UNIVERSITY OF KANSAS
PALEONTOLOGICAL CONTRIBUTIONS

MOLLUSCA

ARTICLE 1
Pages 1-15, Plates 1-3, Figures 1-4

LOWER PERMIAN CEPHALOPODS FROM THE TEXAS COLORADO RIVER VALLEY

By A. K. MILLER and WALTER YOUNGQUIST

ARTICLE 2
Pages 1-11, Plates 1-5, Figures 1-2

A NAUTILOID CEPHALOPOD FAUNA FROM THE PENNSYLVANIAN WINTERSET LIMESTONE OF JACKSON COUNTY, MISSOURI

By A. K. MILLER, J. H. LANE, JR., and A. G. UNKLESBAY

UNIVERSITY OF KANSAS PUBLICATIONS
August 29, 1947

UNIVERSITY OF KANSAS
PALEONTOLOGICAL CONTRIBUTIONS

THE UNIVERSITY OF KANSAS PALEONTOLOGICAL CONTRIBUTIONS comprise publications of research in Paleontology carried on by personnel of the State Geological Survey of Kansas, the University of Kansas Museum of Natural History, or Departments concerned with the University of Kansas Science Bulletin; also, they may include reports of work by others done directly or indirectly under auspices of any branch of the University.

These publications are distributed from Lawrence, Kansas, being sent as exchanges to scientific institutions, libraries, and, on request, to individual specialists in paleontology throughout the world. Requests for numbers should be addressed to the Director of Libraries, University of Kansas, Lawrence, Kansas, accompanied by 25 cents for mailing charge of each number; payment of this charge is normally required in order to obtain copies.

The CONTRIBUTIONS are to be grouped in designated categories, such as Mollusca, within which the successive papers will be numbered in order, as article 1, article 2, and so on. Ultimately, title pages covering a group of these related articles will be issued, for use in binding them together as a volume.

Serial numbers that apply to the entire series of CONTRIBUTIONS, without reference to category, permit checking for completeness of accessions and, if desired, may be used for filing. This issue comprises CONTRIBUTIONS Nos. 2 and 3.

UNIVERSITY OF KANSAS PALEONTOLOGICAL CONTRIBUTIONS
MOLLUSCA, ARTICLE 1, PAGES 1-15, PLATES 1-3, FIGURES 1-4

LOWER PERMIAN CEPHALOPODS FROM THE TEXAS COLORADO RIVER VALLEY

A. K. MILLER and WALTER YOUNGQUIST

CONTENTS

ILLUSTRATIONS

ABSTRACT

The Camp Creek shale, exposed in the Colorado River Valley of central Texas, has yielded representatives of *Pseudorthoceras, Ephippioceras,* and *Artinskia;* and the Wildcat Creek shale the following cephalopod genera: *Pseudorthoceras, Bitaunioceras, Liroceras, Metacoceras, Stenopoceras, Neopronorites?, Artinskia, Pseudogastrioceras, Metalegoceras, Agathiceras, Peritrochia,* and *Properrinites.* It is concluded that both faunas are probably of Early Permian age.

INTRODUCTION

During the latter part of 1945, R. C. MOORE, working as representative of the United States Geological Survey, made a detailed study of the Lower Permian strata exposed in central Texas along the Colorado River. He secured and sent to us for study a few cephalopods from the Camp Creek shale in McCulloch County and a large collection from the Wildcat Creek shale [1] in Coleman County. In each case all the specimens came from a single locality.

The Camp Creek shale, which belongs in the

1. Name introduced here by R. C. MOORE for shale overlying the Hords Creek limestone and next below the Overall limestone (also new), which, in turn, underlies the Jim Ned shale. The Wildcat Creek shale is classed as a member of the Admiral formation.

Pueblo formation or group, lies between the Saddle Creek and the Stockweather limestones. According to BULLARD & CUYLER (1935, p. 245), it consists of 50 to 90 feet of alternating beds of gray or slightly ferruginous shale, sandstone, and thin limestone. Fossils are abundant at certain horizons, and the Camp Creek has yielded many fusulinids, corals, pelecypods, gastropods, trilobites, and a variety of brachiopods. However, insofar as we have been able to ascertain, no cephalopods have been reported from it previously, and we have only four specimens.[2] These represent three species, each of which belongs in a distinct genus. One of them is of little consequence as it is a small fragment that is probably referable to *Pseudorthoceras knoxense* (McCHESNEY), a nautiloid species that has long range in the Late Paleozoic. Two of the others represent a new species of *Ephippioceras,* and they have the distinction of being the youngest examples of that genus known. The other specimen is an exceptionally fine representative of *Artinskia,* and it marks the earliest known occurrence of that ammonoid genus in America. However, *Artinskia irinae* RUZHENCEV of the Upper Carboniferous of the Orenburg (Chkalov) region in the Southern Urals may be still older.

As several authors have pointed out—for example, CHENEY (1940), TOMLINSON & OTHERS (1940), and CHENEY & OTHERS (1945) — the Pennsylvanian-Permian boundary in this area should probably be drawn slightly below the Camp Creek shale. The cephalopods cannot be said to establish the correctness of this view, but they are certainly in harmony with it. That is, the occurrence of *Artinskia* in the fauna seems to mark the début in America of the medlicottids, which are widespread and abundant in the Permian and are generally thought to be characteristic of it. The genus *Artinskia* is known to occur in the Lower and Middle Permian of the Ural region, Timor, Texas, and Kansas, and possibly in the Uralian of the Southern Urals, and the Middle Permian of the Pamirs, Darwaz (Bokhara), and the Carnic Alps. It is a generally accepted paleontological principle that the last remnant of a genus is not nearly as significant as is the heralder of a new group. Thus, the presence in the Camp Creek of *Ephippioceras,* which has long been regarded as characteristic of the Mississippian and the Pennsylvanian, is overshadowed by the appearance of *Artinskia.* Furthermore, ammonoids are known to have greater stratigraphic value than nautiloids.

The great majority of the cephalopods in the collections under consideration came from about 600 feet above the Camp Creek shale in beds that for a long time were termed the Indian Creek shale. As WILMARTH (1938, p. 1009) has pointed out, the name Indian Creek was originally used by DRAKE (1893, p. 374, 386, 421, 423) for two stratigraphic units, one in the Permian (Admiral formation) and the other in the Pennsylvanian (Strawn group). SELLARDS (1933, p. 105, 170, 173) retained the name for the Pennsylvanian unit and discarded it for the Permian unit. Although the Permian name has had greater usage, the Pennsylvanian one has page precedence. The Permian "Indian Creek" shale is renamed Wildcat Creek shale by MOORE. CHENEY (1940, p. 95) proposed the name Fisk formation for this shale combined with overlying limestone which "occur above the Hords Creek formation and below the disconformity at the base of the Jim Ned shale." CHENEY adds that "wells near Fisk show a thickness of about 40 feet of limestone with thin shale partings, overlying 50-60 feet of shale with lenticular sandstones in the lower part."

The Wildcat Creek cephalopods come from outcrops about 4½ miles south-southwest of Coleman on the south side of the Santa Fe Railroad, about half a mile east of the Coleman-San Angelo highway. According to PLUMMER & SCOTT (1937, p. 18) the outcrop there is the "best fossiliferous locality" in this stratigraphic zone and it "was discovered by P. L. APPLIN in 1918." The fossils occur in nodules of light-yellow argillaceous limestone that contains a prolific molluscan fauna. The associated shale also yields abundant small mollusks, crinoid fragments, and brachiopods. In their well-known volume on the Late Paleozoic ammonoids of Texas, PLUMMER & SCOTT (1937) describe the following forms from this locality:

Artinskia adkinsi PLUMMER & SCOTT
Pseudogastrioceras admiralense (PLUMMER & SCOTT)
Metalegoceras colemanense PLUMMER & SCOTT
Agathiceras applini PLUMMER & SCOTT
Peritrochia sellardsi (PLUMMER & SCOTT)
Properrinites bösei bösei (PLUMMER & SCOTT)

To this assemblage, we are now able to add five species of nautiloids and one of ammonoids:

Pseudorthoceras knoxense (McCHESNEY)
Bitaunioceras texanum, n. sp.
Liroceras cf. *L. globulare* (HYATT)
Metacoceras cheneyi, n. sp.
Stenopoceras sp.
Neopronorites? sp.

By far the most abundant species in the fauna are *Pseudorthoceras knoxense* and *Agathiceras applini,* both of which are represented by a very large number of specimens in the collections we are studying. However, with the exception of *Bitaunioceras texanum, Stenopoceras* sp., *Neopronorites?* sp., and *Pseudogastrioceras admiralense,* all the other forms are well represented and cannot be said to be particularly rare.

Perhaps the most significant genera in the assemblage are *Artinskia, Pseudogastrioceras, Meta-*

2. According to R. C. MOORE, the locality from which all four of the Camp Creek cephalopods "and many other fine fossils came is in the east-central part of the E. R. Crockett Survey No. 92, 6 miles west, 1.5 miles north of Fife; exposures west of Saddle Creek on east side of prominent east-facing escarpment at point 1,500 feet south of north tip of the escarpment; also 3,000 feet south of east-west road at point 0.6 mile west of its crossing of Saddle Creek. The locality is 1.2 miles straight south of the mouth of Saddle Creek and 0.6 mile west. The horizon is limestone in the Camp Creek shale, 24 feet above top of Saddle Creek limestone."

legoceras, and particularly *Properrinites.* The occurrence of all these genera together leaves no doubt as to the Early Permian age of the containing beds. In general, this fauna resembles that known from the Wolfcamp formation of western Texas. However, the occurrence of *Pseudogastrioceras* here was hardly to be expected, and its presence may indicate that the fauna is slightly younger than any fossils known from the type Wolfcamp. This possibility is also suggested by the fact that *Properrinites bösei* is more advanced than *P. bakeri* of the Wolfcamp.

CHENEY (1940, p. 96) states that it "appears necessary to place the top of the Wolfcamp series [immediately] above the *Artinskia adkinsi* zone of the Fisk formation" as there is "more evidence of important disconformity between the Fisk formation and the overlying Jim Ned shale than . . . at any other position in this part of the section below definite Leonard beds." Also, he adds that dolomite beds are rarely present below this horizon but become an important part of the overlying strata. It should be noted that this procedure would draw the boundary between the Wolfcamp and Leonard series in the midst of the Wichita group, a term which CHENEY (1940, p. 97) therefore regards as no longer of much use. However, from a study of the cephalopods alone, we would be inclined to place the dividing line under consideration at the top of the Wichita group, for then the beds that contain *Properrinites* would be entirely in the Wolfcamp and those that contain *Perrinites* in the Leonard. In north-central Texas at least two cephalopod faunas are known from the upper part of the Wichita group, that is, from above the Wildcat Creek shale. One of these comes from south of Electra in Wichita County, just below the Beaverburk limestone, near the boundary between the Clyde and Belle Plains formations, and it consists of the following forms:

Artinskia electraensis PLUMMER & SCOTT
Agathiceras contractum PLUMMER & SCOTT
Peritrochia electraensis (PLUMMER & SCOTT)
Properrinites cumminsi vicinus MILLER & FURNISH

This assemblage is indeed reminiscent of that which occurs in the Wildcat Creek beds, about 500 feet lower in the section. Another cephalopod fauna has been described from just above the Beaverburk limestone at the "Old Military Crossing" on the Big Wichita River in Baylor County:

Pseudorthoceras knoxense (MCCHESNEY)?
Liroceras globulare (HYATT)
Endolobus conchiferous (HYATT)
Temmocheilus aff. *T. winslowi* (MEEK & WORTHEN)
Metacoceras? militarium (HYATT)
M.? simplex (HYATT)
Tainoceras aff. *T. quadrangulum* (MCCHESNEY)
Stenopoceras sp.
Medlicottia copei WHITE
Metalegoceras baylorense (WHITE)
Popanoceras walcotti (WHITE)
Properrinites cumminsi (WHITE)

The Wildcat Creek shale carries close counterparts of at least four of the eight species of nautiloids that are represented in this assemblage. Although three of the four ammonoid species listed are somewhat suggestive of a Leonard age, the last, which we regard as a particularly significant form, is indicative of Lower Permian. Inasmuch as the containing beds are near the top of what we regard as the Wolfcamp series, it is to be expected that the fauna would take on something of a Leonard aspect.

Acknowledgments.—We wish to express our sincere appreciation to Prof. R. C. MOORE for entrusting us with the study of this large and varied collection of cephalopods, and to Drs. H. D. MISER, J. B. REESIDE, JR., and JAMES STEELE WILLIAMS, of the U. S. Geological Survey, for permission to work on these fossils. In addition, Prof. C. O. DUNBAR of Yale University loaned us a specimen that proved to be most helpful, and other material was secured from the JOHN BRITTS OWEN collection, which is now at The State University of Iowa. Acknowledgment is due to Mr. HOWARD WEBSTER of Iowa City, who retouched the photographs and inked the suture drawings that accompany this report.

SYSTEMATIC PALEONTOLOGY

GENUS **PSEUDORTHOCERAS** GIRTY, 1911

Pseudorthoceras knoxense (MCCHESNEY)

Plate 1, figures 1-7

MILLER, DUNBAR & CONDRA (1933, p. 81-85, pl. 1, figs. 4-9) have described this species in detail and listed its synonymy, and there seems to be no need for their work to be duplicated here. Therefore, it will suffice to state that the specimens we are studying are quite typical of the species insofar as both external and internal features of the conch are concerned, and there seems to be no question as to their identity. The small adapical portion of the conch is slightly but distinctly curved (Pl. 1, fig. 5), the surface of the test is smooth (Pl. 1, figs. 1, 2), the sutures are straight and directly transverse (Pl. 1, figs. 3, 6), the siphuncle is central in position and is composed of pyriform segments (Pl. 1, figs. 4, 7), and the camerae contain the lamellar deposits that are so characteristic of this species (Pl. 1, fig. 7).

It should be added that from the Camp Creek formation we have only one specimen that we are referring to this species; it is a distorted internal mold of a small portion of a phragmacone some 10 mm in diameter, and it has a central siphuncle which is small at its passage through the septa. In the collections from the Wildcat Creek shale, this species is by far the most abundant nautiloid and

is represented by more than 150 specimens, several of which are being figured. For a time, it was thought that *Pseudorthoceras* did not range above the Pennsylvanian, but in 1942 CLIFTON described undoubted representatives of it from the Middle Permian of north-central Texas.

Occurrence.—Camp Creek shale member of the Pueblo formation (about 24 feet above Saddle Creek limestone) 1.2 miles south and 0.6 mile west of the mouth of Saddle Creek, McCulloch County, Texas; and Wildcat Creek shale member of the Admiral formation, about 4½ miles south-southwest of Coleman, Coleman County, Texas. Conspecific specimens are known to occur throughout the Pennsylvanian system of this country and probably also in the Upper Carboniferous of Europe, for example, near Nassfeld in the Carnic Alps on the Austro-Italian border.

Repository.—U. S. National Museum (Pl. 1, figs. 1-7; and numerous unfigured specimens from the Wildcat Creek shale, as well as one from the Camp Creek shale).

GENUS **BITAUNIOCERAS** SHIMIZU & OBATA, 1936

Bitaunioceras texanum, new species

Plate 1, figure 15

Among the orthoconic nautiloids we are studying, there is a unique specimen that is not referable to any previously described species. It is an internal mold of three camerae of the phragmacone that expands very gradually orad and is circular in cross section. The maximum length and diameter of the preserved portion of this individual measure about 18 mm and 6 mm, respectively.

No trace of the surface markings of the test is discernible on the holotype, but in at least each of the adapical two camerae there is a broad shallow rounded transverse constriction with rather indefinite borders. The camerae are very long in comparison to their diameter. The convexity of the septa is somewhat greater than average. The sutures form simple circles as they are straight and directly transverse. The siphuncle is central in position and at least at its passage through the septa is small; its diameter measures considerably less than 1 mm at the ends of the holotype, which are formed by septa, or impressions of them.

Remarks.—The very gradually expanded conch, transverse constrictions, long camerae, straight sutures, and small central siphuncle of this form all indicate that it belongs in *Bitaunioceras* SHIMIZU & OBATA. The type species of that genus, *Orthoceras bitauniense* HANIEL, is from the Middle Permian (Leonard equivalent) of Timor, and congeneric forms have so far been described from only the Middle Permian of Sicily and the Middle and Upper Permian of Coahuila. None of these is particularly close to our species, which is perhaps to be expected, inasmuch as it is by a considerable amount the oldest known representative of the genus.

Occurrence.—Wildcat Creek shale member of the Admiral formation, about 4½ miles south-southwest of Coleman, Coleman County Texas.

Holotype.—U. S. National Museum.

GENUS **LIROCERAS** TEICHERT, 1940

Liroceras cf. **L. globulare** (HYATT)

Plate 1, figures 8-12

(?) *Nautilus* ———? WHITE, *1891,* U. S. Geol. Survey, Bull. 77, p. 23, pl. 3, figs. 6-8.

(?) *Coloceras globulare* HYATT, 1893, Texas Geol. Survey, Ann. Rept. 4, p. 452-453, text figs. 25-27. ——— MILLER, DUNBAR & CONDRA, *1933,* Nebraska Geol. Survey, 2d ser., Bull. 9, p. 131.

(?) *Coloceras* sp. MILLER, DUNBAR & CONDRA, *1933,* Nebraska Geol. Survey, 2d ser., Bull. 9, p. 131.

(?) *Liroceras* sp. MILLER & UNKLESBAY, *1942,* Jour. Paleontology, vol. 16, p. 720.

(?) *Liroceras globulare* MILLER & UNKLESBAY, *1942,* Jour. Paleontology, vol. 16, p. 720.

The collections from the Wildcat Creek shale that we are studying contain 17 specimens that seem to belong in Teichert's genus *Liroceras.* All of them are rather fragmentary and poorly preserved, but we are illustrating the two best individuals.

As might be expected, there is a considerable amount of variation within this group of specimens, and we are of the opinion that they are not all conspecific. The variation is particularly noticeable in the relative height of conch (cf. Pl. 1, figs. 9, 11),

EXPLANATION OF PLATE 1

All specimens illustrated on this plate are at the U. S. National Museum, and all are from the Wildcat Creek shale member of the Admiral formation about 4½ miles south-southwest of Coleman, Coleman County, Texas.

FIGURE — PAGE

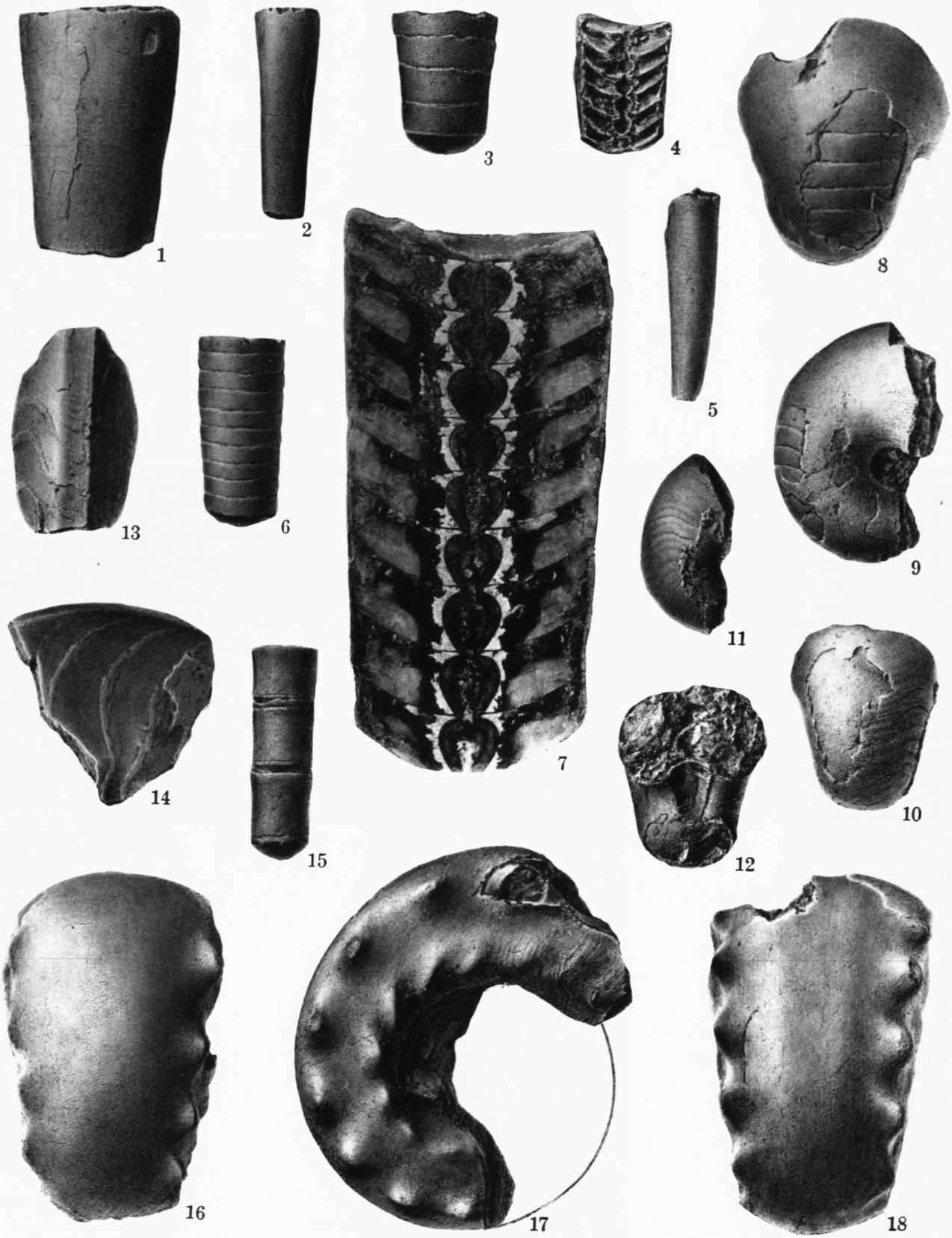
1-7—Pseudorthoceras knoxense (MCCHESNEY). Seven specimens. *1, 2,* A large and a typical testiferous individual, × 1; *3,* an internal mold showing sutures, × 1; *4,* a natural longitudinal section through the siphuncle, × 1; *5,* curved adapical portion of the conch, × 2½; *6,* an internal mold showing sutures, × 1; *7,* an unretouched photograph of a longitudinal section through the siphuncle, × 5 3

8-12—Liroceras cf. *L. globulare* (HYATT). Two specimens, × 1 4

13, 14—Stenopoceras sp. A small testiferous fragment of a whorl, × 2 7

15—Bitaunioceras texanum, n. sp. The holotype, × 2 4

16-18—Metacoceras cheneyi, n. sp. *16,* Paratype, × 1; *17, 18,* the holotype, × 1 6



Miller & Youngquist — Permian Nautiloids

the size of the umbilicus, the depth of the impressed zone, and particularly the position of the siphuncle. In some of the specimens the siphuncle is located closer to the dorsum than to the venter (as is the case in the holotype of *Liroceras globulare*), whereas in others the reverse is the case. We are uncertain in regard to the taxonomic significance of these variations.

The specimen represented by figures 8 and 9 on Plate 1 is about 42 mm in diameter, and near the adoral end its conch is about 35 mm wide and 22 mm high. The adoral two-fifths of the outer volution of this specimen are nonseptate and presumably therefore represent living chamber. One of the unfigured specimens in the collection under consideration seems to have attained a slightly but distinctly greater size, and it is septate throughout.

The over-all length of the specimen represented by figures 10-12 on the same plate is about 33 mm, and near the mid-length of this individual the conch is about 22 mm wide and 14 mm high, and the impressed zone is about 2 mm deep. The growth-lines form a broad deep rounded ventral sinus, but they are more or less straight and directly transverse on the lateral zones of the conch and on the umbilical walls. In both of the figured specimens, structures that seem to represent the siphuncle are distinctly nearer the venter than the dorsum.

Remarks. — Some of the unfigured congeneric specimens are more nearly globular than either of those figured, whereas others are less so. None of them has camerae that are relatively as short as those of the holotype of *Liroceras globulare,* but that specimen may represent the adoral portion of the phragmacone of a late mature individual, in which commonly the camerae are very short.

Occurrence.—Wildcat Creek shale member of the Admiral formation, about 4½ miles south-southwest of Coleman, Coleman County, Texas. The holotype of *Liroceras globulare* (and the probably conspecific specimens illustrated and described by WHITE) also came from north-central Texas but some 500 or 600 feet higher in the section; that is, they are from the lower part of the Clyde formation (just above the Beaverburk limestone) at the "Old Military Crossing" on the Big Wichita River, Baylor County, Texas.

Repository.—U. S. National Museum.

GENUS **EPHIPPIOCERAS** HYATT, 1884

Ephippioceras inexpectans, new species

Plate 2, figures 1-4

Two internal molds preserved in limestone constitute the basis for description of this species. Both of these represent the living chamber, and fortunately the adoral camera of the phragmacone is retained by one of them. Inasmuch as these two specimens are of the same order of magnitude, it seems logical to conclude that they are probably mature individuals.

The conch is moderate in size, subglobular in shape, and nautiliconic in its mode of growth. Its diameter, when complete, was somewhat more than 50 mm. The whorls are reniform in cross section as they are broadly rounded ventrally and laterally and are impressed dorsally. At the junction of the phragmacone and the living chamber of the holotype, which is our most nearly complete specimen (Pl. 2, figs. 1, 2), the width and height of the conch measure about 23 mm and 16 mm, respectively. This specimen represents about two-fifths of a volution, and near its adoral end it is about 35 mm wide. The other specimen (Pl. 2, figs. 3, 4) is terminated adapically by an impression of the adoral septum, which is about 23 mm wide and 17 mm high. This specimen represents about one-third of a volution, and the maximum width and height of its conch, which are attained near its adoral end, measure about 34 mm and 23 mm, respectively. These measurements show that the conch is expanded orad rather gradually for this genus.

The living chamber is at least one-third of a volution in extent. The umbilicus is moderately small but seems to be deep—that of our most nearly complete specimen attained a diameter of at least 16 mm. The umbilical shoulders are rounded and the umbilical walls are steep.

No trace of surface ornamentation is discernible on either of the types, internal molds, and presumably therefore the test was essentially smooth. The length of the single camera that is preserved on one of the type specimens measures about 4½ mm along the venter. Each suture forms a broad deep V-shaped but narrowly rounded ventral saddle, and on either side of it a broad rounded lateral lobe, and apparently a shallow saddle on or just inside the umbilical shoulder. Neither the shape of the internal sutures nor the nature of the siphuncle is known, but presumably they do not differ materially from those of other representatives of this genus.

Remarks. — Congeneric forms are known to be widespread in Europe (including the Ural Mountains) and in North America. In Europe they occur in both the Lower and the Upper Carboniferous, whereas in this country they have not been reported previously except from the Pennsylvanian. However, they are widespread both geographically and stratigraphically in that system. They have been found from Pennsylvania on the east to Nebraska and Texas on the west. They appear here in the base of the Cherokee (Atoka formation of Arkansas) and have been known to continue up to the top of the Lansing (South Bend limestone of Nebraska); the above-described specimens extend the vertical range up into what we believe should be considered as the lower portion of the Permian in central Texas.

All of the American representatives of this genus that have been described previously seem to be referable to one species, *Ephippioceras ferratum* (COX). *Nautilus divisus* WHITE & ST. JOHN (1867,

p. 124) is very poorly known but is probably to be suppressed as a synonym of *E. ferratum*. Our species resembles *E. ferratum* in most of its characters that we are able to ascertain, but its conch is less rapidly expanded orad and presumably is much smaller at maturity.

Occurrence.—Camp Creek shale member of the Pueblo formation (about 24 feet above Saddle Creek limestone), 1.2 miles south and 0.6 mile west of the mouth of Saddle Creek, McCulloch County, Texas, in association with *Pseudorthoceras knoxense* (McCHESNEY) and *Artinskia lilianae*, n. sp.

Types.—U. S. National Museum.

GENUS **METACOCERAS** HYATT, 1883

Metacoceras cheneyi, new species

Plate 1, figures 16-18

This species is based on two specimens, both of which are illustrated. The more nearly complete one (Pl. 1, figs. 17, 18) is chosen as the holotype. It represents the adoral camera of the phragmacone and much of the living chamber, whereas the paratype is nonseptate throughout and presumably, therefore, represents only living chamber. The holotype attains a maximum diameter of about 70 mm, and near its adapical end its conch is about 25 mm wide and 17 mm high; the maximum width is attained at the umbilical shoulders. The conch is expanded orad rather gradually and regularly, but because of the incompleteness of the adoral portion of the holotype significant measurements of it cannot be secured.

The whorls are irregularly hexagonal in cross section. The broad ventral zone is in general convex, but it is very slightly concave medianly. The lateral zones are distinctly concave, the dorsolateral convex, and the dorsal concave. The umbilical shoulders are fairly distinct, the umbilical walls are only moderately steep, and the maximum diameter of the umbilicus of the holotype measures about 40 mm. The living chamber is at least three-fifths of a volution in length.

Traces of the growth-lines are preserved on the adoral portion of the holotype. They are more or less straight and directly transverse on the umbilical walls and the lateral zones of the conch, but they form sinuses as they cross the umbilical shoulders. On each ventrolateral and dorsolateral shoulder of the conch there is a single row of prominent nodes. Those on the ventrolateral shoulders are longitudinally elongate, and the distance between them seems to increase adorally. There are eight of these nodes on the adoral half-volution of the holotype. The dorsolateral nodes are less prominent than the ventrolateral ones. They are also elongate but the direction of their elongation is oblique to the long axis of the conch. Although the dorsolateral and the ventrolateral nodes are about equal in number, there seems to be no interrelationship between the nodes in the two rows.

Along the venter, the adoral camera of the phragmacone of the holotype (the only camera preserved) is about 6 mm in length. The sutures are directly transverse to the long axis of the conch, but they are slightly sinuous, forming shallow ventral, lateral, dorsolateral, and almost certainly dorsal saddles. No trace of the siphuncle is visible in either of the type specimens.

The single paratype (Pl. 1, fig. 16) does not seem to differ materially from the holotype, and a study of it adds little to the data available from the holotype. However, inasmuch as this specimen is of about the same general size and proportions as the holotype, it seems probable that both represent mature individuals.

Remarks.—This species is readily differentiated from most of the known representatives of the genus *Metacoceras* by means of the nodes on its umbilical shoulders. Furthermore, in the few forms in which dorsolateral nodes occur, they are not very prominent or obliquely elongate, as, for example, in *M. mutabile* MILLER & OWEN and *M. biseriatum* MILLER & OWEN of the Cherokee of Missouri and in *M. angulatum* SAYRE of the Westerville limestone (Kansas City) of the same state.

For the sake of completion, it should be mentioned that the collections we are studying contain four small fragments which are congeneric with the above-described type specimens, but at least one of them is probably not conspecific. It has very prominent rounded ventrolateral nodes reminiscent of those that occur on *Metacoceras mammiferum* MILLER of the Bone Spring limestone of western Texas.

This species is named in honor of Mr. MONROE G. CHENEY, of Coleman, Texas, who has contributed much to the study of Pennsylvanian and Permian deposits of Texas.

Occurrence.—Wildcat Creek shale member of the Admiral formation, about 4½ miles south-southwest of Coleman, Coleman County, Texas.

Types.—U. S. National Museum.

GENUS **STENOPOCERAS** HYATT, 1893

Stenopoceras sp.

Plate 1, figures 13, 14

The general physiognomy of the small testiferous fragment of a whorl represented by figures 13 and 14 on Plate 1 indicates that it belongs in *Stenopoceras*. Near the mid-length of this specimen, the conch is about 18 mm high and 11 mm wide, and the flat ventral zone is about 3 mm wide and the dorsal impressed zone about 5 mm deep. The growth-lines form deep rounded ventral sinuses, broad rounded lateral salients, small shallow sinuses

on or near the umbilical shoulders, and similar salients on the umbilical walls. The siphuncle is small and is subcentral in position but is distinctly closer to the venter than the dorsum; at the adapical end of the specimen the siphuncle is something like 1 mm in diameter, and it is about 4½ mm from the venter and 7 mm from the dorsum.

Remarks.—The genus *Stenopoceras* is known to occur in the Pennsylvanian of Nebraska, Wyoming, New Mexico, and central European Russia, and in the Permian of Kansas and Texas. The specimen under consideration represents such a small part of the conch that satisfactory comparisons cannot be made. Its whorls seem to be rather low and broad for the genus, which may be due in part, at least, to the fact that it represents a small volution of the conch.

Occurrence.—Wildcat Creek shale member of the Admiral formation, about 4½ miles south-southwest of Coleman, Coleman County, Texas.

Repository.—U. S. National Museum.

GENUS **NEOPRONORITES** RUZHENCEV, 1936

Neopronorites? sp.

Plate 3, figures 11, 12

The specimen illustrated by figures 11 and 12 on Plate 3 represents the dorsolateral portion of about one-quarter of a volution of a phragmacone. Its over-all length measures approximately 19 mm.

The complete conch of this form is almost certainly discoidal as it is essentially flat laterally, more or less subangular ventrolaterally, and flattened (but nevertheless very broadly rounded) ventrally. Only the internal sutures are preserved on this specimen. The prominent bifid lobe shown by figure 12 on Plate 3 is probably the dorsal lobe. The saddle next to it is U-shaped, and it is followed by an undivided obtusely pointed lobe more or less on the shoulder, and then another similar but smaller U-shaped saddle. It can be discerned that the internal sutures form at least three more lateral lobes and two more lateral saddles, which become progressively smaller.

Remarks.—The above-described specimen represents such a small portion of the conch that its affinities cannot be determined with certainty. However, in all available particulars it seems to resemble typical representatives of *Neopronorites*, and as that genus is known to be widespread and to occur in both the Upper Pennsylvanian and the Lower Permian of Texas, we are referring our specimen to it with question.

Occurrence.—Wildcat Creek shale member of the Admiral formation, about 4½ miles south-southwest of Coleman Coleman County, Texas.

Repository.—U. S. National Museum.

GENUS **ARTINSKIA** KARPINSKY, 1926

Artinskia adkinsi PLUMMER & SCOTT

Plate 3, figures 6, 7

Artinskia adkinsi PLUMMER & SCOTT, *1937*, Texas Univ. Bull. 3701, p. 18, 19, 22, 23, 92, 93-95, 96, 224, 380, 382, 390, 391, 392, 394, 395, 399, 401, text fig. 88 (opp. p. 402), pl. 4, figs. 6-17. —— RUZHENCEV, *1938*, Problems Paleontology, vol. 4, p. 250. —— MILLER & FURNISH, *1940*, Geol. Soc. America, Special Paper 26, p. 18, 20, 45, 48, 49.

This species is not rare in the collections we are studying, but all of the specimens are fragmentary. Nevertheless, collectively they elucidate most of the significant characters, and there is no doubt in our minds as to their identity. The general shape and ornamentation of the conch are shown by figures 6 and 7 on Plate 3. One of the paratypes is in the Yale Peabody Museum. It is a good study specimen but is so crushed and fragmentary that satisfactory photographs of it cannot be secured. The preserved portion of this individual is septate throughout, and it attains a maximum diameter of about 28 mm and a maximum height and width of conch of about 16 mm and 6 mm, respectively. The umbilicus of this specimen attains a maximum diameter of about 2 mm, and near the adoral end of the penultimate volution the conch is about 5 mm high and 3½ mm wide. The sutures of this Yale specimen are in an advanced *Propinacoceras* stage at a diameter of only 10 mm. The shape of the sutures at full maturity is shown by our Figure 1C. It should perhaps be added that the published measurements of the original type specimens of this species seem to contain errors; in their text, PLUMMER & SCOTT (1937, p. 93, 95) refer to these specimens as "cotypes" but on their plate legend they designate one of them as a holotype.

Remarks.—Insofar as shape and ornamentation of conch are concerned, all the American representatives of the genus *Artinskia* are very much alike. They are more primitive than the genotype, *A. falx* (EICHWALD) of the Artinskian (Leonard equivalent) of the Ural region, and, with the exception of *A. lilianae*, n. sp., they can be said to belong in the group of *A. transitoria* (HANIEL). The sutures of *A. adkinsi* in general resemble those of such other American Lower Permian species as *A. electraensis* PLUMMER & SCOTT, *A. huecoensis* MILLER & FURNISH, and *A. whortani* MILLER. From the first two of these, *A. adkinsi* differs particularly in the details of the subdivisions of the first lateral saddle; and from the third species it can be readily distinguished by the fact that the first lateral lobe of its sutures is bifid rather than trifid. In the sutures of *A. lilianae*, which also occurs in the Lower Permian of north-central Texas, but some 600 feet lower in the section, there are two, rather than one, small secondary lobes on each side of the ventral lobe

(see Fig. 1). *A. adkinsi* resembles very closely *A. transitoria* (HANIEL) of the Bitauni beds (Leonard equivalent) of Timor, but, as might be expected, the sutures of that species are somewhat more advanced.

Occurrence.—Wildcat Creek shale member of the Admiral formation, about 4½ miles south-southwest of Coleman, Coleman County, Texas. Also, PLUMMER & SCOTT (1937, p. 22) list this species from the Wolfcamp formation 2 miles northwest of Poplar Tank on the Decie Ranch in the Glass Mountains of western Texas, and on a later page of the same publication (p. 391) they list *Artinskia whortani* from the same horizon and locality; however, they do not illustrate or describe their Wolfcamp specimens, and therefore we are unable to express an opinion in regard to their affinities with *A. adkinsi, A. whortani,* and *A. huecoensis.*

Types.—U. S. National Museum (Pl. 3, figs. 6, 7; and more than 25 unfigured specimens); Yale Peabody Museum, 15936 (Fig. 1C); and PLUMMER collection at the Bureau of Economic Geology at The University of Texas (holotype and paratypes).

Artinskia lilianae, new species

Plate 3, figures 8, 9,

The single specimen on which this species is based is a well-preserved internal mold representing about one-third of a volution of a phragmacone. Its overall length measures about 42½ mm. The maximum width of conch is about 10 mm, and the corresponding height of conch is estimated to have been some 30 mm. The conch is discoidal in shape, being essentially flat laterally and slightly but distinctly grooved ventrally. As shown by figure 9 on Plate 3, on each ventrolateral shoulder there is a single row of prominent obliquely elongated nodes which, on the holotype, are about 3 mm apart. In the adoral portion of this specimen the ventral groove is some 2 mm wide and almost that deep.

The camerae are short and the sutures are somewhat telescoped. As shown by Figure 1B, each suture forms a long narrow ventral lobe and on either side of it a very large broad asymmetrical subdivided first lateral saddle, a bifid first lateral lobe, a high spatulate undivided second lateral saddle, a large bifid second lateral lobe, and several auxiliary lobes and saddles—the first two auxiliary lobes are bifid. There are two small secondary lobes on each side of the ventral lobe and four additional small secondary lobes in the first lateral saddle—none of these secondary lobes is bifid.

Remarks.—This species is the oldest representative of *Artinskia* known from America, though several other Lower Permian forms have been described from this country: *A. adkinsi* PLUMMER & SCOTT of the Admiral formation in central Texas and possibly the Wolfcamp formation of western Texas, *A. electraensis* PLUMMER & SCOTT of the Clyde formation of north-central Texas, *A. huecoensis* MILLER & FURNISH of the Hueco limestone and possibly the Wolfcamp formation of western Texas, and *A. whortani* MILLER of the Florena shale of Kansas and possibly the Wolfcamp formation of western Texas. In all of these species, except the one described above, there is only one small secondary lobe on each side of the ventral lobe and the largest of the secondary lobes in the first lateral saddle is bifid.

A single representative of this genus is known that is probably older than any of our American forms. It is *Artinskia irinae* RUZHENCEV of the Orenburgian (Upper Carboniferous) of the southern Urals. The sutures of that species (Fig. 1A) are quite comparable in several respects to those of *A. lilianae.* That is, in both forms there are two small secondary lobes on each side of the ventral lobe, and none of the small secondary lobes in the

EXPLANATION OF PLATE 2

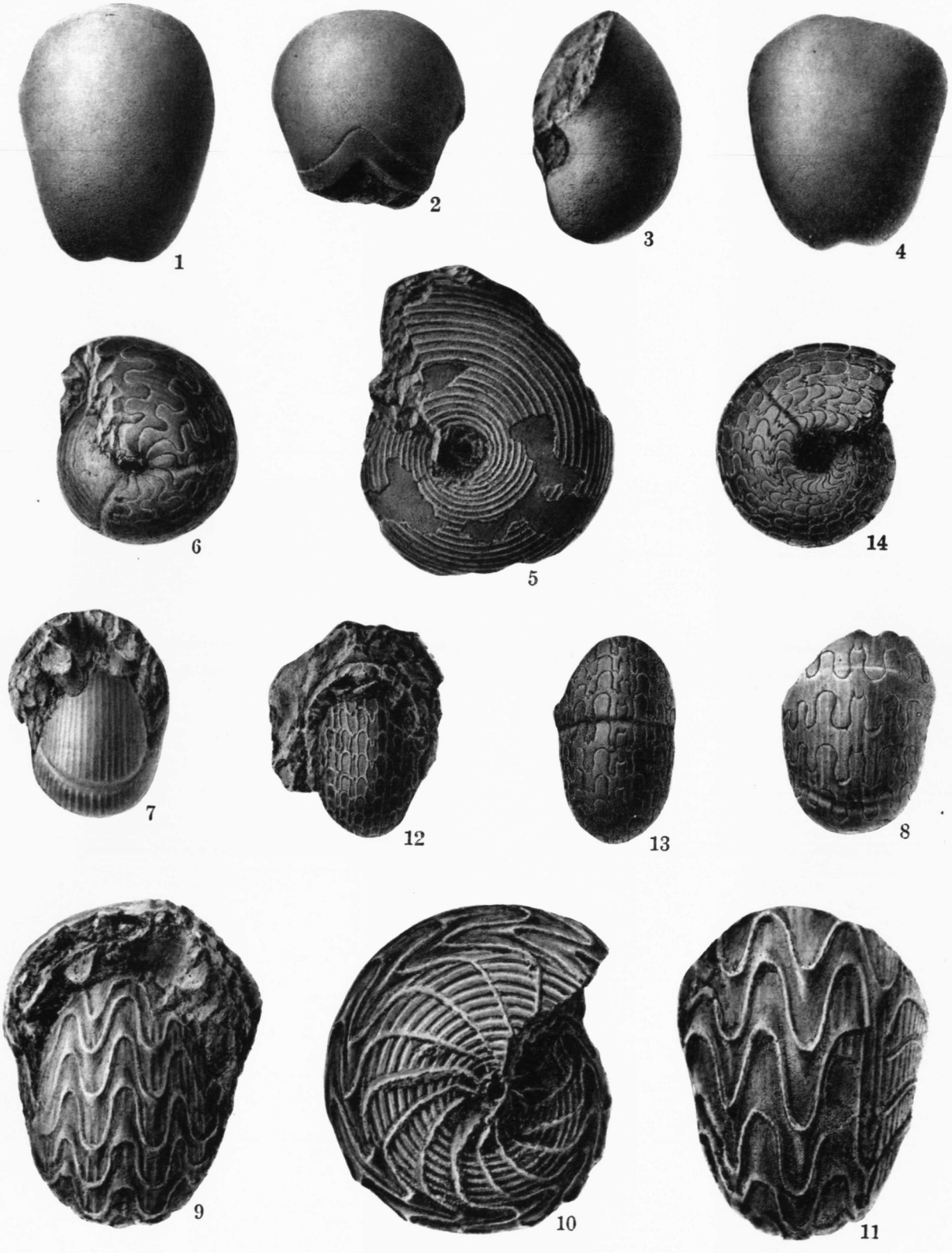
All specimens illustrated on this plate are at the U. S. National Museum, and all but two (figs. *1-4*) are from the Wildcat Creek shale member of the Admiral formation about 4½ miles south-southwest of Coleman, Coleman County, Texas. The specimens represented by figures *1-4* are from the Camp Creek shale member of the Pueblo formation 1.2 miles south and 0.6 mile west of the mouth of Saddle Creek, McCulloch County, Texas.

FIGURE — PAGE

1-4—Ephippioceras inexpectans, n. sp. Two views of each of the types. *1, 2,* The holotype, × 1; *3, 4,* paratype, × 1... 5

5-11—Agathiceras applini PLUMMER & SCOTT. Three specimens. *5,* A mature individual showing the longitudinal lirae on the surface of the test, × 2½; *6-8,* a small individual showing external sutures, × 8; *9-11,* a somewhat larger (but nevertheless rather small) specimen showing internal sutures, × 8. See, also, Plate 3..... 11

12-14—Peritrochia sellardsi (PLUMMER & SCOTT). *12,* A specimen showing the internal sutures, × 2½; *13, 14,* a specimen showing the external sutures, × 2½..... 12



MILLER & YOUNGQUIST — Permian Nautiloids and Ammonoids

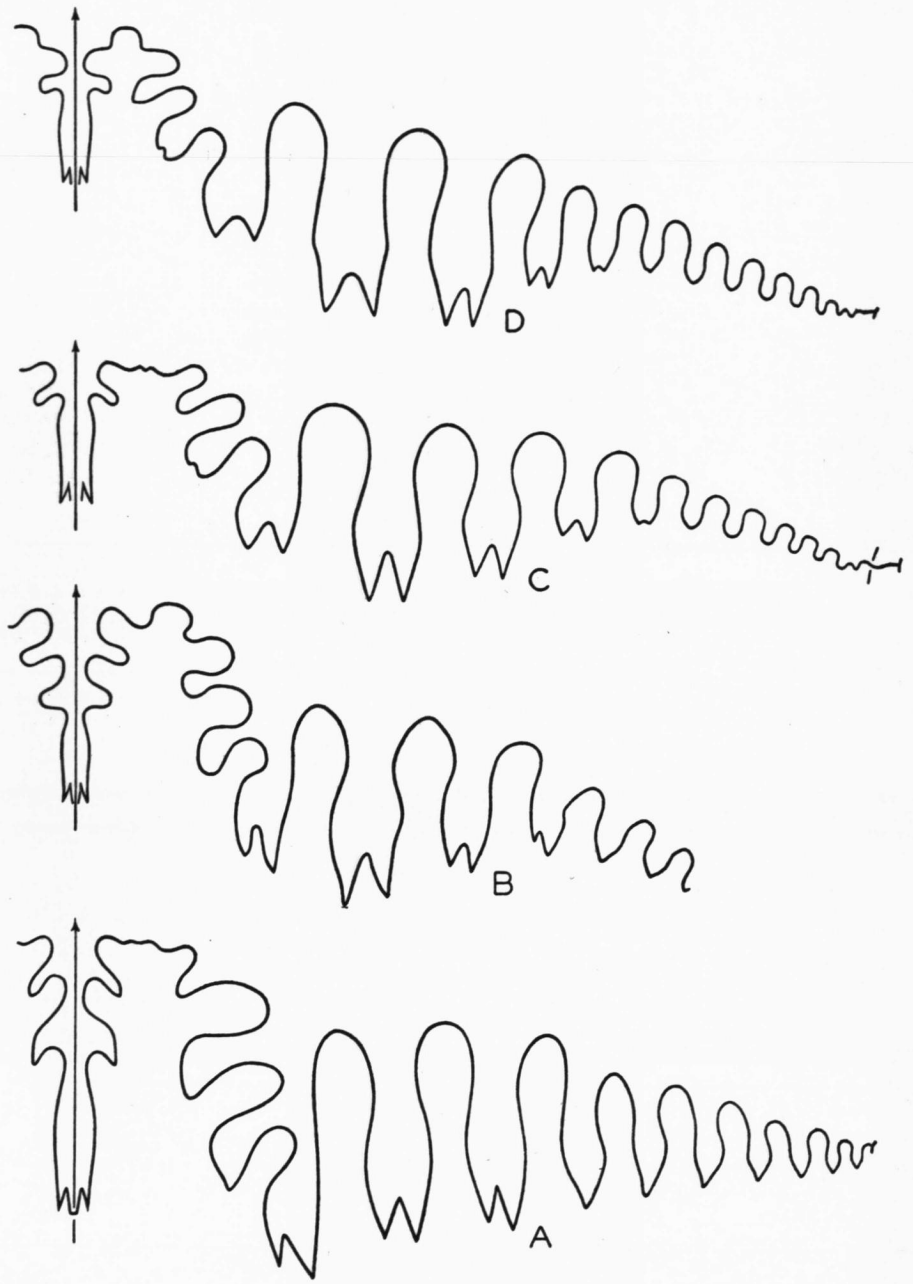


FIGURE 1.—Diagrammatic representations of mature sutures of four species of *Artinskia*. (*A*) *A. irinae* RUZHENCEV at a height of conch of 31.5 mm, × 3; based on the holotype, from the Orenburgian (Upper Carboniferous) along the Ural River in the Orenburg region of the southern Urals (after RUZHENCEV). (*B*) *A. lilianae*, n. sp., at an estimated height of conch of some 27½ mm, × 3; based on the holotype, from the Camp Creek shale near the mouth of Saddle Creek in McCulloch County, Texas. (*C*) *A. adkinsi* PLUMMER & SCOTT at a height of conch of about 16 mm, × 6; based on one of the original type specimens (Yale Peabody Museum, 15936) from the Wildcat Creek shale about 4½ miles south-southwest of Coleman, Texas. (*D*) *A. electraensis* PLUMMER & SCOTT at a height of conch of about 28 mm, × 4; based on the holotype (Yale Peabody Museum, 15949) from the Clyde formation about 4 miles south of Electra, Texas.

first lateral saddle is bifid. However, in the Russian species the first lateral lobe is distinctly deeper than the second lateral lobe, whereas in our form the reverse is true. It should also be noted that in some younger species, for example, the genotype, *A. falx* (EICHWALD) of the Artinskian (Leonard equivalent) of the Ural region, there are two lateral lobes on each side of the ventral lobe; but in *A. multituberculata* of the Sakmarian (Wolfcamp equivalent) of the same general area there is only one small secondary lobe on each side of the ventral lobe. Finally, we want to point out that three species of *Artinskia* are now known from the Permian of north-central Texas (Figs. 1B-D), and in them it can be seen that there is a progressive decrease in the relative depth of the first lateral lobe of the sutures; this trend, however, is not continued in younger forms, like *A. falx*.

The holotype and only known representative of this species was found by Mrs. R. C. (LILIAN) MOORE, in whose honor it is named.

Occurrence.—Camp Creek shale member of the Pueblo formation (about 24 feet above the Saddle Creek limestone), 1.2 miles south and 0.6 mile west of the mouth of Saddle Creek, McCulloch County, Texas, in association with *Pseudorthoceras knoxense* (MCCHESNEY) and *Ephippioceras inexpectans*, n. sp.

Holotype.—U. S. National Museum.

GENUS **PSEUDOGASTRIOCERAS** SPATH, 1930

Pseudogastrioceras admiralense

(PLUMMER & SCOTT)

Paragastrioceras admiralense PLUMMER & SCOTT, *1937*, Texas Univ. Bull. 3701, p. 19, 222, 223-224, 225, 391, 392, 399, text fig. 88 (opp. p. 402), pl. 22, figs. 1-9.

Paragastrioceras admiralensis PLUMMER & SCOTT, *1937*, Texas Univ. Bull. 3701, p. 394.

Pseudogastrioceras admiralense MILLER & FURNISH, *1940*, Geol. Soc. America, Special Paper 26, p. 18, 20.

Only two specimens, the holotype and a paratype, of this rare species are known, and unfortunately both of them are rather small and not very complete. The collections we are studying do not contain a single representative of the genus or species. However, it is clear from PLUMMER & SCOTT'S published illustrations and descriptions of the type specimens that this form is much closer to the genotype of *Pseudogastrioceras, P. abichianum* (MÖLLER) of the Upper Permian Djoulfa beds of Armenia, than to that of *Paragastrioceras, P. jossae* (DE VERNEUIL) of the Middle Permian Artinskian beds of the Ural region. The genotype of *Paragastrioceras* differs from typical *Pseudogastrioceras* in that its umbilical nodes are much more prominent and are not lost at maturity, and its whorls are much lower and broader and are subtrapezoidal rather than helmet-shaped in cross section. However, there is more or less complete gradation between these two genera, and it seems probable that *Pseudogastrioceras* developed from *Paragastrioceras*, for all of the representatives of the former genus that we have been able to study in detail go through a *Paragastrioceras* stage rather early in their ontogenetic development.

The genus *Paragastrioceras* is probably not known to occur outside the Permian of the Ural region and Western Australia, whereas *Pseudogastrioceras* is widespread in the Permian, both geographically and stratigraphically. This latter genus, which ranges from Lower to Upper Permian, inclusive, has been found in Texas, Coahuila, Wyoming, Sicily, Croatia, Armenia, the Ural region, Novaya Zemlya, Kashmir (and possibly the Transalai Range), several widely separated localities in China, and Western Australia. In the Lower Permian it is rare but is known, from the species under consideration, to occur in Texas, and also it is probably represented in the Ural region. In the Middle Permian Artinskian beds of the latter locality it is abundant, but, peculiarly enough, it is rare in equivalent strata (Leonardian series) in America. However, it is common in the overlying Word and Capitan beds of Texas and Coahuila and is locally abundant in the Phosphoria formation of Wyoming. *Pseudogastrioceras admiralense* is not well enough known to enable us to make very satisfactory comparisons with other species, and more and better specimens of it are urgently needed.

EXPLANATION OF PLATE 3

All specimens illustrated on this plate are at the U. S. National Museum, and all but one (figs. *8, 9*) are from the Wildcat Creek shale member of the Admiral formation, about 4½ miles south-southwest of Coleman, Coleman County, Texas. The specimen represented by figures *8, 9* is from the Camp Creek shale member of the Pueblo formation about 1.2 miles south and 0.6 mile west of the mouth of Saddle Creek, McCulloch County, Texas.

FIGURE — PAGE

1-5—Properrinites bösei bösei (PLUMMER & SCOTT). *1-4*, A small but well-preserved specimen showing internal sutures, × 3; *5*, another specimen showing internal sutures, × 3..... 13

6, 7—Artinskia adkinsi PLUMMER & SCOTT. Two specimens showing the general shape of the conch, × 2..... 7

8, 9—Artinskia lilianae, n. sp. The holotype, × 2..... 8

10—Agathiceras applini PLUMMER & SCOTT. A septate internal mold, × 2½. See, also, Plate 2..... 11

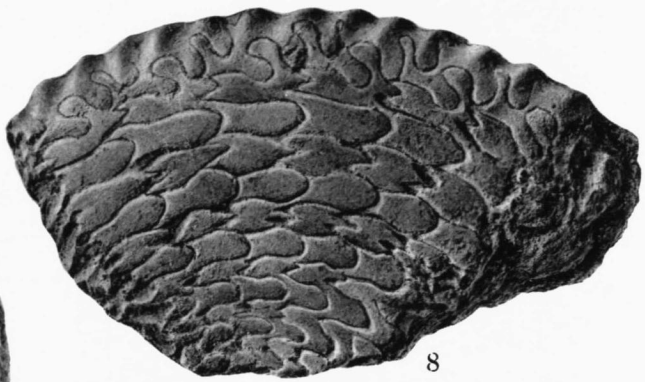
11, 12—Neopronorites? sp. A fragment of a conch showing internal sutures, × 2.....

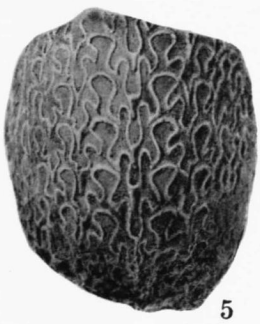

1


6


7


2


8


5


10


11


12


9


3


4

MILLER & YOUNGQUIST — Permian Ammonoids

Occurrence.—Wildcat Creek shale member of the Admiral formation about 4½ miles south-southwest of Coleman, Coleman County, Texas.

Types.—PLUMMER collection at the Bureau of Economic Geology of The University of Texas (holotype and paratype).

GENUS METALEGOCERAS SCHINDEWOLF, 1931

Metalegoceras colemanense PLUMMER & SCOTT

Metalegoceras colemanense PLUMMER & SCOTT, *1937*, Texas Univ. Bull. 3701, p. 19, 281, 282-284, 285, 287, 391, pl. 21, figs. 1-7. ——— RUZHENCEV, *1938*, Problems Paleontology, vol. 4, p. 279. ——— MILLER & FURNISH, *1940*, Geol. Soc. America, Special Paper 26, p. 18, 21, 98, 99.

Metalegoceras colmanense PLUMMER & SCOTT, *1937*, Texas Univ. Bull. 3701, p. 224, 394, text fig. 88 (opp. p. 402).

(?) *Metalegoceras* cf. *M. colemanense* MILLER & FURNISH, *1940*, Geol. Soc. America, Special Paper 26, p. 15, 21, 101.

This species has been well illustrated and described by PLUMMER & SCOTT. The collections we are studying contain several representatives from the same horizon and locality as the types, but all of them are so fragmentary that they will not yield satisfactory photographs. Furthermore, PLUMMER & SCOTT's illustrations elucidate the general physiognomy and the surface markings of the conch very well.

The shape of the mature sutures is shown by our Figure 2, which is based on a paratype in the JOHN

FIGURE 2.—Diagrammatic representation of a mature suture of *Metalegoceras colemanense* PLUMMER & SCOTT at a diameter of about 15 mm and a width of about 9½ mm, × 5.

BRITTS OWEN collection. The sutures of all known representatives of *Metalegoceras* are very similar, and they consist of twelve lobes, only one of which (the ventral lobe) is subdivided. In the few forms that have been described from the Lower Permian—*M. somoholense* (HANIEL) of Timor, *M. jacksoni* (ETHERIDGE) of Western Australia, *M. distale* RUZHENCEV and *M.* sp. (of RUZHENCEV) of the southern Urals, and *M. colemanense* PLUMMER & SCOTT of Texas—the sutures are relatively primitive in that the lobes immediately adjacent to the umbilical lobe are small and poorly developed. The sutures of *M.? aricki* PLUMMER & SCOTT of the Wolfcamp formation of the Glass Mountains in western Texas are so poorly known that we are uncertain as to even its generic affinities. Both of the other congeneric forms known from America, *M. baylorense* (WHITE) of the Clyde formation or group of north-central Texas and *M. schucherti* MILLER & FURNISH of the Leonard formation of western Texas, have more advanced sutures in which the lobes on either side of the umbilical lobe are relatively large and well developed.

It should probably be added that the genus *Metalegoceras*, which was established by SCHINDEWOLF in 1931, seems to be confined stratigraphically to the lower half of the Permian (Wolfcamp and Leonard and their equivalents). Geographically, however, it is world-wide in its distribution, and representatives of it have been found in the Ural region, Timor, Western Australia, Texas, and Kansas. They are particularly abundant in the Lower Permian of the Irwin River coal field of Western Australia, and in the Middle Permian Artinskian beds of the Urals and Bitauni beds of Timor.

Occurrence.—Wildcat Creek shale member of the Admiral formation about 4½ miles south-southwest of Coleman, Coleman County, Texas. Also, MILLER & FURNISH (1940, p. 101) have described a fragment of a whorl that probably belongs in this species from the lower part of the Hueco limestone at the southern end of the Hueco Mountains in western Texas; and PLUMMER & SCOTT (1937, p. 391) indicate that they have a specimen that may possibly be conspecific from the Florena shale of Cowley County in southern Kansas.

Types.—U. S. National Museum (five hypotypes); State University of Iowa (JOHN BRITTS OWEN collection), 13629 (two paratypes, on one of which Figure 2 is based).

GENUS AGATHICERAS GEMMELLARO, 1887

Agathiceras applini PLUMMER & SCOTT

Plate 2, figures 5-11; Plate 3, figure 10

Agathiceras applini PLUMMER & SCOTT, *1937*, Texas Univ. Bull. 3701, p. 19, 119, 122-123, 126, 224, text fig. 88 (opp. p. 402), pl. 29, figs. 13-18. ——— MILLER & FURNISH, *1940*, Geol. Soc. America, Special Paper 26, p. 18, 21.

The collections we are studying contain more than 450 specimens that belong in the genus *Agathiceras*. Most of them are small and more or less crushed, but presumably all are conspecific.

The small limonitic internal mold represented by figures 6-8 on Plate 2 is only 4½ mm in diameter, and the maximum width of the preserved portion of its conch measures only about 3½ mm. Very distinct traces of longitudinal lirae are preserved on this specimen, and they do not seem to be materially different from those of large fully mature individuals like that illustrated by figure 5 on the same plate. Also, our small figured specimen shows faint traces of transverse growth-lines and four transverse constrictions on its outer volution. Both the growth-lines and the constrictions are slightly but distinctly sinuous, forming slight ventral and lateral sinuses and similar ventrolateral salients. The adapical two of the visible constrictions on our small specimen are quite prominent, and the next one is moderately so. However, the adoral constriction is rather faint, and it is very doubtful if any constrictions were formed orad of this one.

Furthermore, no trace of constrictions can be discerned on any of our larger specimens.

The sutures of our small figured specimen are much like those of the large mature individual shown by figure 10 on Plate 3, but the lobes are distinctly more pointed on the latter (larger) individual, which is also an internal mold preserved in limonite. The shape of the internal sutures in this species is elucidated by figures 9-11 on Plate 2, and they are typical of the genus.

Remarks. — PLUMMER & SCOTT'S diagrammatic representation of the external sutures of this species shows the lobes at maturity to be rounded rather than pointed, but presumably their drawing is based on a worn specimen. The sutures in most representatives of this genus are very much alike. The species under consideration seems to resemble rather closely *Agathiceras frechi* BÖSE of the Upper Pennsylvanian Gaptank formation of western Texas, which, however, may retain its constrictions during somewhat later ontogenetic stages. *A. contractum* PLUMMER & SCOTT of the Lower Permian Clyde formation of north-central Texas is known from only one rather mediocre specimen, but it also seems to be similar to *A. applini.*

Agathiceras is one of the most abundant ammonoids in the Late Paleozoic, insofar as number of individuals is concerned, and it is by far the most abundant form in the collections we are studying. Stratigraphically the genus ranges throughout almost all of the Pennsylvanian and all but the upper portion of the Permian; and geographically it is world-wide in distribution.

Occurrence.—Wildcat Creek shale member of the Admiral formation about 4½ miles south-southwest of Coleman, Coleman County, Texas.

Types.—U. S. National Museum (Pl. 2, figs. 5-11; Pl. 3, fig. 10; and numerous unfigured specimens). The original type specimens are in the PLUMMER collection at The University of Texas.

GENUS **PERITROCHIA** GIRTY, 1908

Peritrochia sellardsi (PLUMMER & SCOTT)

Plate 2, figures 12-14

Marathonites sellardsi PLUMMER & SCOTT, *1937,* Texas Univ. Bull. 3701, p. 19, 138, 146-148, 149, 391, 392, 399, text fig. 88 (opp. p. 402), pl. 32, figs. 3-9.

Marathonites ganti [part] PLUMMER & SCOTT, *1937,* Texas Univ. Bull. 3701, p. 146.

Peritrochia sellardsi MILLER & FURNISH, *1940,* Geol. Soc. America, Special Paper 26, p. 13, 15, 18, 21, 122, 127, 128-129, 179, pl. 28, figs. 8-12.

Kargalites sellardsi RUZHENCEV, *1940,* Acad. Sci. U. R. S. S., Trav. Inst. Paléont., t. 11, p. 128.

Conch moderate in size and thickly subdiscoidal, the whorls being depressed dorsoventrally, rather broadly rounded ventrally, somewhat flattened laterally, impressed dorsally, and helmet-shaped in cross section. Our best specimen (Pl. 2, figs. 13, 14), which is septate throughout and which is not entirely free from distortion, is about 15 mm in diameter, and near its adoral end its conch is about 9 mm wide and 6 mm high. One of the original type specimens of this species is stated to attain a diameter of 21 mm, and seemingly it also is septate throughout but no information is available in regard to the living chamber.

The umbilicus is small but deep—the diameter of that of our best specimen is only about 3½ mm or a little less than one-fourth the corresponding diameter of the conch. The umbilical shoulders are abruptly rounded, and the umbilical walls are very steep.

The surface of the test bears fine growth-lines which are directly transverse to the long axis of the conch and are only very slightly sinuous. Also, the internal mold bears a few constrictions which do not seem to be regular in their development. The rather prominent constriction near the mid-length of the adoral half-volution of the larger of our figured specimens (Pl. 2, figs. 13, 14) is essentially straight and directly transverse, but slightly apicad of it is a somewhat comparable structure that is confined to the umbilical zone—probably the latter is adventitious. PLUMMER & SCOTT state that one of the original type specimens "shows a constriction that bends sharply backward across the venter."

The shape of the sutures at maturity is elucidated by Figure 3. Altogether there are 20 lobes and an equal number of saddles in each of these sutures. The ventral lobe is prominently bifid, whereas all of the others (except the small ones in the immediate vicinity of the umbilicus) are trifid. The saddles are undivided.

Remarks.—This form is one of a group of species that is both abundant and widespread in the Upper Carboniferous and Lower Permian. Minor differences in the sutures and the shape of the conch have been used to differentiate species within the group. The species under consideration is characterized by the narrowness of the dorsal lobe of its sutures and by the fact that its umbilicus is neither very large nor very small. Minor differences in the denticulations of the sutures are not of specific value in this group, for such differences are present on opposite sides of individual specimens. In 1938 RUZHENCEV proposed the generic name *Kargalites* for forms like the one under consideration with narrow dorsal lobes, but inasmuch as the genotype of *Peritrochia, P. erebus* GIRTY, has such a dorsal lobe, *Kargalites* is, in our opinion, to be regarded as a synonym of *Peritrochia.*

Externally, *Peritrochia sellardsi* resembles rather closely *P. ganti* (SMITH) from the Upper Pennsylvanian of Texas and probably Kansas, but in that species the dorsal lobe of the sutures is very broad. Such a criterion is difficult to use, but it seems to

indicate a specific difference between the two forms. The type specimens of *P. electraensis* (PLUMMER & SCOTT) from the Clyde formation are poorly preserved, but their umbilici are very small, which again is perhaps sufficient to indicate that these two forms are specifically distinct. Nevertheless, it should be clearly understood that all three of the species just mentioned are very closely related. The characters cited can be used to differentiate American species from each other but not from those known from the Ural region and Timor.

Occurrence.—Wildcat Creek shale member of the Admiral formation about 4½ miles south-southwest of Coleman, Coleman County, Texas; and in the Wolfcamp and Hueco formations of western Texas.

bilical shoulders. One of the paratypes of this species (and variety) attains a diameter of about 25 mm, and fragments of an outer volution which adhere to this specimen show that originally the phragmacone formed at least one more full volution and therefore attained a maximum diameter of at least 45 to 50 mm. The height of conch of a large representative of this form (40 mm in diameter) as given by PLUMMER & SCOTT (1937, p. 307) seems to be based on a distorted specimen or to contain a misprint. No information is available regarding the length of the living chamber.

The umbilicus is moderate in size and is deep. At the adoral end of the specimen represented by

FIGURE 3.—Diagrammatic representation of a mature suture of one of the original type specimens of *Peritrochia sellardsi* (PLUMMER & SCOTT) at a diameter of about 16 mm, × 5.

Types.—U. S. National Museum (Pl. 2, figs. 12-14; and 20 unfigured specimens). The original type specimens are in the PLUMMER collection at The University of Texas, in the Yale Peabody Museum, and in the JOHN BRITTS OWEN collection at The State University of Iowa. Also, specimens from western Texas have been deposited at all three of these institutions, and Figure 3 is based on one at The State University of Iowa, number 13629. In order to establish nomenclatural stability, we here designate as the holotype of this species the specimen represented by PLUMMER & SCOTT's figures 3-5 on their Plate 32 of 1937; presumably this specimen is in the PLUMMER collection at The University of Texas.

GENUS **PROPERRINITES** ELIAS, 1938

Properrinites bösei bösei (PLUMMER & SCOTT)

Plate 3, figures 1-5

Perrinites bösei PLUMMER & SCOTT, *1937,* Texas Univ. Bull. 3701, p. 19, 224, 296, 298, 300, 304, 305, 306, 307-309, 310, 380, 391, text fig. 88 (opp. p. 402), pl. 25, figs. 1-8.

Perrinites boesei PLUMMER & SCOTT, *1937,* Texas Univ. Bull. 3701, p. 399.

Properrinites bösei ELIAS, *1938,* Jour. Paleontology, vol. 12, p. 101, 102, 103, 104. ——— MILLER & FURNISH, *1940,* Geol. Soc. America, Special Paper 26, p. 18, 21 [part], 139, 140, 143, 145.

Properrinites bösei bösei MILLER & FURNISH, *1940,* Geol. Soc. America, Special Paper 26, p. 138, 140, 141, 151.

Conch subglobular as whorls are depressed dorsoventrally, broadly rounded ventrally and laterally, impressed dorsally, and helmet-shaped in cross section. The maximum diameter of our best specimen (Pl. 3, figs. 1-4), which is septate throughout and is essentially free from distortion, measures about 19½ mm, and near its adoral end the conch is about 9 mm high and 14 mm wide. The maximum width of the conch is attained at, or just outside, the umbilical shoulders. The umbilicus is about 5 mm in diameter, which is approximately one-fourth the corresponding diameter of the conch. The umbilical shoulders are abruptly rounded and are fairly definite, and the umbilical walls are steep.

Although statements to the contrary exist in the literature, in this variety the test bears fine growth-lines and interior thickenings which form constrictions on the internal mold. Both the growth-lines and the constrictions are directly transverse and only very slightly sinuous—they form slight ventral and lateral sinuses.

As shown by Figure 4A, during early maturity each external suture forms a broad bifid ventral lobe and on either side of it six lobes, one of which is located on the umbilical wall. The prongs (major subdivisions) of the ventral lobe and all but the smallest of the lateral lobes are digitate. There is only one digit (small secondary lobe) on each side of the prongs of the ventral lobe. On the ventral side of the first lateral lobe there are two digits (one of which is bifid), but on the dorsal side of that lobe there is only one digit. However, there are two digits on each side of the second lateral lobe. The auxiliary lobes of the external sutures are reminiscent of the first lateral lobe, but dorsad they become progressivly smaller and less modified. The internal suture consists of a rather large trifid dorsal lobe and on either side of it four internal lateral lobes. The dorsal two of these internal lateral lobes are very much alike, and they are deep and slender and possess one digit on their dorsal side and none on their ventral side. The next internal lateral lobe is asymmetrically bifid, and its major (dorsal) prong also has a rudimentary digit on its dorsal side. The remaining internal lateral lobe, which is

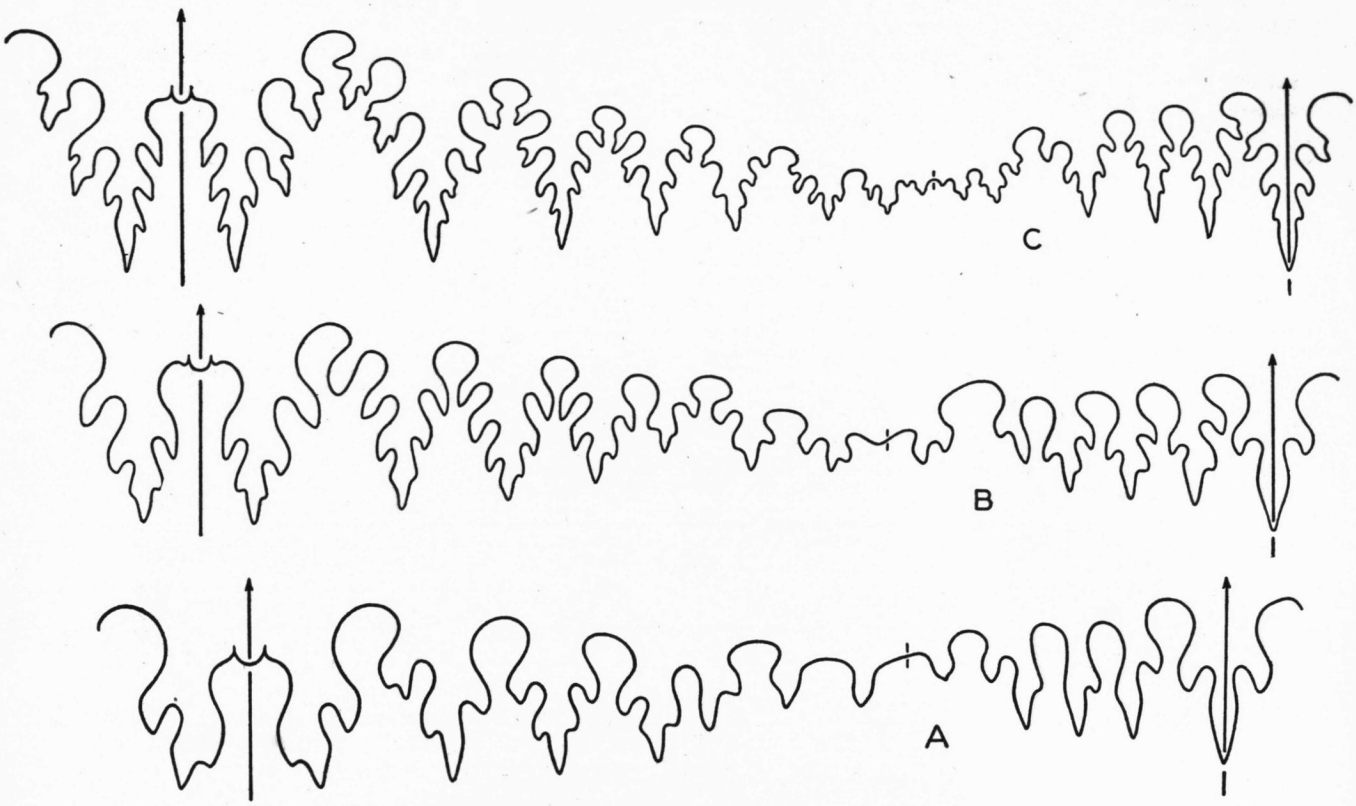


FIGURE 4.—Diagrammatic representations of sutures of two species of *Properrinites* and one of *Perrinites*. (*A*) Early mature suture of *Properrinites bösei bösei* (PLUMMER & SCOTT) at a diameter of about 20 mm, × 6½; based on a paratype (JOHN BRITTS OWEN collection at State Univ. Iowa, 13607) from the Admiral formation about 4½ miles south-southwest of Coleman, Texas. (*B*) Mature suture of *Properrinites cumminsi vicinus* MILLER & FURNISH at a diameter of about 55 mm, × 2½; based on a specimen (Yale Peabody Museum, 15967B) from the Clyde formation about 4 miles south of Electra, Texas. (*C*) Mature suture of *Perrinites hilli hilli* (SMITH) at a diameter of about 65 mm, × 2; based on a topotype (State Univ. Iowa, 1379) from the Guthrie member of the Dog Creek formation at the falls on Salt Croton Creek in Stonewall County, Texas.

located just inside the umbilical seam, is small and is essentially unmodified.

Remarks.—The diagrammatic representation of a suture of this form that was published by PLUMMER & SCOTT (1937, pl. 25, fig. 8) is probably based on a worn specimen, for much smaller individuals in the collections we are studying have more complicated sutures—all come from the same horizon and locality and almost certainly represent only one species. The general physiognomy of the conch and the sutures of this variety are closely similar to those of *Properrinites bösei denhami* MILLER & FURNISH of the Hueco limestone of the Hueco Mountains in western Texas. However, these two forms can be distinguished by certain minor differences in their sutures. Those of the above-described variety are slightly less advanced than those of the Hueco limestone form, though in the former the dorsal digit of the first lateral lobe becomes bifid rather early in the ontogenetic development of the conch. It should be emphasized that the sutures of *P. bösei bösei* are known from only moderately small specimens, and larger and better preserved representatives of these two varieties may show other differences. *P. mooreae* MILLER & FURNISH of the Cibolo formation (Wolfcamp zone) of the Chinati Mountains in western Texas is also very similar to the form under consideration, but it has a smaller umbilicus and slightly more complicated sutures.

As is obvious from comparison of Figures 4A and 4B, *Properrinites bösei bösei* has distinctly more primitive sutures than does *P. cumminsi vicinus* MILLER & FURNISH, which also occurs in the Lower Permian of north-central Texas but much higher in the section, that is, in the Clyde formation. This form (*P. cumminsi vicinus*) is clearly intermediate between the genotype of *Properrinites, P. bösei,* and that of *Perrinites, P. hilli* (cf. Figs. 4A-4C), but in our opinion it is closer to the former than the latter. Therefore, we place it in *Properrinites* rather than *Perrinites.* As we interpret the genus *Properrinites,* it is known from only the United States (and possibly Crimea), and in addition to the forms men-

tioned above, probably it includes *P. plummeri* ELIAS of the Neva limestone of Kansas, *P. bakeri* (PLUMMER & SCOTT) of the Wolfcamp formation of the Glass Mountains in western Texas, and *P. cumminsi cumminsi* (WHITE) of the Clyde formation in north-central Texas. All these are from beds that we believe to be Early Permian in age, and we regard the genus *Properrinites* as characteristic of that epoch. The Crimean form referred to above has never been illustrated or described, but it also is from the Lower Permian, that is, the Soramnian beds.

Occurrence.—Wildcat Creek shale member of the Admiral formation about 4½ miles south-southwest of Coleman, Coleman County, Texas.

Types.—U. S. National Museum (Pl. 3, figs. 1-5; and 20 unfigured specimens); and State University of Iowa (JOHN BRITTS OWEN collection), 13607 (Fig. 4A). It is stated by PLUMMER & SCOTT that the holotype and paratypes are in the PLUMMER collection at the Bureau of Economic Geology of The University of Texas, and that metatypes are at Texas Christian University and the Yale Peabody Museum.

REFERENCES

BULLARD, F. M., & CUYLER, R. H., *1935,* The Upper Pennsylvanian and Lower Permian section of the Colorado River Valley, Texas: Texas Univ. Bull. 3501, p. 191-258.

CHENEY, M. G., *1940,* Geology of north-central Texas: Am. Assoc. Petroleum Geologists, Bull., vol. 24, p. 65-118.

——— & OTHERS, *1945,* Classification of Mississippian and Pennsylvanian rocks of North America: Am. Assoc. Petroleum Geologists, Bull., vol. 29, p. 125-169.

CLIFTON, R. L., *1942,* Invertebrate faunas from the Blaine and Dog Creek formations of the Permian Leonard series: Jour. Paleontology, vol. 16, p. 685-699, pls. 101-104.

———, *1944,* Paleoecology and environments inferred from some marginal Middle Permian marine strata: Am. Assoc. Petroleum Geologists, Bull., vol. 28, p. 1012-1031.

DRAKE, N. F., *1893,* Report on the Colorado coal field of Texas: Texas Geol. Survey, Ann. Rept. 4, pt. 1, p. 355-446. [Reprinted in 1917 as Texas Univ. Bull. 1755.]

DUNBAR, C. O., & SKINNER, J. W., *1937,* Permian Fusulinidae of Texas (The geology of Texas, vol. 3, pt. 2): Texas Univ. Bull. 3701, p. 517-825, pls. 42-81.

ELIAS, MAXIM, *1938,* Studies of Late Paleozoic ammonoids: Jour. Paleontology, vol. 12, p. 86-105, pls. 19, 20.

HYATT, ALPHEUS, *1893,* Carboniferous cephalopods; second paper: Texas Geol. Survey, Ann. Rept. 4, pt. 2, p. 377-474.

KRUGLOV, M. V., *1928,* Les Nautilides du Carbonifère supérieur et de l'étage d'Artinsk de l'Ural: Acad. Sci. U. R. S. S., Trav. Mus. Géol., tome 3, p. 63-206, pls. 5-15.

MILLER, A. K., DUNBAR, C. O., & CONDRA, G. E., *1933,* The nautiloid cephalopods of the Pennsylvanian system in the Mid-Continent region: Nebraska Geol. Survey, 2d ser., Bull. 9, p. 1-240, pls. 1-24.

MILLER, A. K., & FURNISH, W. M., *1940,* Permian ammonoids of the Guadalupe Mountain region and adjacent areas: Geol. Soc. America, Special Paper 26, p. 1-242, pls. 1-44.

MILLER, A. K., & UNKLESBAY, A. G., *1942,* Permian nautiloids from western United States: Jour. Paleontology, vol. 16, p. 719-738, pls. 111-117.

SELLARDS, E. H., *1933,* The geology of Texas, vol. 1, Stratigraphy: Univ. Texas Bull. 3232, pp. 1-1007, figs. 1-54, pls. 1-11.

WILLMARTH, M. G., *1938,* Lexicon of geologic names of the United States: U. S. Geol. Survey, Bull. pp. 1-2396.