

SOME AMMONOIDS FROM THE RIPLEY FORMATION OF MISSISSIPPI, ALABAMA, AND GEORGIA

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Abstract.—Heteromorph ammonoids occur in the Coon Creek Tongue of the Ripley Formation of Late Cretaceous (Maestrichtian) age in northeastern Mississippi and in the age-equivalent part of the Ripley Formation along the Chattahoochie River separating Alabama and Georgia. Ammonoids treated in this report are *Nostoceras alternatum* (Tuomey), *Exiteloceras* sp., *Axonoceras?* sp., and the new species *Solenoceras nitidum* and *Axonoceras sohli*. None of these species is known outside the eastern part of the Mississippi embayment area.

Ammonoids representing the genera *Baculites*, *Hoploscaphites?*, *Solenoceras*, *Axonoceras*, *Exiteloceras*, and *Nostoceras* are present in the U.S. Geological Survey's collections of fossils from the lower part (Coon Creek Tongue) of the Ripley Formation of northeastern Mississippi and the time-equivalent part of the Ripley Formation along the boundary between Alabama and Georgia. *Baculites* and *Hoploscaphites?*, represented by a very few fragmentary specimens, are not included in the present report. The ammonoids represent a single zone herein referred to as the zone of *Nostoceras alternatum* (Tuomey).

The Ripley Formation in northeastern Mississippi attains a thickness of nearly 350 ft and is divisible into five units as follows, from oldest to youngest: transitional clay, Coon Creek Tongue, McNairy Sand Member, sand of the upper part of the Ripley, and Chiwapa Member (Sohl, 1960, p. 10-20; 1964, fig. 12). Ammonoids representing the zone of *Nostoceras alternatum* occur in the Coon Creek Tongue in Tippah and Union Counties. Southward from Union County the Ripley Formation thins rapidly, and the five lithologic units lose their identity (Sohl, 1960, pl. 1). Farther southward in Mississippi the thinned Ripley becomes calcareous and grades into impure sandy chalk. Far to the southeast, along the Chattahoochie River forming part of the boundary between Alabama and Georgia, the Ripley consists of about 135 ft of dark-gray micaceous clayey sand (Eagle, 1955, p. 57-59).

The ammonoids from Tippah and Union Counties and from the exposures along the Chattahoochie River are very well preserved and usually retain their nacreous shell material. The figured specimens are at the National Museum of Natural History, Washington, D.C., and plaster casts of some are at the U.S. Geological Survey, Federal Center, Denver, Colo. Robert

E. Burkholder, of the Geological Survey, photographed the specimens.

AMMONOID RECORDS FROM THE RIPLEY FORMATION

References to ammonoid species are scarce in the literature concerning the Ripley Formation of Mississippi, Alabama, and Georgia. The earliest record seems to be that of Tuomey (1854, p. 168), who briefly described the new species *Turrilites alternatus* from Noxubie County, Miss. Six years later Conrad (1860, p. 284) described as a new species *Turrilites spinifera* from Eufaula, Ala., and Tippah County, Miss. Although neither Tuomey nor Conrad illustrated his specimens, the descriptions suggest the same species which is best assigned to *Nostoceras*.

The Ripley Formation was named by Hilgard (1860, p. 93, 95), who reported the presence of Conrad's *Turrilites spinifera* [*Nostoceras alternatum*] in it from Tippah County as well as *Solenoceras annulifer* (Morton), a species known previously only from older strata in Delaware. The *Solenoceras* from Tippah County is probably the new species *S. nitidum*.

Nostoceras alternatum was recorded as *Turrilites alternatus* from the Ripley Formation of northeastern Mississippi by Crider (1906, p. 21) and Stephenson (1914, table 2) and from the Ripley along the Chattahoochie River in Alabama and Georgia by Stephenson (1911, p. 178, 211, 213; 1914, table 8). Stephenson and Monroe (1940, chart opposite p. 182) recorded *Nostoceras* sp. from the Ripley Formation of Union County, Miss., and Cooke (1943, p. 30) reported *N. stantoni* Hyatt? from the Ripley of Georgia. These specimens are probably all *N. alternatum*.

LOCALITIES OF COLLECTIONS

Localities that contain heteromorph ammonoids in the Coon Creek Tongue of the Ripley Formation and in the age-equivalent part of the Ripley of Alabama and Georgia are listed in the following descriptions from the northwest to the southeast. The location of the collection site is followed by the name of the collector, the year of collection, and the stratigraphic assignment. Collections that contain only baculites or scaphites are not included. The largest and best

collections of heteromorphs are from localities described by Stephenson and Monroe (1940, p. 182–192) and Sohl (1960, p. 28–31). These authors presented stratigraphic sections for some of the collecting localities. Most of the northeastern Mississippi fossil localities are shown on a map by Sohl (1960, pl. 2). For the Chattahoochie River area, the reader is referred to the sketch map by Stephenson (1911, fig. 6).

USGS Mesozoic localities 542, 708. Bullock's old overshot mill, 2 mi south of Dumas, in sec. 36, T. 5 S., R. 4 E., Tippah County, Miss. L. C. Johnson, 1888; T. W. Stanton, 1889. This locality, in the Coon Creek Tongue of the Ripley Formation, was described by Stephenson and Monroe (1940, p. 188) and Sohl (1960, p. 28).

Baculites cf. B. undatus Stephenson

Solenoceras nitidum Cobban

Exiteloceras? sp.

Axonoceras sohli Cobban

Nostoceras alternatum (Tuomey)

USGS Mesozoic locality 709. W. O. Kelly farm 2.3 mi south of Dumas in the NE¼ sec. 35, T. 5 S., R. 4 E., Tippah County, Miss. T. W. Stanton, 1909. Coon Creek Tongue of Ripley Formation (Sohl, 1960, p. 28).

Solenoceras nitidum Cobban

Nostoceras alternatum (Tuomey)

Hoploscapites? sp.

USGS Mesozoic locality 25407. Roadcut on northeast-facing slope of Hall Creek 2.9 mi southwest of Dumas, in the center of the S½NW¼ sec. 34, T. 5 S., R. 4 E., Tippah County, Miss. N. F. Sohl, 1950–52. Coon Creek Tongue of Ripley Formation (Sohl, 1960, p. 28).

Nostoceras alternatum (Tuomey)

USGS Mesozoic localities 18078, 18629, and 25411. Scraped area north of dam of Union County Lake, 1.1 mi northeast of Pleasant Ridge, in the NW¼NE¼NE¼ sec. 11, T. 6 S., R. 4 E., Union County, Miss. L. C. Conant and Andrew Brown, 1939; L. W. Stephenson and W. H. Monroe, 1940; N. F. Sohl, 1950–52, 1955; G. R. Scott, 1961. This highly fossiliferous locality near the base of the Coon Creek Tongue of the Ripley Formation has been mentioned in several reports (Stephenson and Monroe, 1940, p. 182, 192; Conant, 1942, p. 22–25, fig. 3; Harbison, 1945, p. 75; Sohl, 1960, p. 31).

Baculites sp.

Solenoceras nitidum Cobban

Exiteloceras sp.

Axonoceras sohli Cobban

Nostoceras alternatum (Tuomey)

USGS Mesozoic localities 6873, 25408. Lee's old millsite, roadcut on northeast-facing slope of Tallahatchie River valley, 2 mi north-northeast of Keownville, in the NW¼NE¼ sec. 17, T. 6 S., R. 4 E., Union County, Miss. L. W. Stephenson, 1910; N. F. Sohl, 1950–52. Upper part of Coon Creek Tongue of Ripley Formation (Sohl, 1960, p. 30–31). See Stephenson and Monroe (1940, p. 191) for a photograph of this locality.

Axonoceras sohli Cobban

Exiteloceras sp.

Nostoceras alternatum (Tuomey)

USGS Mesozoic locality 712. Bluff on North Branch of Wilhite Creek, 3 mi south of Molino and 0.8 mi south of Mount Olivet School, in the NW¼ sec. 21, T. 6 S., R. 4 E., Union County, Miss. T. W. Stanton, 1889. Coon Creek Tongue of Ripley Formation (Sohl, 1960, p. 30). *Nostoceras* sp. was identified from this locality by Stephenson (Stephenson and Monroe, 1940, chart opposite p. 182).

Solenoceras nitidum Cobban

Nostoceras alternatum (Tuomey)

USGS Mesozoic locality 857. Chattahoochie River, 2 mi below the landing at Eufaula, Ala. T. W. Stanton, 1891. Ripley Formation

(Stephenson, 1911, p. 178).

Nostoceras alternatum (Tuomey)

USGS Mesozoic locality 27883. Falls on Lumberyard Creek near center of sec. 4, T. 10 N., R. 29 E., Barbour County, Ala. N. F. Sohl and A. Karl, 1961. Ripley Formation.

Nostoceras alternatum (Tuomey)

USGS Mesozoic locality 28434. Left bank of Barbour Creek downstream from bridge of U.S. Highway 431, in the SE¼NE¼SE¼ sec. 7, T. 10 N., R. 29 E., Barbour County, Ala. N. F. Sohl and R. L. Rieke, 1961. Ripley Formation.

Baculites sp.

Nostoceras alternatum (Tuomey)

USGS Mesozoic locality 27923. Bluff on right bank of Barbour Creek at first bend above bridge of U.S. Highway 431, in the NW¼SE¼ sec. 7, T. 10 N., R. 29 E., Barbour County, Ala. N. F. Sohl and A. Karl, 1961. Ripley Formation.

Nostoceras alternatum (Tuomey)

USGS Mesozoic locality 28437. Right side of Chattahoochie River 0.5–0.7 mi below Tabannee Creek and 1.8 mi below the landing at Eufaula, in the SW¼NE¼ sec. 9, T. 10 N., R. 29 E., Quitman County, Ga. N. F. Sohl and R. L. Rieke, 1961.

Solenoceras sp.

Nostoceras alternatum (Tuomey)

USGS Mesozoic localities 27542, 28431. Left bank of Chattahoochie River about 2 mi below crossing of Central of Georgia Railroad, Quitman County, Ga. N. F. Sohl and S. C. Crosby, 1959; Sohl and R. L. Rieke, 1961. Ripley Formation.

Baculites cf. B. undatus Stephenson

Solenoceras nitidum Cobban

Nostoceras alternatum (Tuomey)

USGS Mesozoic locality 28438. Left bank of Chattahoochie River in Quitman County, Ga., 2.6–2.7 mi below the landing at Eufaula, Ala. N. F. Sohl and R. L. Rieke, 1961. Ripley Formation.

Nostoceras alternatum (Tuomey)

USGS Mesozoic locality 26014. Bluff on left bank of Chattahoochie River 2.8 mi below Eufaula landing, Quitman County, Ga. N. F. Sohl and H. I. Saunders, 1955. Ripley Formation.

Nostoceras alternatum (Tuomey)

USGS Mesozoic locality 25991. Bluff on left side of Chattahoochie River about 0.25 mi above the mouth of Barbour Creek, 4 mi south of Eufaula in Quitman County, Ga. N. F. Sohl and H. I. Saunders, 1955. Ripley Formation.

Nostoceras alternatum (Tuomey)

SYSTEMATIC DESCRIPTIONS

Phylum MOLLUSCA

Class CEPHALOPODA

Order AMMONOIDEA

Family NOSTOCERATIDAE Hyatt, 1894

Genus SOLENOCERAS Conrad, 1860

Type (by original designation).—*Hamites annulifer* Morton, 1842.

Conrad's (1860, p. 284) definition of *Solenoceras* was brief: "Differs from PTYCHOCERAS, *D'Orbigny*, in the smaller tube lying in a furrow, of the larger one, which is straight only for a short distance from the junction, and then suddenly recurved." He cited *Hamites annulifer* Morton (1841, p. 109; 1842, p. 213, pl. 11, fig. 4) as the type and recorded its presence in Tuomey's collection from Eufaula, Ala. The

holotype was said to have come from "the Ferruginous sand at the Deep-cut of the Chesapeake and Delaware canal" (Morton, 1842, p. 213). The deep cut is chiefly in the early Campanian Merchantville Formation (Pickett, 1970). Additional specimens of *S. annulifer* have not been reported from the deep cut since Conrad's original record. This species, however, does occur in the younger Mount Laurel Sand farther east along the canal. At the well-known Biggs farm fossil locality (Groot and others, 1954, p. 37; Richards and Shapiro, 1963; Owens and others, 1970, fig. 6, p. 16, 44) several examples of *S. annulifer* were found by Mrs. Eldon Homsey and Dr. W. A. Sheppard of Wilmington, Del. Other ammonoids in the Homsey-Sheppard collections from this locality include *Didymoceras cheyennense* (Meek and Hayden) and *Anaklinoceras reflexum* Stephenson which suggest that *S. annulifer* lies somewhere in the zone of *D. cheyennense* or in the zone of *Baculites compressus* Say in terms of the ammonoid sequence of the western interior region (Izett and others, 1971, table 1, p. A15). *Solenoceras annulifer* is much younger than the early Campanian age (Merchantville and Woodbury Formations) usually assigned to it (Richards, 1962, p. 227), and the record of the holotype from the deep cut of the Chesapeake and Delaware Canal is questionable.

Gabb (1861, p. 89–90) noted that the holotype of *S. annulifer* was not "suddenly recurved" at its larger end as indicated in Conrad's definition of the genus. Morton's (1841, p. 109) original description of the specimen was brief, but Whitfield (1892, p. 273, pl. 45, figs. 6–8) and Reeside (1962, p. 121, pl. 70, figs. 8–10) later described the specimen in detail. In summary the type consists of a complete body chamber 21 mm long that is nearly straight for most of its length and is sharply recurved into an elbow at its older end. Its dorsum has a pronounced concave impressed area where it grew over the venter of the more or less straight septate limb. Ribbing is dense and slightly rursiradiate. Each rib bears a very small bullate tubercle on each side of the venter; these tubercles are conspicuous on the elbow but become almost indiscernible on the shaft. A constriction is present on the middle of the straight limb and on the middle of the elbow. The impressed area on the dorsum reveals that at least two constrictions were present on the septate limb. Two high ribs bounding a constriction lie near the aperture.

Solenoceras nitidum Cobban, n. sp.

Figures 1a–k, 2

This species is about the size of the genotype from which it differs mainly by having a smaller impressed area or none at all on the body chamber and by lacking tubercles. The type lot consists of three complete or nearly complete body chambers (fig. 1a–f, i–k) and almost a dozen smaller fragments of body chambers and septate limbs from USGS Mesozoic locality 18078 near Pleasant Ridge, Union County, Miss.

The holotype (fig. 1a–c) is largely an internal mold of a body chamber that has part of the septate limb attached. Some shell

material is preserved on the venter and flanks near the aperture. The specimen is 21 mm long, and the subcircular intercostal section at the larger end is 4.5 mm high and 4.8 mm wide. The internal mold of the septate limb does not touch the body chamber, but the original shelled limbs probably were in contact. A distinct impressed dorsal area is lacking on the body chamber (fig. 1f, i). Ribs, which are rounded and are narrower than the interspaces, are prorsiradiate on the septate limb and retroradiate to slightly rursiradiate on the body chamber. The ribs are arched forward a little on the dorsum (fig. 1f) and very slightly so on the venter of some specimens (fig. 1d). The rib spacing index (whorl height ÷ distance between crests of two adjacent ribs) is 4 on the septate limb and 6 on the body chamber. The aperture is not preserved, but a nearly complete body chamber is indicated by the occurrence near the adoral end of a constriction followed by two high ribs separated by a very thin rib.

Two paratypes reveal the details of the apertural end. One has a high rib followed by two very weak ribs and then the slightly flared aperture (fig. 1d). The other has two high ribs bounding a constriction and then three weak ribs followed by the slightly flared aperture (fig. 1k).

The figured paratypes differ very little from the holotype, and the fragments of other specimens in the type lot suggest that *S. nitidum* does not vary much in the size of adults and in the nature of the ribbing. One specimen, however, shows a considerable gap between the limbs at the elbow (fig. 1h).

The suture is very simple (fig. 2). The lateral and umbilical lobes are symmetrically bifid and a little narrower than the siphonal lobe. The saddles are symmetrically bifid and about twice as wide as the lateral and umbilical lobes.

Solenoceras nitidum is easily separated from other species by its lack of tubercles. The nearest species is probably *S. minimus* (Basse, 1931, p. 17, pl. 1, figs. 20–22) from Madagascar which, however, has minute tubercles.

Types.—Holotype USNM 187711; paratypes USNM 187712–187714.

Genus *EXITELOCERAS* Hyatt, 1894

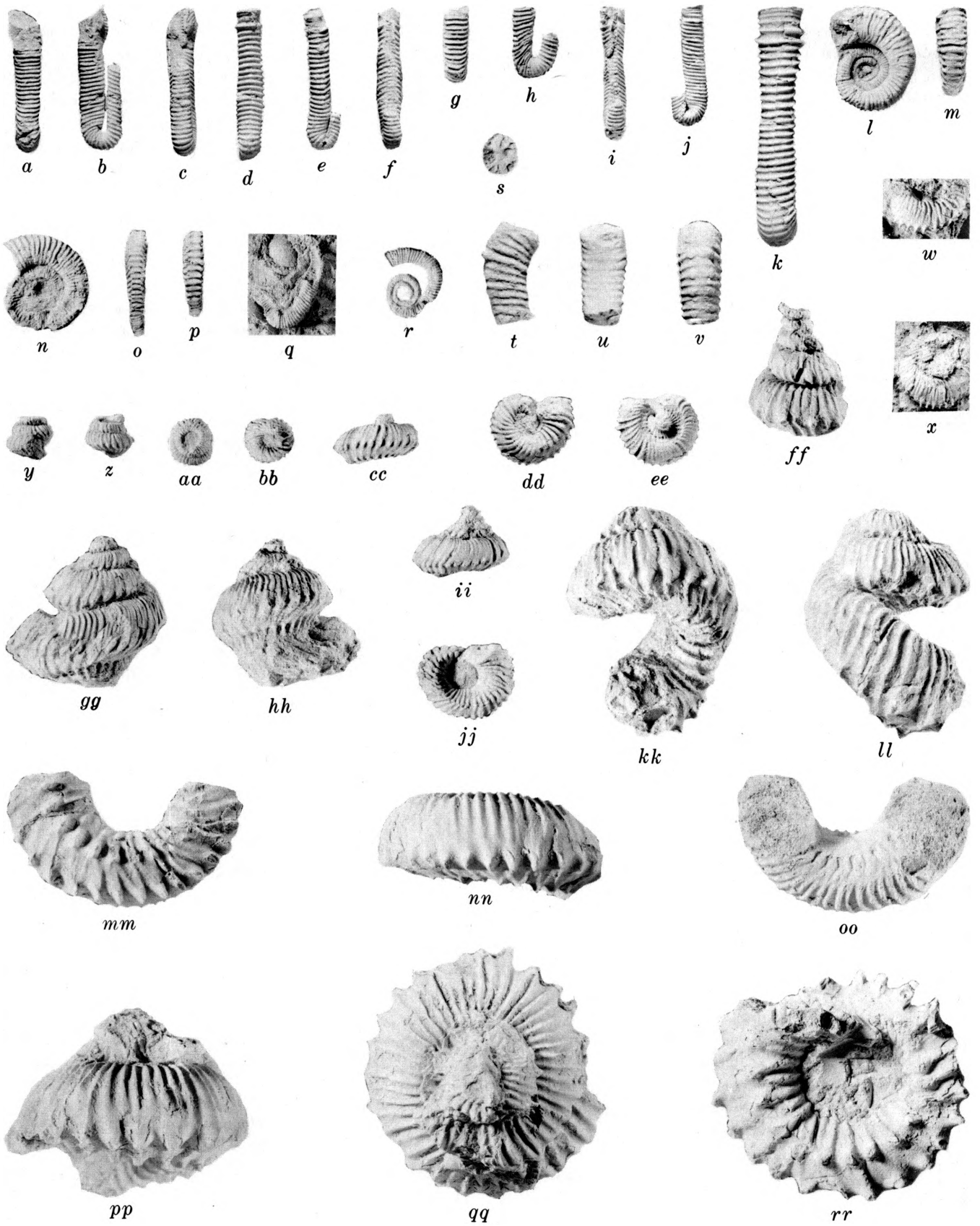
Type species.—*Ancylloceras jennyi* Whitfield, 1877.

Exiteloceras includes heteromorph ammonoids loosely coiled in a plane. The early whorls may consist of straight limbs connected by semicircular elbows. The venter is flattened and is narrower than the dorsum. Ribs are narrow and numerous and usually terminate in a ventrolateral tubercle, but on some forms nontuberculated ribs may separate tuberculated ones. Opposite tubercles on the venter are connected by one or two low ribs.

Exiteloceras sp.

Figure 1s–v, 3

Two fragments of heteromorphs from Tippah County, Miss. (loc. 25411), may represent some species of *Exiteloceras*. One



fragment consists of only the side of a curved limb. The other and better preserved fragment, 19 mm long, is part of a curved limb retaining some shell material. Its cross section is a little higher than wide; the dorsum is broader than the venter which is slightly flattened, and the flanks are broadly rounded. Ribs are narrowly rounded, prorsiradiate, weakest on the dorsum, and strongest on the upper part of the flank where their spacing index is 5. Every other rib terminates in a tubercle that is flat topped on the internal mold, but where some shell material is preserved, a sharp spine is present. Tubercles on opposite sides of the venter are connected by two low ribs. The suture (fig. 3) resembles that of the type of the genus, *Exiteloceras jenneyi* (Whitfield, 1880, pl. 16, fig. 9).

Type.—Figured specimen USNM 187715.

Genus *AXONOCERAS* Stephenson, 1941

Type species.—*Axonoceras compressum* Stephenson, 1941.

Stephenson (1941, p. 422) proposed this genus for "long slender shells coiled in one plane, with numerous closely spaced ribs and two rows of ventral nodes. * * * The shells may be closely coiled, though not involute, but most of them are more or less loosely and irregularly coiled." The genus seems to be also characterized by its small size and by the presence of constrictions. *Axonoceras* has been recorded previously only from Texas (Stephenson, 1941, p. 422–425), Colorado (Izett and others, 1971, p. A7), and Angola (Haas, 1943, p. 7–10; Antunes and Sornay, 1969, p. 88)

Axonoceras sohli Cobban, n. sp.

Figures 11–p, 4

This species is characterized by its flattened flanks and

Figure 1.—Ammonites from the Ripley Formation, all natural size except figure 1k.

- a–k. *Solenoceras nitidum* Cobban, n. sp., from locality 18078. a–c, holotype USNM 187711; d–f, paratype USNM 187712; g, h, paratype USNM 187713; i–k, paratype USNM 187714 (k is enlarged $\times 2$ to show details of ribbing near aperture).
- l–p. *Axonoceras sohli* Cobban, n. sp. l, m, holotype USNM 187716 from locality 18078; n–p, paratype USNM 187717 from locality 708.
- q–r. *Axonoceras* sp. q, figured specimen USNM 187718 from locality 708; r, figured specimen USNM 187719 from locality 18078.
- s–v. *Exiteloceras* sp. from locality 25411, figured specimen USNM 187715.
- w–rr. *Nostoceras alternatum* (Tuomey). w, hypotype USNM 187729 from locality 27542; x, hypotype USNM 187730 from locality 26014; y–bb, hypotype USNM 187720 from locality 18078; cc–ee, hypotype USNM 187725 from locality 25411; ff, hypotype USNM 187721 from locality 18078; gg, hh, hypotype USNM 187722 from locality 18078; ii, jj, hypotype USNM 187723 from locality 18078; kk, ll, hypotype USNM 187728 from locality 708; mm–oo, hypotype USNM 187727 from locality 18629; pp–rr, hypotype USNM 187724 from locality 25411.

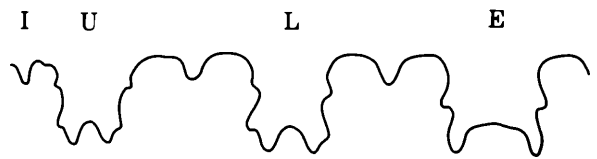


Figure 2.—Suture, $\times 12$, of the holotype of *Solenoceras nitidum* n. sp., USNM 187711. Lobes are external (E), lateral (L), umbilical (U), and internal (I).

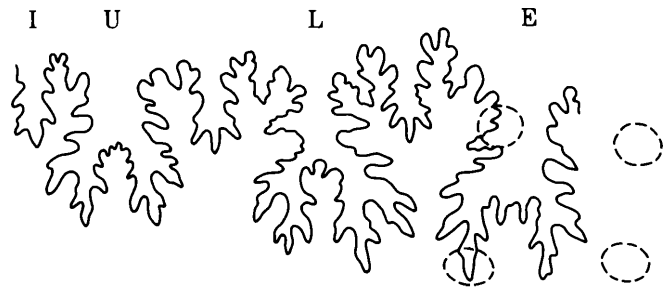


Figure 3.—Suture, $\times 6$, of *Exiteloceras* sp. Figured specimen USNM 187715. Lobes are external (E), lateral (L), umbilical (U), and internal (I).

venter and by the presence of tubercles on every rib on the body chamber as well as on each rib of at least the last septate whorl. The innermost whorls have not been observed. Whorl sections are higher than wide and decidedly rectangular. Ribs are numerous, rectiradiate to rursiradiate, and, on the body chamber, slightly flexuous. They are spaced along the venter of the body chamber at 5 to 6 for the whorl height.

The holotype (fig. 11, m) is a somewhat distorted adult 19.6 mm in diameter that has parts of the shell material preserved. The last quarter whorl consists of body chamber and possibly represents half of it. Two and a half septate whorls are preserved, and although they are crushed and distorted, they appear to have been slightly helical. Ribs on these whorls are rounded, a little narrower than the interspaces, and number four for the whorl height. Five constrictions are present on the last half septate whorl, and most constrictions are bounded on their adapical side by a high rib. Ribbing is slightly denser on the portion of body chamber preserved, and two constrictions are visible. Ventrolateral tubercles are small and pointed.

A complete suture was not observed. Much of the suture is visible on the holotype where it consists of a moderately incised pattern characterized by squarish lobes and rectangular saddles (fig. 4). The lateral and umbilical lobes are about equal in size and a little narrower than the siphonal lobe. The first two saddles are wider than the external lobe and are symmetrically bifid.

Axonoceras sohli is an uncommon species; only six specimens can be assigned to it with certainty. This species readily differs from the genotype *A. compressum* (Stephenson, 1941,

p. 422, pl. 89, figs. 1–5) by having flatter flanks and venter and by having tubercles on every rib. *A. angolatum* (Haas, 1943, p. 8, text figs. 3, 10–13) from Angola also has more inflated flanks and rounded venter as well as a more incised suture with narrower lobes and saddles.

The species is named for Norman F. Sohl in recognition of his important contributions to the paleontology and stratigraphy of the Ripley Formation.

Types.—Holotype USNM 187716, paratype USNM 187717.

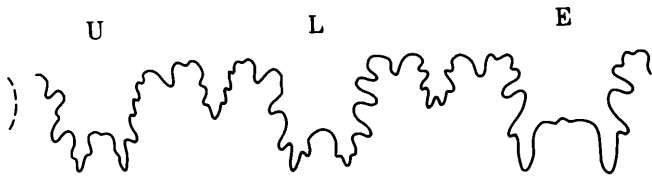


Figure 4.—Most of the suture, $\times 15$, of the holotype of *Axonoceras sohli* n. sp., USNM 187716. Visible lobes are external (E), lateral (L), and umbilical (U).

Axonoceras? sp.

Figure 1q, r

Two small heteromorphs from Tippah County, Miss. (locs. 708, 18078), are loosely and irregularly coiled in a plane. Inasmuch as some individuals of *Axonoceras* are irregularly coiled (Haas, 1943, figs. 10a, b, 11a), the Ripley specimens could be interpreted as aberrant forms of the genus.

The more complete of the two specimens consists of two whorls in contact followed by half of an arcuate whorl considerably removed from the other whorls (fig. 1r). The half whorl, part of a body chamber, has a cross section higher than wide with somewhat flattened flanks and rounded venter. Its rib index along the venter is 5. A few inconspicuous constrictions are present, and one is bounded on its adapical side by a high thickened rib. Tubercles are absent which, combined with the irregular coiling, suggest that the specimen represents a different species than *A. sohli*. The other specimen, part of an asymmetrically curved limb, also lacks tubercles (fig. 1q). The irregular planospiral coiling of these specimens recalls that of *Exicrioceras diabloense* Anderson (1958, p. 208, pl. 72, figs. 1–3) from the upper Campanian or Maestrichtian of California.

Types.—Figured specimens USNM 187718, 187719.

Genus *NOSTOCERAS* Hyatt, 1894

Type species.—*Nostoceras stantoni* Hyatt, 1894.

Ammonoids assigned to this genus have a tight spire of several septate whorls and a body chamber that bends away from the spire or, in some species, bends downward away from the spire and then curves back toward it forming a U-shape. Ribbing is usually dense, and constrictions are present on the spire. Two rows of tubercles are ordinarily present.

Nostoceras alternatum (Tuomey)

Figures 1w–rr, 5

1854. *Turrulites alternatns* [sic] Tuomey, Acad. Nat. Sci. Philadelphia Proc., v. 7, no. 5, p. 168.
 1860. *Turrulites spinifera* Conrad, Acad. Nat. Sci. Philadelphia Jour., 2d ser., v. 4, p. 284.
 1861. *Turrulites alternatus* Tuomey, Gabb, Am. Philos. Soc. Proc., v. 8, p. 91.
 1861. *Turrulites spinifera* Tuomey, Gabb, Am. Philos. Soc. Proc., v. 8, p. 92.

Tuomey (1854, p. 168) described this species as *Turrulites* [*Turrulites*] *alternatns* [*alternatus*]. His description was brief: "Shell turreted, spire dextral; whorls angulated, lower side ornamented by two tuberculated carinae, transversely plaited; plaits double the number of tubercles, alternately terminating in a tubercle." The specimen, which was not illustrated, was said to have come from Noxubee County, Miss. The whereabouts of the holotype is unknown; it was not listed among the types at the Academy of Natural Sciences of Philadelphia (Johnson, 1905).

Six years after the publication of Tuomey's paper, Conrad (1860, p. 284) described as a new species, *Turrulites spinifera*, an ammonoid that was apparently the same species as that of Tuomey. Conrad's description was also brief: "Sinistral, conical; ribs numerous, rounded, alternately ending in a sharp spine; on the angle of the body whirl the spines are erect, those on the spire projecting very obliquely over the contiguous whirl; umbilicus wide, profound, longitudinally ribbed within. Length $1\frac{3}{4}$ inches. Diameter the same nearly." Conrad gave Eufaula, Ala., and Tippah County, Miss., as localities without stating which produced the holotype. The type specimen was never illustrated, and it may be lost.

Ammonoids like those described by Tuomey and Conrad are present in many of the U.S. Geological Survey's collections from the Ripley Formation. The largest collection, from near Pleasant Ridge, Tippah County, Miss. (locs. 18078, 18629, 25411), contains 34 specimens and fragments of which 21 are sinistral and 13 are dextral. These specimens reveal the general characteristics of the species—a tight spire of about four whorls followed by a slight uncoiling of the younger part of the body chamber; numerous ribs; and the two rows of tubercles occupying a basal position on the whorls (fig. 5).

The earliest whorls are not preserved in any of the collections. The smallest whorl observed (fig. 1ff) is rather loosely wound and lacks an impressed area suggesting that the earliest whorls may have formed a loose helicoid spire. The four whorls following the loosely coiled one are tightly wound, and a conspicuous impressed area is present on each. Spire angles of *N. alternatum* range from 45° to 90° . An unusually long body chamber is present occupying $1\frac{1}{4}$ to almost $1\frac{1}{2}$ whorls of which the first complete whorl is part of the tightly wound spire. The younger part of the body chamber pulls away from the spire at angles ranging from 15°

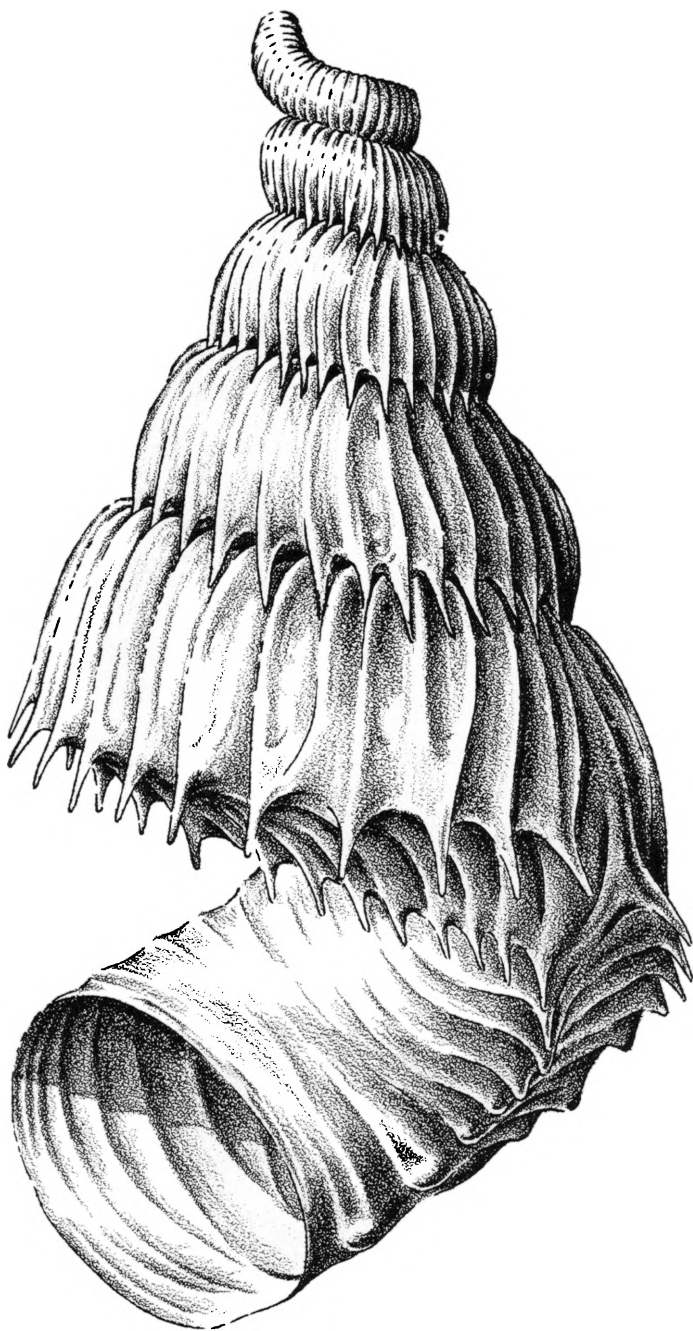


Figure 5.—Restoration of *Nostoceras alternatum*, $\times 4$, based on the specimens shown in figure *lw-rr*. Drawing by John R. Stacy, of the U.S. Geological Survey.

(fig. *lgg*) to 30° (fig. *lll*). A complete mouth border is not preserved on any of the specimens.

Ribs are conspicuous, narrowly rounded, and not as broad as the interspaces. They are strongest at the top of the whorl where they number 40 to 50 per whorl. Each pair of ribs usually terminates in a sharp tubercle at the base of the whorl (fig. *lnn*). From each tubercle a low rib may obliquely cross

the base of the whorl and terminate in a sharp umbilical tubercle (fig. *lrr*) or two ribs may extend from an outer tubercle and connect to two adjacent umbilical tubercles in a zigzag manner (fig. *lmm*). One or two ribs extend from each umbilical tubercle into the umbilicus. Well-preserved specimens reveal that both rows of tubercles supported spines (fig. *lw, x, hh*).

Adult specimens show a considerable range in size. The smallest adult (fig. *lgg*) is about one-half as large as the largest specimen (fig. *lpp*).

The suture (fig. 6) is not as incised as those of other species of *Nostoceras* such as the one illustrated from Angola by Haas (1943, fig. 1) and Howarth (1965, figs. 16, 17) and the one from New Jersey figured by Whitfield (1892, pl. 45, fig. 5). As in other species of helical ammonoids, the external lobe is considerably offset from the position of the siphuncle.



Figure 6.—Part of the suture, $\times 5$, of *Nostoceras alternatum* (Tuomey) from locality 25411. Hypotype USNM 187726. Visible lobes are external (E), lateral (L), and umbilical (U).

Nostoceras alternatum is easily distinguished from most species of the genus by the low position of its tubercles. A closely related form is the species described by Favre (1869, p. 30, pl. 7, figs. 5a-c) from France as *Helicoceras schloenbachi*. Many different heteromorphs have been referred to the French species, but certain specimens resemble *N. alternatum*. Among these is a whorl from Poland figured as *Heteroceras polyplacum* Roemer var. *schloenbachi* Favre by Nowak (1914, p. 386, pl. 41, fig. 14) which has the tubercles low on the flank and a distinct angularity developed at the position of the upper row. Except by having fewer ribs, the Polish specimen resembles some whorls from the Ripley Formation such as those shown in figure *lcc*. Several specimens from Madagascar illustrated by Basse (1931, p. 19, pl. 2, figs. 11-15) as *Turrilites (Bostrychoceras) schloenbachi* (Favre) resemble *N. alternatum* by their dense ribbing and presence of constrictions, but their tubercles are higher on the flank.

Another closely related species is *Nostoceras obtusum* Howarth (1965, p. 384, pl. 10, fig. 2, text fig. 17) from Angola which has the tubercles on the base of the whorls. The African species differs from *N. alternatum* chiefly by its very low spire and wide umbilicus.

Types.—Hypotypes USNM 187720-187730.

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