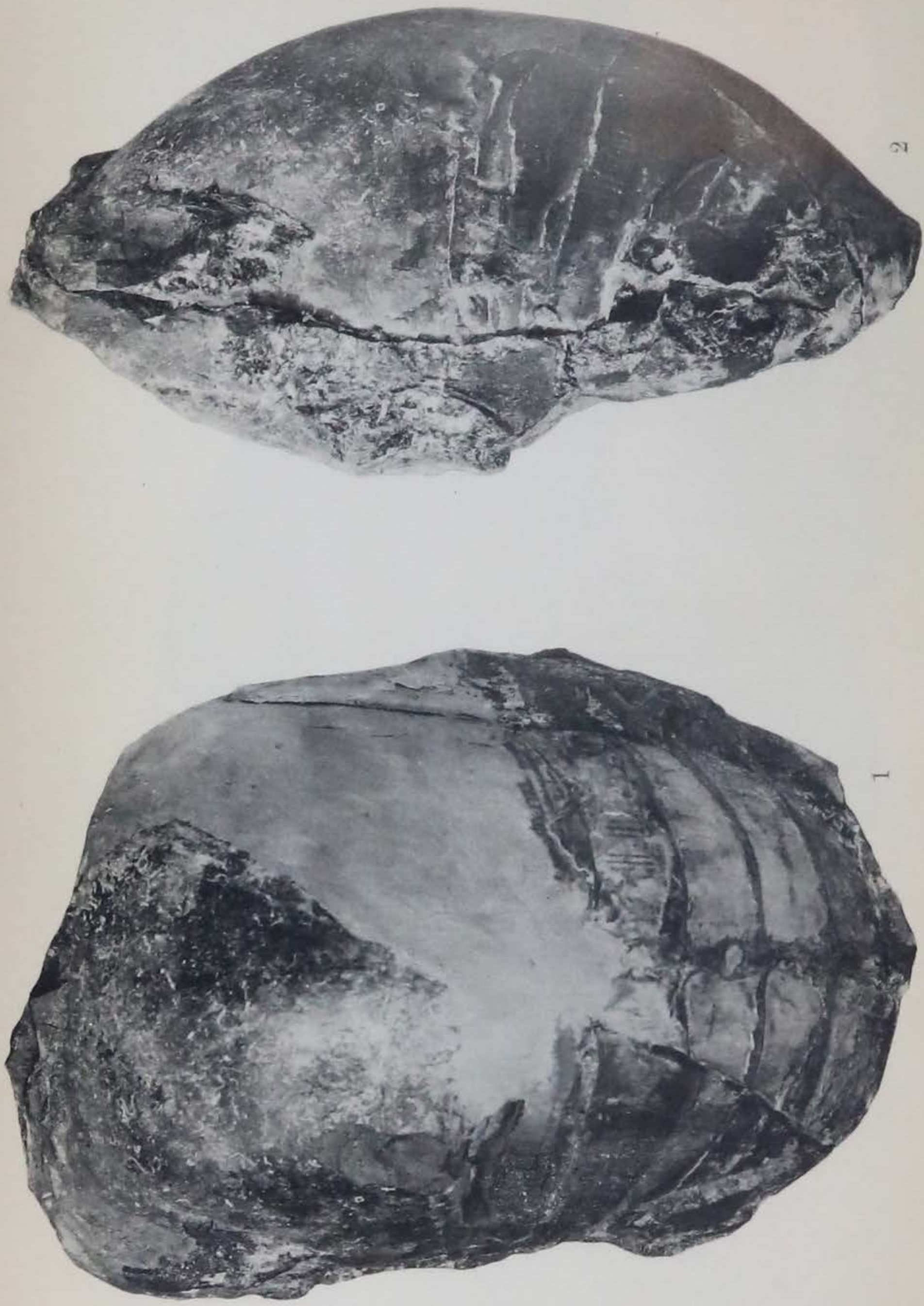
Miller and Owen, Cherokee Nautiloids



Miller and Owen, Cherokee Nautiloids

PLATE XIX

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Figures 1,2.—*Solenochilus peculiare* Miller and Owen, n. sp. 254
Ventral and lateral views of the holotype, x 9/10; from below Jordan coal (Cherokee), Henry County, Misouri.

INDEX

Asterisks refer to illustrations.

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