

A COILED NAUTILOID FAUNA FROM THE MATTOON FORMATION
(PENNSYLVANIAN) OF ILLINOIS

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ABSTRACT

A large cephalopod fauna has been collected from the Shumway Limestone Member of the Mattoon Formation (Virgilian: Pennsylvanian) from Effingham Co., Illinois. The coiled nautiloids include eleven species ten of which are considered in the present paper. Seven new species are described including Tainoceras sexlineatum n. sp., Metacoceras copei n. sp., Domatoceras wortheni n. sp., D. mattoonense n. sp., Stearoceras involutum n. sp., Solenochilus shumwayense n. sp., and Ehippioceras moineellae n. sp. Previously described species included in the fauna are Tainoceras monilifer Miller, Dunbar and Condra and Liroceras liratum (Girty). An unidentified specimen is tentatively referred to Metacoceras. The ontogeny of Tainoceras monilifer is described in detail for the first time and an ancestral group of Metacoceras is suggested. Tainoceras murrayi formerly considered a valid species is shown to be a specimen of T. monilifer.

INTRODUCTION

Except for Illinois, the nautiloid faunas of the Pennsylvanian Period of the Mid-Continent states have been studied in some detail (Miller, Dunbar and Condra, 1933; Miller and Owen, 1934). Unklesbay (1962) also described Pennsylvanian nautiloids from Oklahoma and the nautiloids of the Pennsylvanian in Ohio have been extensively studied (Miller and Unklesbay, 1942 and 1947; Sturgeon, 1946; Sturgeon and Miller, 1948; Murphy, 1970 and 1974). Except for the 19th century descriptions of a few species of nautiloids by McChesney, Meek and Worthen information about Pennsylvanian nautiloids of Illinois is very incomplete and represents a significant gap in our knowledge about the distribution and character of nautiloid faunas in the Mid-Continent. The present paper describes the coiled nautiloids from a large cephalopod fauna (Table 1) from the Mattoon Formation of Illinois.

The type localities of all newly described species are at the type locality of the Shumway Limestone Member at SE1/4 SE1/4 SW1/4, sec. 26, T.9N., R.5E., Effingham Quadrangle, Effingham Co., Ill. All specimens were collected in the lower bed of the Shumway Limestone Member. Catalog numbers unless otherwise noted are those of the invertebrate paleontological

TABLE 1. The cephalopods of the Shumway Limestone Member. * denotes species that are described in this report.

Mooreoceras sp.
Brachycycloceras normale Miller, Dunbar and Condra
Brachycycloceras sp.
Tainoceras monilifer Miller, Dunbar and Condra *
T. sexlineatum n. sp. *
Metacoceras copei n. sp. *
Metacoceras sp. *
Cooperoceras n. sp. (Tucker, in press)
Domatoceras wortheni n. sp. *
D. mattoonense n. sp. *
Stearoceras involutum n. sp. *
Solenochilus shumwayense n. sp. *
Liroceras liratum (Girty) *
Ephippioceras moinellae n. sp. *
Gonioloboceras sp.
Eosinites sp.

collections of the Field Museum of Natural History, Chicago where all types are deposited. Although most of the specimens reported here were collected by the author over a period of years, D. Moll and G. Paukstis made significant contributions. R. Hart, G. Paukstis and R. Weigel made laboratory and darkroom equipment available. I thank L. Brown, R. Funk and D. Moll for reading the manuscript. The University of Iowa Geology Department and the Carnegie Museum made specimens available.

STRATIGRAPHIC AND FAUNAL SUMMARY

The Shumway Cyclothem which includes the Shumway Limestone Member was described by Kosanke et al. (1960). It is probably Lower Virgilian in age and roughly correlates with the Lawrence Shale or Iatan Limestone of the Mid-Continent and presumably the Upper Conemaugh of Ohio (Kosanke et al., 1960). The lower bed of the Shumway Limestone is a blue-grey to grey, fine grained, impure limestone that weathers reddish to buff in color. Associated with the limestone are some terrigenous sediments and occasionally logs are found preserved in it. The most common and best preserved invertebrates are the productid brachiopods. These are for the most part unsorted and are generally articulated. Pedunculate brachiopods are much rarer. The nature of the brachiopod fauna suggests that the Shumway Limestone was a carbonate bank similar to Watkins' (1974) Lissomarginifera association although differing in species composition. The nautiloids of the Shumway Limestone are similar to those found in other Upper Pennsylvanian units in the United States. Cooperoceras and Stearoceras are characteristic of Permian and Pennsylvanian beds of the southwest and their occurrence in the Shumway Limestone suggests faunal connections with the southwestern United States.

SYSTEMATIC PALEONTOLOGY

Order Nautilida Agassiz, 1847
 Family Tainoceratidae Hyatt, 1883
 Genus Tainoceras Hyatt, 1883
Tainoceras monilifer Miller, Dunbar and Condra, 1933
 Pl. 1, fig. 7, text fig. 1.

1933. Tainoceras monilifer Miller, Dunbar and Condra, Nebraska Geol. Survey, Bull. 9, 2d ser., p. 148-151, Pl. 10, figs. 1-5.
 1942. Tainoceras monilifer Miller and Unklesbay, Carnegie Museum Annals, 29, p. 142-143, Pl. 4, fig. 3 (not 1-2).
 1942. Tainoceras murrayi Miller and Unklesbay, Jour. Paleontology, 16, p. 729, Pl. 114, figs. 2,3.
 1962. Tainoceras monilifer Unklesbay, Oklahoma Geol. Survey, Bull. 96, p. 31-33, Pl. 2, fig. 10.
 1962. Tainoceras murrayi Unklesbay, Oklahoma Geol. Survey, Bull. 96, p. 33, Pl. 2, fig. 11,12.

Material. 47 specimens (PE 27971-PE 28017) mostly testiferous fragments were collected.

Description. The general features of this species were described by Miller, Dunbar and Condra (1933); only details that they could not observe are considered here. Two specimens have the earliest whorls preserved and show that shells 55 mm in diameter consisted of two volutions. Mature specimens (85-95 mm in diameter) must have consisted of about 3.5 volutions. The umbilicus is large with an umbilical perforation of 2-6 mm in diameter. The ventral nodes abruptly appear at a diameter of 28 mm or after about 1.5 volutions. They are staggered and remain so with few exceptions until they disappear at a ventral width of 37.2 mm (range = 32-43 mm) or a diameter of at least 85 mm. The left row of ventral nodes appears first in the two specimens where this could be observed. The mid-ventral sulcus is present before the ventral nodes are visible. This furrow develops at a diameter of about 25 mm. The first quarter volution is essentially circular in cross section and is unornamented. Lateral plicae that slant apicad from the ventrolateral shoulders appear on the second quarter volution. The plicae become more and more slanted apically as the end of the first volution is approached. The ventrolateral and umbilical ends of the plicae are elevated into nodes during the last quarter of the first volution. The ventrolateral nodes become enlarged very abruptly while the umbilical nodes remain smaller. The plicae become less pronounced mid-laterally by the end of the first volution. Although plicae are detectable upto 1.5 volutions, the nodes are very pronounced and some umbilical nodes are no longer associated with plicae. By two volutions plicae have disappeared except for the swollen areas immediately above each ventrolateral node. Mid-ventrally there is a slight ridge on the internal mold that represents the conchal furrow. The siphuncle is slightly ventrad of center at all stages. The connecting rings are cylindrical and segments of the siphuncle are not expanded within the camerae. The septal necks are orthochoanitic but are slightly more curved dorsally than ventrally.

Discussion. The early ontogeny of T. monilifer is most similar to that seen in Metacoceras species such as M. perelegans. It is likely that Tainoceras evolved from some species of Metacoceras that possessed umbilical nodes rather than those lacking them such as M. cornutum. The holotype of T. murrayi, contrary to the description, was found to have umbilical nodes and is considered a synonym of T. monilifer.

Tainoceras sexlineatum n. sp.

Pl. 1, figs. 4,5.

1942. Tainoceras monilifer Miller and Unklesbay (not Miller, Dunbar and Condra), Carnegie Museum Annals, 29, p. 142-143, Pl. 4, figs. 1-2 (not 3).

Etymology. This species is named for the six lines of nodes that characterize it.

Material. The holotype (PE 27919) and a paratype (PE 27910) were available for study.

Diagnosis. This species is a convolute Tainoceras with umbilical nodes that extend onto the sides of the conch as indistinct ribs, longitudinally elongate to hemispherical ventrolateral nodes that are small and relatively close together, and a subrectangular conch that is wider than high.

Description. The holotype is a poorly preserved partially crushed specimen. The shell, measuring about 46 mm in diameter, is a convolute rapidly expanding nautilicone consisting of at least two whorls. The umbilical diameter is about 1/3 that of the entire shell. At the adoral end of the whorl, the cross section is subrectangular, being wider than high. The conch is widest at the umbilical shoulders. The dorsal impressed zone is about equal in width to that of the umbilical walls. These are very steep, nearly flat, and form distinct umbilical shoulders with the sides of the conch. The lateral walls are flat and nearly parallel though slightly convergent ventrad. The ventrolateral shoulders are narrowly rounded between the ventrolateral nodes. The venter is evenly convex in early stages and becomes flattened in later stages.

The venter has four rows of nodes, one at each of the ventrolateral shoulders and a central pair that divides the venter into three equal parts. The laterally paired ventrolateral nodes are rather narrow and longitudinally elongate. They increase regularly in size and become hemispherical with enlargement of the shell. Where the venter has a width of 7 mm, these nodes are about 5 mm apart from crest to crest. This distance increases to 7 mm where the venter has a width of 14 mm. The ventrolateral nodes are spaced so that the distance between adjacent nodes is less than the length of the preceeding node. The staggered ventral nodes first appear after at least one volution has been completed. At first the nodes are confluent and form two parallel longitudinal ridges which are soon divided into discrete nodes. At first the nodes are longitudinally elongated but later they become more hemispherical in shape. The space between the ventral nodes develops into a mid-ventral sulcus. Each umbilical shoulder bears a row of nodes. These are almost as numerous and as large as the ventrolateral nodes in the first 1.5 whorls. The ventrolateral nodes enlarge more quickly than the umbilical nodes and soon become much larger than the umbilical nodes. Each umbilical node is elongated into a slight ridge that extends toward the venter. The growth lines form a moderately deep hyponomic sinus and a shallow lateral salient. The last two camerae of the phragmocone of the paratype are crowded suggesting it represents a mature individual. The sutures are sinuous with well developed ventral and lateral lobes. The height and width at mid-length of the paratype is 28 mm and 32 mm respectively. The siphuncle was not observed.

Comparison. Miller and Unklesbay (1942, Pl. 4, figs. 1-2) illustrated two specimens identified as T. monilifer. I have examined these and they are not T. monilifer. The ventral nodes of the Conemaugh Tainoceras are only slightly laterally elongated where they disappear. Those of T. monilifer are laterally elongated after the first 1.5 volutions and remain that way until they disappear. Although the Conemaugh specimens are badly distorted they appear to be conspecific with T. sexlineatum. T. nebrascense Miller, Dunbar and Condra and Tainoceras sp. Miller, Dunbar and Condra lack umbilical nodes. T. wyomingense has umbilical nodes but the ventrolateral nodes of that species are much larger at comparable stages than those of T. sexlineatum.

Genus Metacoceras Hyatt, 1883

Metacoceras copei n. sp.

Pl. 1, fig. 6; Pl. 3, figs. 1,2; Pl. 4, fig. 3.

Etymology. This species is named for Edward Drinker Cope, vertebrate paleontologist and herpetologist.

Material. The holotype (PE 27920), a fragment of about half a whorl, and paratypes (PE 27921-PE 27923, PE 27949, PE 27961-PE 27969) were collected.

Diagnosis. This species is a depressed Metacoceras with ventrolateral nodes that have knob-like distal ends and that have lateral extensions of the nodes running almost to the umbilical shoulder which is non-nodose.

Description. The evolute conch consists of about three whorls. The umbilicus is perforate and about half the diameter of the conch. The nearly circular umbilical perforation is about 4 mm wide. The living chamber makes up at least half a whorl. The cross section of the whorl is variable at different stages of growth. Where the venter is 5 mm wide the whorl is elliptical in cross section. The umbilical shoulders are apparent but rounded where the venter is 7 mm wide or after a little more than half a volution. At this stage the conch is subtrapezoidal in cross section being widest at the venter. After 1.5-2 whorls the cross section is depressed subrectangular being wider than high. The dorsum is slightly impressed. The venter is evenly convex and about equal in width to the umbilical shoulders. The ventrolateral and umbilical shoulders are rounded. The lateral zones are flattened though slightly convex. After 2-2.5 whorls the conch has a width of 28 mm and a height of 15 mm. The whorl is widest slightly ventrad of the umbilical shoulders. The venter is flattened and has a slight mid-ventral sulcus developed. The lateral zones are flat but the ventrolateral and umbilical shoulders are rounded. The umbilical walls are only slightly convex and meet the dorsum at an acute angle.

The ornamentation consists of laterally paired ventrolateral nodes that extend onto the sides of the conch as distinct ribs. Umbilical nodes are absent throughout. On the first half volution the conch has pronounced transverse lirae that may be homologous to growth lines. These are greatly reduced at the end of the first half volution where the ventrolateral nodes appear. The ventrolateral nodes are associated with ribs at all growth stages observed. The nodes have enlarged knob-like distal ends that become apparent after one whorl has been completed. The ventrolateral nodes of the holotype are reduced in size at the adoral end and are irregularly spaced. This may be due to injury or to mature modification of the nodes. The exact cause could not be determined.

as the nodes on the other side are not preserved and none of the paratypes are as large as the holotype. Growth lines show that a deep hypnomic sinus was present along with slight lateral salients.

The sutures are somewhat sinuous with a slight ventral lobe bordered by ventrolateral saddles, lateral lobes and umbilical saddles. There is a slight dorsal lobe but no annular process. The siphuncle is variable in position depending on growth stage. In the first half volution it is 0.6 mm in diameter and almost in contact with the venter. By the time 1.5 volutions have been completed the siphuncle has moved dorsally and is about central in position. The internal structure of the siphuncle is not known.

Comparison. This species is most similar to Metacoceras cornutum Girty. The position of the siphuncle is not known to vary in that species. M. cornutum has ventrolateral nodes that are much larger and elongate than those of M. copei. Also M. cornutum does not retain lateral extensions of the nodes as does M. copei. M. dubium Hyatt resembles M. copei in cross section. The internal mold of M. dubium lacks lateral extensions of the ventrolateral nodes. These may be easily seen on the internal mold of M. copei.

Discussion. Murphy (1970) with some question included the small paratype of M. cornutum Girty in the synonymy of his M. mcchesneyi. This is certainly incorrect because Girty's figure (1915, Pl. 29, fig. 4) is at odds with Murphy's (1970) description of M. mcchesneyi. Murphy pointed out that M. mcchesneyi has angular umbilical shoulders and lacks well developed ventrolateral nodes and their lateral extensions at an early stage. The specimen figured by Girty has angular umbilical shoulders but it also has well developed ventrolateral nodes and their lateral extensions on the first whorl. Girty's paratype more closely resembles M. sangamonense than any other species.

(?) Metacoceras sp.
Pl.2, fig. 2; Pl.4, fig. 2.

Material. One poorly preserved specimen (PE 27970) was collected.

Comparison. The specimen is too poorly preserved to describe but it may be differentiated from all other species of Tainoceratidae of the fauna by the nature of its ventrolateral nodes. These do not closely resemble those of equal sized M. copei nor of young Tainoceras.

Family Grypoceratidae Hyatt in Zittel, 1900

Genus Domatoceras Hyatt, 1891

Domatoceras wortheni n. sp.

Pl. 1, figs. 1-3; Pl.2, fig. 1; Pl. 4, fig. 1.

Etymology. This species is named for A. H. Worthen, State Geologist for Illinois from 1858-1888.

Material. The holotype (PE 27951) though fragmentary shows the features of the species. The paratypes (PE 27924-PE 27936, PE 27938-PE 27948, PE 27950, PE 27952-PE 27955) were also available.

Diagnosis. This species is a slightly convolute Domatoceras with convergent, nearly flat sides, flat to slightly convex venter, moderately elongate ventrolateral nodes that are interconnected by a persistent carina on the last volution.

Description. The evolute conch is subdiscoidal with 3.5-4 whorls;

the maximum observed diameter is 117 mm. The diameter of the umbilicus is about 1/3 the diameter of the entire shell. The umbilical perforation varies from 4-7 mm in diameter. The whorl section is compressed subtrapezoidal, higher than wide though it is variable at different growth stages. The cross section is essentially circular in the first half volution. Lateral zones appear at a width of 8 mm or after about 3/4 volution. At this stage the venter is evenly convex on both the internal mold and the test. Because the width of the whorl increases more rapidly at the dorsum than the venter, beyond a width of 10 mm the flanks become convergent ventrad. The flanks are evenly convex except for a flattened zone immediately above the ventrolateral carina. Beyond a height of 20 mm the sides are flattened. The impressed zone is present at a height of 12 mm. The venter is evenly convex in young stages but becomes nearly flat in later whorls. The ventrolateral carinae, developed at a height of 8 mm, remain prominent at all growth stages. The carinae develop into a series of longitudinally elongated nodes at a height of 28 mm or after about 3 whorls have been completed. The nodes are closely spaced with the space between adjacent nodes smaller than the length of the preceding node. At this stage the ventrolateral nodes are present on the internal mold and are about as numerous as they are on the test. The ventrolateral carinae are persistent and follow the lateral edge of the venter both between and over the nodes making the venter look concave. The ventral surfaces of the nodes have marked concave appearance due to the carinae. Widely spaced ventrolateral nodes are also found on the internal mold where the dorsoventral diameter is about 25 mm but these are not visible on the test due to thickening of the shell between the nodes. The umbilical shoulders are narrowly rounded on the test but more narrowly rounded on the internal mold. Very indistinct umbilical nodes are present on the test of the living chamber of mature specimens. The ventrolateral shoulders of the test are angular and carinate while those of the internal mold are broadly rounded. The umbilical slopes are steep and they meet the dorsum at slightly less than a right angle. Shells of less than two volutions are more angular in general than larger shells. Longitudinal lirae were observed on the venter of large individuals. The growth lines form a deep hyponomic sinus that is bordered on both sides by a lateral salient, and an umbilical sinus. The septal foramen is subcentral in position. The segments of the siphuncle are cylindrical. The septal necks are orthochoanitic in shape though the dorsal ones are more curved than the ventral ones. A conchal furrow was not observed. Up to the first half whorl the suture pattern is essentially transverse to the longitudinal axis of the conch. A few camerae from there the ventral suture is still transverse but slight ventrolateral saddles, lateral lobes, umbilical saddles and a dorsal lobe have appeared. By the end of the first volution a ventral lobe has appeared and the other elements of the suture are more pronounced. The ventral lobe becomes much deeper and more angular in specimens of 2-3 volutions.

Comparison. D. wortheni may be compared to the more subquadratic species of Domatoceras including D. sculptile (Girty), D. umbilicatum Hyatt, D. williamsi Miller and Owen, D. shepherdii Sturgeon and D. walteri Miller and Unklesbay. D. sculptile develops nodes at an earlier stage than does D. wortheni. D. walteri has lateral nodes that are lacking in D. wortheni. D. shepherdii has a lirate internal mold while D. wortheni does not. D. umbilicatum has concave lateral zones while those

of D. wortheni are flat to convex. D. williamsi has pronounced umbilical nodes and lateral crenulations as well as an umbilicus that makes up half of the whorl diameter.

Domatoceras mattoonense n. sp.

Pl. 3, fig. 7.

Etymology. This species is named for the Mattoon Formation.

Material. The holotype (PE 27960) and a paratype (PE 27937) were collected.

Diagnosis. This species is a compressed (height/width = 1.5), convolute Domatoceras with the umbilicus 23% of the diameter of the conch, venter concave on the test and internal mold, septal foramen about central in position.

Description. The compressed convolute subdiscoidal conch has a small perforate umbilicus making up 23% of the diameter of the conch. The whorl section is compressed subtrapezoidal being about 2/3 wide as high. The venter is concave on the internal mold and even more concave on the test due to pronounced ventrolateral carinae. The venter is less than 1/2 as broad as the greatest width of the whorl which is attained a little below the umbilical shoulders. The sides are slightly convex over the upper half of the whorl and become slightly concave toward the venter. The sides converge toward the venter which they meet at sharp ventrolateral angles, both on the test and the internal mold. The umbilical shoulders are broadly rounded on the internal mold and more narrowly rounded on the test. The umbilical walls of the test meet the dorsal impressed zone at acute angles. At the end of the first half whorl, the whorl section is almost circular though slightly higher than wide. Here the height of the whorl is 7 mm and the venter is evenly convex. At 1.5 volutions, the whorl has increased in height to 12 mm, its width is 8 mm and a shallow dorsal impressed zone is present. The venter is flat on the internal mold but concave on the test due to well developed ventrolateral carinae. The venter is about 1/2 as wide as the greatest width of the whorl at the umbilical shoulder. The ventrolateral shoulders of both the test and the internal mold are angular. At this stage the umbilical shoulders are rounded on the internal mold and more narrowly rounded on the test. The narrow, nearly flat umbilical walls are about perpendicular to the plane of coiling. The whorl expands to a height of 30 mm where the body chamber begins. Its impressed zone is 5 mm deep at that point, the greatest width of the whorl is at about 2/3 the distance between the umbilical shoulders and ventrolateral shoulders and is 20 mm. The venter at this stage has a width of 9 mm.

The living chamber is at least 1/3 volution in length. The surface of the internal mold is smooth except for sutures and the periphraet which is pleuromyarian in shape. At 1.5 volutions the suture forms a rounded ventral lobe, sharp ventrolateral saddles, broad lateral lobes and a dorsolateral saddle centered near each umbilical shoulder. Since the last cameræ of the holotype is somewhat narrower than the preceding ones, this specimen was probably approaching maturity. The siphuncle is slightly ventrad of center at all stages.

Comparison. D. moorei Miller, Dunbar and Condra and D. mattoonense are compressed to about the same degree. D. mattoonense has a concave venter on the internal mold (flat in D. moorei), has the septal foramen about central in position (ventral in D. moorei) and has an umbilicus making up about 23% of its diameter (16% in D. moorei). D. gardi Murphy

is also similar in degree of involution but is less compressed than D. mattoonense.

Genus Stearoceras Hyatt, 1893

Stearoceras involutum n. sp.

Pl. 4, fig. 4.

Etymology. This species is named for the great degree of involution that characterizes it.

Material. The holotype (PE 27956), a well preserved, partially testiferous mature specimen was available for study.

Diagnosis. This is a relatively compressed, involute Stearoceras which has a width/height ratio of 1.2 at the junction of the living chamber and the phragmocone at maturity, an umbilicus making up about 10% of the diameter and no annular process in at least the outer third volution.

Description. The involute nautiliconic shell makes at least 2.5 and more likely 3.5 volutions and is only slightly depressed. The diameter of the shell measured across the umbilicus is 121 mm. The umbilicus at the same place has a diameter of 13 mm. The whorl is widest at or slightly ventrad of the umbilical shoulders. At the junction of the phragmocone and living chamber, the shell is 78 mm wide and 62 mm high. 1/3 whorl apicad of there the width is 55 mm and the height is 49 mm indicating that the width increases slightly faster than the height. The outer whorl is rounded subtrapezoidal in cross section being only slightly depressed. At maturity, the venter is gently convex while the sides are somewhat flatter. The umbilical walls are steep flattened slopes that form both angular umbilical shoulders and meet the dorsal impressed zone at about 90 degrees. The dorsal impressed zone is deep occupying about 1/6-1/5 the height of the whorl. The cross section is variable with age as the venter and sides are somewhat more convex in inner whorls. The width and height of the whorl are about equal 1.5 whorls apicad of the oral end of the type. The test is thickest at the umbilical shoulders and thins as the venter is approached. It is unornamented except possibly for growth lines which could not be observed on the type.

The camerae are moderately convex apicad and the sutures are only slightly sinuous. There are distinct ventral and lateral lobes that are separated by ventrolateral saddles. Slight saddles center on the umbilical shoulders and the sutures are essentially straight on the umbilical walls. A very shallow lobe is present dorsally. An annular process is not present in at least the outer third volution. The siphuncle is 2-3 mm dorsad of the venter in the inner whorls but moves to about central in position in the outer whorl. It appears to be orthochoanitic and is not greatly expanded within the camerae. The siphuncle is 3 mm in diameter where the shell has a width of 18 mm and is 4 mm wide where the shell is 59 mm wide.

Comparison. The diameter of the umbilicus of S. gibbosum (Hyatt), which is the most involute species previously included in the genus, makes up between 1/3-1/4 the diameter of the shell (Gordon, 1964). S. involutum is much more involute with the diameter of the umbilicus being about 1/10 the diameter of the shell.

Family Solenochilidae Hyatt, 1893

Genus Solenochilus Hyatt, 1893

Solenochilus shumwayense n. sp.

Pl. 1, fig. 8; Pl. 2, fig. 3; Pl. 3, fig. 3.

Etymology. This species is named for the Shumway Limestone Member.

Material. The holotype (PE 27887) and paratypes (PE 27886, PE 27888-PE 27897, PE 27899, PE 27901-PE 27906, PE 27909, PE 27911-PE 27959) were available for study.

Diagnosis. This species is a Solenochilus that is widest ventrad of the umbilical shoulders, has a broad depressed, rapidly expanding involute conch, long dorsolateral spines, rounded sides, lateral concave zones, wide camerae with 3-4 occurring in the space equal to the width of the whorl and relatively straight sutures.

Description. This is a large species that has a depressed nautili-conic conch with a small, deep umbilicus. The umbilicus makes up about 8% of the diameter of the shell. One larger paratype is a fragment of a shell that is estimated to have been at least 180 mm in diameter. The holotype is a fragment of about 3/4 volution from a juvenile shell that probably consisted of close to 2 volutions. The conch is rapidly expanded orad with the width increasing from 35 mm to 50 mm in the space of 27 mm as measured along the venter. The whorls are depressed being about half as high as they are wide. The venter broadly rounds into the more narrowly rounded ventrolateral zones. The umbilical walls are at first convex then become steep flattened slopes that meet the shallow dorsal impressed zone at nearly right angles. The sides are evenly convex in shells that have not surpassed 50 mm in width. Beyond this point revolving concave zones become apparent as do developing apertural spines. Although the concave zones remain indistinct except on very large shells, the sides are considerably flattened beyond a width of 70 mm. The shell is widest about midway between the venter and the umbilical shoulders on shells that

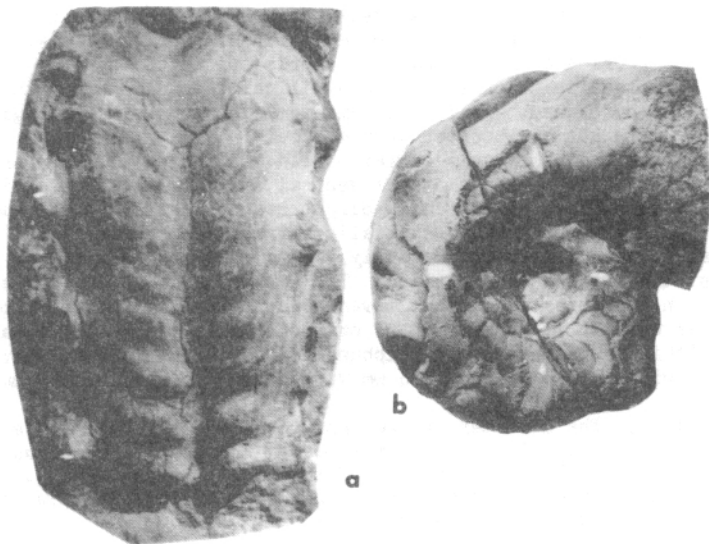


Figure 1. Ventral and lateral views of two Tainoceras monilifer specimens from the Shumway limestone (both $\times 1$).

are less than 50 mm in width. The developing concave zones and the flattening of the sides causes the point of greatest width to move ventrally. Where the dorsolateral spine is fully developed the shell is widest at the umbilical shoulder. The dorsal impressed zone becomes apparent where the conch is 40 mm wide but is never very pronounced. The living chamber which was at least half a volution in length maintains the same general shape as the phragmocone except for the developing apertural spine. The umbilical carinae are present where the conch is 25 mm wide. Where the conch is 40 mm wide the carinae are about 2 mm high and the adoral portion of the shell is slightly flared. The height of the umbilical carinae and the degree of dorsolateral modification gradually increases as the size of the conch increases. A paratype has a portion of one apertural spine preserved. The spine is 30 mm long and 7 mm wide at its broken distal end. It is normal to the plane of coiling and essentially straight. The posterior surface of the spine is uniformly rounded. The anterior surface is not present and probably had not developed yet. Growth lines are poorly preserved ventrally on all specimens. Laterally they form a slight lateral salient.

Ventrally the camerae are deep with 3-4 occurring in the space equal to the width of the whorl. They are only moderately convex apicad. The sutures are very nearly transverse to the longitudinal axis of the conch having only a broad shallow ventral lobe and very slight ventrolateral saddles. Laterally the sutures are straight. Since the siphuncle was in contact with the venter for only part of its length, the ventral septal necks appear to converge apicad when seen on internal molds. The dorsal portion of the septal necks are cyrtochaenitic. Although the segments of the siphuncle do not appear to be in contact with the test ventrally, they are expanded within the camerae. The length of the ventral septal necks and the width of the siphuncle increases as the size of the conch increases. The siphuncle is 1.5 mm wide and the septal necks are 3 mm long where the conch is 40 mm wide and 4 mm and 6 mm respectively where the conch is 70 mm wide.

Comparison. S. shumwayense is most similar to S. brammeri Miller, Dunbar and Condra. S. shumwayense expands at a more rapid rate than S. brammeri. The ventral septal necks of S. brammeri extend half way through the camerae while those of S. shumwayense extend only 1/3 the length of the camerae. The siphuncle of S. brammeri was in contact with the test for a longer distance as the septal necks do not converge as they do in S. shumwayense. The septal necks of S. shumwayense are in direct contact with the test only near the cameral wall. They then dip down into the camerae. S. greenense is also similar but it has a distinctive siphuncle and much more pronounced concave zones. Other species of Solenochilus are not particularly close to S. shumwayense.

Family Liroceratidae Miller and Youngquist, 1949

Genus Liroceras Teichert, 1940

Liroceras liratum (Girty)

Pl. 3, fig. 4.

- 1911. Coloceras liratum Girty, New York Acad. Sciences, Annals, 21, p. 144.
- 1911. Coloceras liratum var. obsoletum Girty, New York Acad. Sciences, Annals, 21, p. 145.
- 1970. Liroceras liratum Murphy (includes full synonymy), Jour. Paleontology, 44, p. 203-204, Pl. 36, fig. 9.

Material. 15 specimens of this wide spread species were collected (PE 28018-PE 28032).

Description. The involute subglobose conch is reniform in cross section. The venter and sides are evenly rounded, the umbilical shoulders are abruptly rounded, and the umbilical walls are flat. The narrow deep umbilicus is about $1/4$ the diameter of the conch. An indistinct ventral sulcus is present on the living chamber of specimens larger than 25 mm in diameter. The siphuncle is not visible on any specimen. Ornamentation consists of fine growth lines and revolving lirae. The growth lines form deep rounded hyponomic sinuses bordered on each side by lateral salients and a sinus slightly ventrad of the umbilical shoulders. The revolving lirae are restricted to the umbilical walls and adjacent portions of the lateral walls. None of the specimens collected (smallest = 15 mm diameter) have the lirae reaching beyond the umbilical area. Lateral lirae are persistent to a diameter of 29 mm. The sutures are essentially transverse to the longitudinal axis of the conch. The internal suture could not be observed on any of the specimens. A very indistinct conchal furrow is present on the living chambers of large individuals.

Family Ehippioceratidae Miller and Youngquist, 1949

Genus Ehippioceras Hyatt, 1894

Ehippioceras moinellae n. sp.

Pl. 3, figs. 5, 6.

Etymology. This species is named for my mother encouraged and supported my studies of the Shumway Limestone faunas.

Material. The holotype (PE 27914) and paratypes (PE 27900, PE 27907-PE 27908, PE 27915-PE 27918) were collected.

Diagnosis. This species is a very depressed (about twice as wide as high), rapidly expanding Ehippioceras which has a narrowly rounded umbilical shoulder and a broad V-shaped ventral saddle.

Description. The holotype is an internal mold of about half a volution including part of the body chamber and eight adoral camerae of the phragmocone. The conch is a rapidly expanding involute nautilicone that apparently consisted of 2-3 volutions. In at least the outer volutions the whorl section is reniform being greatly depressed, broadly rounded ventrally and laterally, and more narrowly rounded dorsolaterally. The dorsum is not visible but it was surely impressed for part of its width. The whorls are about twice as wide as they are high. At the junction of the living chamber and the phragmocone the holotype is 27 mm wide and 15 mm high. The conch is widest at or just below the umbilical shoulders. The umbilicus is small and deep with a diameter of $1/8$ - $1/11$ that of the entire shell. The test is poorly preserved but appears to be smooth except for growth lines. The living chambers of large individuals have thickened growth lines that are set at irregular intervals. The living chamber of this species was at least $1/2$ - $2/3$ a volution in length. The holotype is near maturity since some paratypes whose phragmocones are about the same size as the holotype's have crowded adoral camerae. The camerae except for the ones bordering the living chamber in mature specimens are spaced at 6 mm intervals mid-ventrally and 3 mm mid-laterally. The sutures have a moderately wide slightly rounded V-shaped ventral saddle flanked on either side by a broad shallow ventrolateral lobe and a narrow slightly angular dorsolateral saddle centered on the umbilical shoulder. The internal suture and the position and nature of the siphuncle are not known. There is a conchal

furrow present on larger individuals.

Comparison. This species is much more depressed than its closest relative E. ferratum (Cox). Since all the Shumway specimens are depressed to about the same degree, the degree of depression cannot be easily attributed to distortion during preservation.

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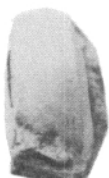
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Plate 1.

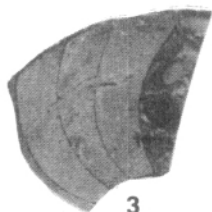
- Fig. 1,2. Lateral and ventral views of a juvenile paratype (PE 27942) of Domatoceras wortheni. X 1.
- Fig. 3. Longitudinal section of a paratype (PE 27925) of Domatoceras wortheni showing septal necks and connecting rings. X 2.
- Fig. 4,5. Ventral and lateral views of the holotype (PE 27919) of Tainoceras sexlineatum. X 1.
- Fig. 6. Lateral view of the holotype (PE 27920) of Metacoceras copei showing distal swellings of the ventrolateral nodes and irregular placement and obsolescence of the ventrolateral nodes adorally. X 1.
- Fig. 7. Longitudinal section of a specimen (PE 27975) of Tainoceras monilifer showing septal necks. X 1.5.
- Fig. 8. Ventral view of the holotype (PE 27887) of Solenochilus shumwayense. X 0.75.



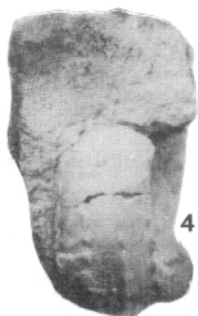
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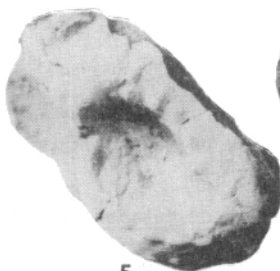
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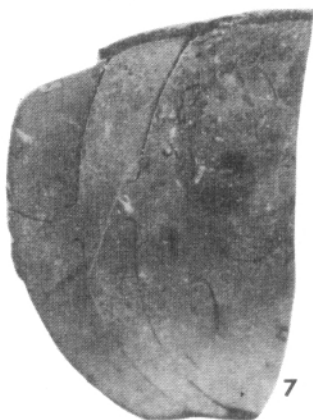
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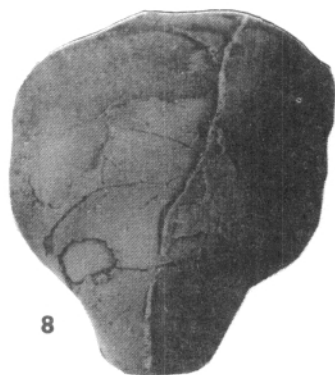
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Plate 2.

- Fig. 1. Lateral view of the holotype (PE 27951) of Domatoceras
wortheni. X 1.
- Fig. 2. Lateral view of Metacoceras sp. (PE 27970). X 1.2.
- Fig. 3. Ventral view of a paratype (PE 27886) of Solenochilus
shumwayense showing developing dorsolateral spine. X 1.



Plate 3.

- Fig. 1. Ventral view of the holotype (PE 27920) of Metacoceras copei. X 1.
- Fig. 2. Lateral view of a paratype (PE 27967) of Metacoceras copei that is exfoliated and nearly complete adorally. X 1.
- Fig. 3. Ventral view of a paratype (PE 27889) of Solenochilus shumwayense. X 1.
- Fig. 4. Ventral view of a specimen (PE 28020) of Liroceras liratum showing slight midventral sulcus that develops at maturity. X 1.
- Fig. 5. Ventral view of the holotype (PE 27914) of Ehippioceras moinellae. X 1.
- Fig. 6. Lateral view of a paratype (PE 27915) of Ehippioceras moinellae. X 1.
- Fig. 7. Lateral view of the holotype (PE 27960) of Domatoceras mattoonense. Note anterior and posterior borders of the periphraet. X 1.1.

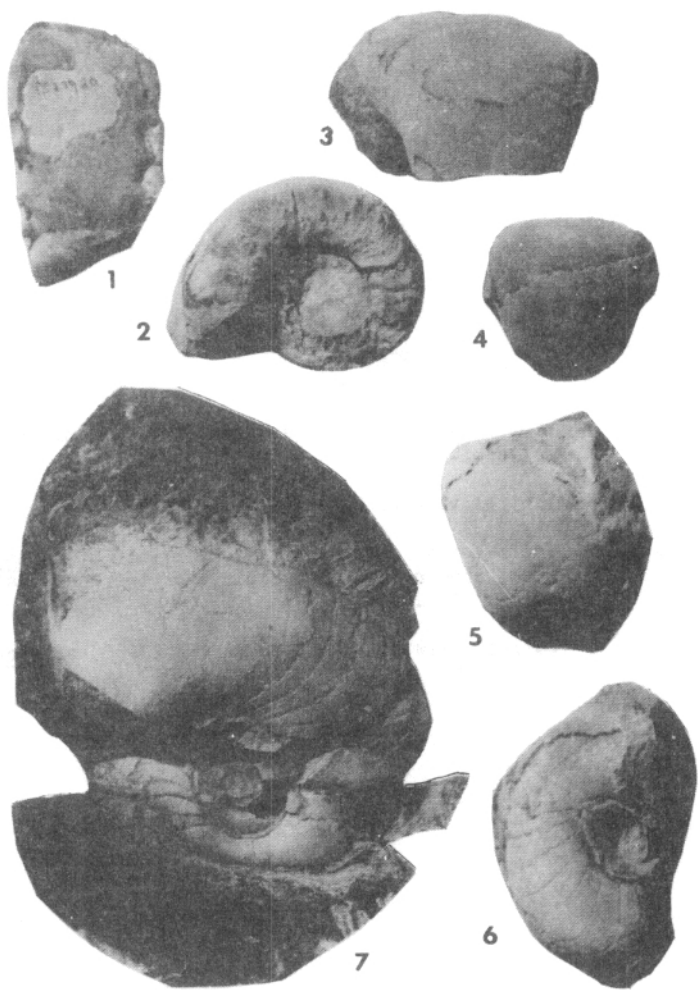


Plate 4.

- Fig. 1. Ventral view of the holotype (PE 27951) of Domatoceras
wortheni. X 1.
- Fig. 2. Ventral view of Metacoceras sp. (PE 27970). X 1.
- Fig. 3. Ventral view of a paratype (PE 27961) of Metacoceras
copei showing distal swellings of the ventrolateral
nodes. X 1.
- Fig. 4. Lateral view of the holotype (PE 27956) of Stearoceras
involutum. X 0.9.

