

# AMERICAN MUSEUM *Novitates*

PUBLISHED BY THE AMERICAN MUSEUM OF NATURAL HISTORY  
CENTRAL PARK WEST AT 79TH STREET, NEW YORK, NY 10024  
Number 3221, 40 pp., 52 figures, 8 tables April 6, 1998

## Engonoceratid Ammonites from the Glen Rose Limestone, Walnut Clay, Goodland Limestone, and Comanche Peak Limestone (Albian) in Texas

W. J. KENNEDY,<sup>1</sup> N. H. LANDMAN,<sup>2</sup> AND W. A. COBBAN<sup>3</sup>

### ABSTRACT

Ammonites of the family Engonoceratidae, commonly referred to as pseudoceratites because of their distinctive suture, are locally abundant in rocks of early to mid-Albian age in Texas, but have received little or no attention since their original description. Ten species are dealt with in the present publication in the following order: *Engonoceras elegans*, n. sp., *En-*

*gonoceras gibbosum* Hyatt, 1903, *Engonoceras stolleyi* Böhm, 1898, *Engonoceras hilli* Böhm, 1898, *Engonoceras complicatum* Hyatt, 1903, *Parengonoceras roemeri* (Cragin, 1893), *Metengonoceras inscriptum* Hyatt, 1903, *Metengonoceras ambiguum* Hyatt, 1903, *Protengonoceras gabbi* (Böhm, 1898), and *Platinknemicer- as flexuosum*, n. sp.

### INTRODUCTION

The family Engonoceratidae Hyatt, 1900, is a distinctive group of mid-Cretaceous ammonites with simplified sutures characterized by a proliferation of adventive and auxiliary elements. These sutures are thus convergent on those of many Triassic ceratites; hence the name "pseudoceratite" is commonly applied to these ammonites (von Buch, 1848; Hyatt,

1903; Geyer, 1995). In some genera, both the lobes and saddles are entire, as in the genus *Neolobites* Fischer, 1882, and the suture bears a superficial resemblance to that of the predominantly Paleozoic prolecanitids.

The evolutionary origin of the group is uncertain; Wright (1996) placed them, with a query, in the superfamily Hoplitaceae. The

<sup>1</sup> Curator, Geological Collections, University Museum, Parks Road, Oxford OX1 3 PW, U.K.

<sup>2</sup> Curator and Chairman, Department of Invertebrates, American Museum of Natural History.

<sup>3</sup> 70 Estes Street, Lakewood, Colorado 80226.

NORTH CENTRAL TEXAS	NORTH EAST TEXAS
KIAMICHI	KIAMICHI
EDWARDS	GOODLAND
COMANCHE PEAK	
WALNUT	WALNUT
PALUXY	PALUXY
GLEN ROSE	GLEN ROSE

Fig. 1. Stratigraphic relationships of units mentioned in the text (after Young, 1967).

engonoceratids exhibit a typically Tethyan distribution, and are abundant in both Old and New Worlds. However, some members of the group occur in the Boreal region, but generally only as stray individuals, e.g., *Par-engonoceras* from the lower Albian (Casey, 1978) and *Engonoceras* from the middle and upper Albian (Spath, 1924, 1931). *Par-engonoceras* is also known in the Austral

Realm in the lower Albian of Bathurst Island, northern Australia (Wright, 1963). Exceptions to this typically Tethyan distribution appear, however, in the U.S. Western Interior, where *Metengonoceras* occurs locally in enormous numbers in the Mowry Shale as far north as Montana (Cobban and Kennedy, 1989).

In Texas, pseudoceratites first appear in the lower Albian Glen Rose Limestone, and they are locally common at horizons extending to the upper Cenomanian *Sciponoceras gracile* Zone (Kennedy, 1988). Below, we describe the pseudoceratites of the Glen Rose Limestone, Walnut Clay, Goodland Limestone, and Comanche Peak Limestone. Figure 1 summarizes the stratigraphic relationships of these units.

USGS MESOZOIC LOCALITIES MENTIONED

- 21585:** Walnut Clay, roadcuts on Cleburne-Glen Rose Highway, 2.3 km (1.4 mi) east of junction with Texas Farm Highway, Somervell County, Texas.
- 22191:** Walnut Clay, 2.5 km (1.5 mi) west of the Court House in Weatherford on Highway 180, Parker County, Texas.
- 22193:** Walnut Clay, north of Goldthwaite on the Waco-Brownwood Road, Mills County, Texas.

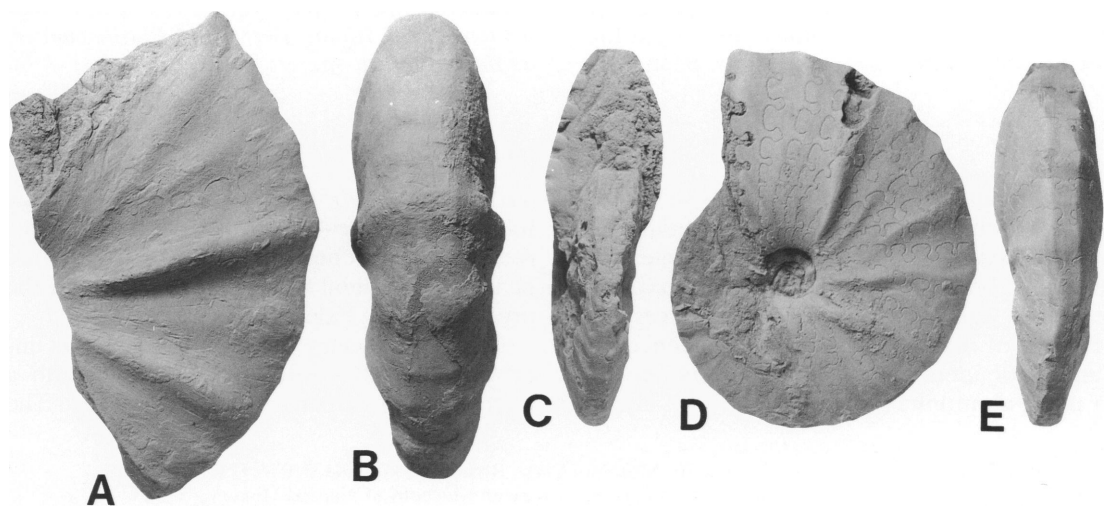


Fig. 2. *Engonoceras elegans*, n. sp. A, B. Paratype, USNM 486463, Glen Rose Limestone, outcrops east and west of bridge on U.S. Highway 199 over Ash Creek, 500 m southeast of Azle, Tarrant County, Texas. C–E. Holotype, USNM 486462, same locality as A, B. All figures are  $\times 1$ .

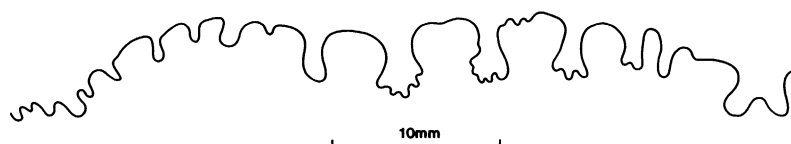


Fig. 3. *Engonoceras elegans*, n. sp. External suture of holotype, USNM 486462.

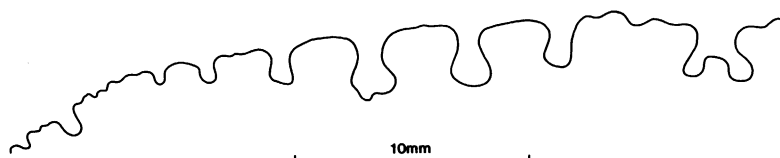


Fig. 4. *Engonoceras elegans*, n. sp. External suture of paratype, USNM 486463.

**22194:** Walnut Clay, 11.5 km (7 mi) east of Decatur on Highway 24, Wise County, Texas.

**22320:** Goodland Limestone, Mary's Creek, 4.95 km (3 mi) west of Benbrook, Tarrant County, Texas.

**22322:** Goodland Limestone, Shaw's Farm, 8.25 km (5 mi) west of Fort Worth, Tarrant County, Texas.

**22324:** Goodland Limestone, 16.5 km (10 mi) west on White Settlement Road, 800 m (0.5 mi) south on farm road, Parker County, Texas.

**22333:** Goodland Limestone, 16 km (10 mi) west of Fort Worth, Tarrant County, Texas.

#### CONVENTIONS

All specimens described here are in the U.S. National Museum of Natural History (USNM) in Washington, D.C. Specimens are photographed in the conventional position with the aperture on top although the authors recognize that the animal would have been oriented differently in life. Arrows on photographs indicate the adapical end of the body chamber where preserved.

#### SYSTEMATIC PALEONTOLOGY

##### FAMILY ENGONOCERATIDAE HYATT, 1900

(= *Knemiceratidae* Hyatt, 1903: 144; *Neolobitinae* Lupov and Mikhailov, 1958: 125)

##### Genus *Engonoceras* Neumayr and Uhlig, 1881

**TYPE SPECIES:** *Ammonites pierdenalis* von Buch, 1848: 31, pl. 6, figs. 8–10, by the subsequent designation of Pervinquière (1907: 200).

**DIAGNOSIS:** "Involute inner whorls very compressed, with narrow, flat or sulcate venter, later flexuous striae normally replaced by weak, flat, flexuous or straight ribs ending in small ventral clavi placed alternately and, in some shells, joined across venter by zigzagging ribs; umbilical and lateral tubercles may be present, and venter of last whorl may be rounded. Suture with more elements than *Knemiceras* and with saddles normally all entire except that outermost are bifid; external lobe normally with strongly divergent branches" (Wright, 1996: 130).

**DISCUSSION:** Wright (1996: 130) regarded *Engonohoplitoidea* Basse, 1940 (p. 441) as a

TABLE 1  
Dimensions (mm) of *Engonoceras elegans* n. sp.<sup>a</sup>

Specimen	D	Wb	Wh	Wb:Wh	Ud
USNM 486462	49.5 (100)	15.5 (31.3)	25.8 (52.1)	0.52	6.5 (13.1)

<sup>a</sup> D = diameter; Wb = whorl breadth; Wh = whorl height; Ud = umbilical diameter. Figures in parentheses are dimensions as a percentage of diameter.

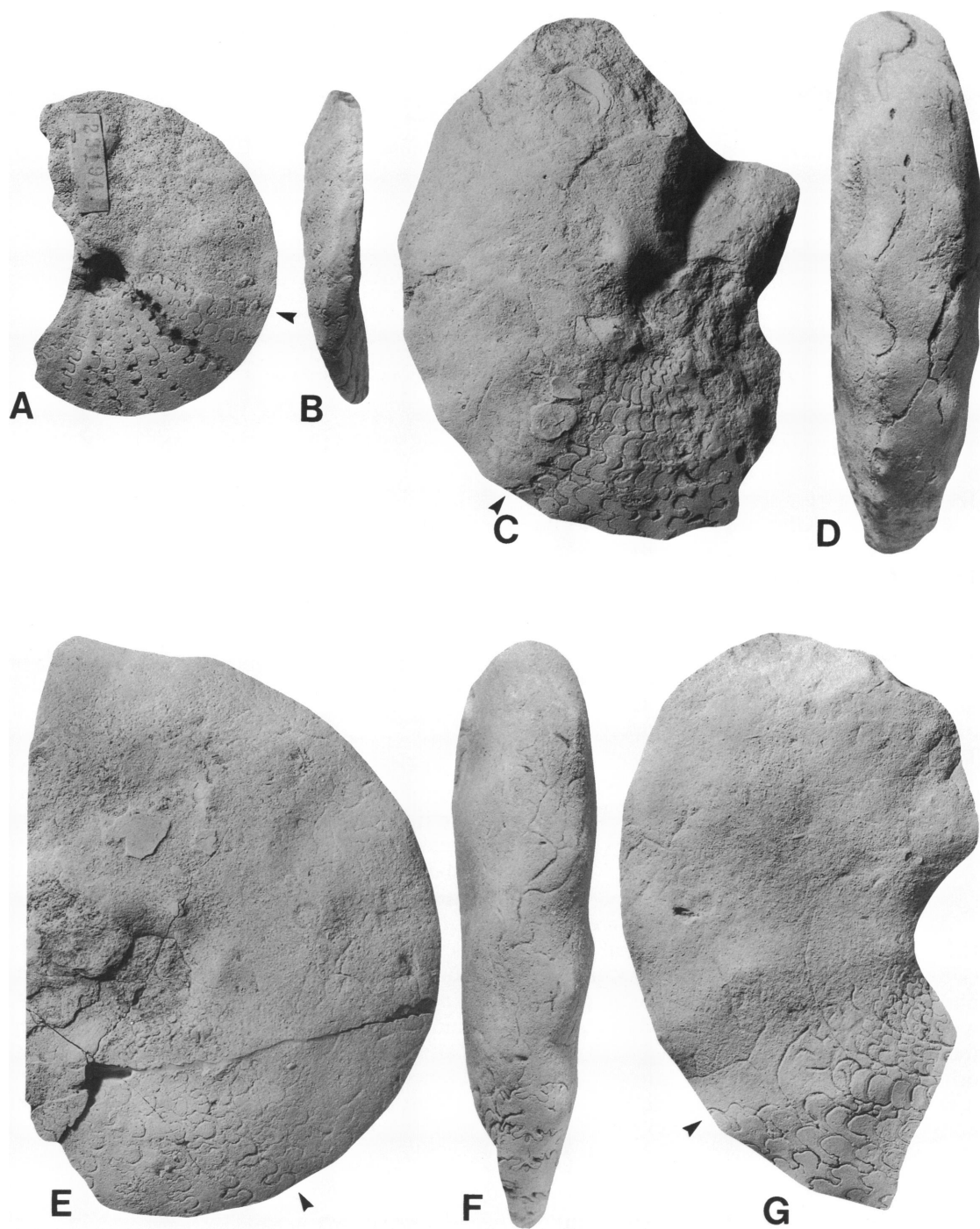


Fig. 5. *Engonoceras gibbosum* Hyatt, 1903. A, B. USNM 486464, Walnut Clay, USGS Mesozoic locality 22194. C, D. USNM 486467, Goodland Limestone, Scurry County, Texas. E, F. USNM 486465, same locality as A, B. G. USNM 486466, same locality as A, B. All figures are  $\times 1$ .



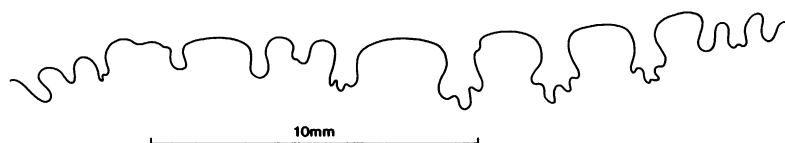


Fig. 6. *Engonoceras gibbosum* Hyatt, 1903. External suture of USNM 486464.

possible synonym of *Engonoceras*. *Engonohoplitoides khenchelaensis* Basse, 1940 (p. 442, pl. 4, figs. 5, 6; text-fig. 12) is the type species of *Engonohoplitoides*, and *Engonohoplitoides zumoffei* Basse, 1940 (p. 443, pl. 5, fig. 1) and *E. vicorpense* Basse, 1940 (p. 443, pl. 5, figs. 2, 3) have been referred to it. Basse differentiated *Engonohoplitoides* from *Engonoceras* on the basis of the external suture line, notably the subdivision of the lateral lobe, remarking that the morphology of the shell resembled that of *Engonoceras*, but that the suture line was closer to that of *Knemiceras*. We follow Wright's view.

**OCCURRENCE:** Lower Albian to middle Cenomanian; England, France, Algeria, Tunisia, Syria, United States (Texas, New Mexico, and Kansas), Mexico, and Colombia.

### *Engonoceras elegans*, new species

Figures 2–4

**TYPES:** The holotype is USNM 486462, paratype USNM 486463, both from outcrops of the Glen Rose Limestone, east and west of the bridge on U.S. Highway 199 over Ash Creek, 500 m southeast of Azle, Tarrant County, Texas.

**DERIVATION OF NAME:** Latin, *elegans*, “fine,” after the delicate ventral clavi.

**DIAGNOSIS:** *Engonoceras* with coarse, distant primary ribs with midlateral bullae and few short secondaries; all ribs with feeble ventral clavi linked across the venter by broad, barlike ribs in middle and later growth.

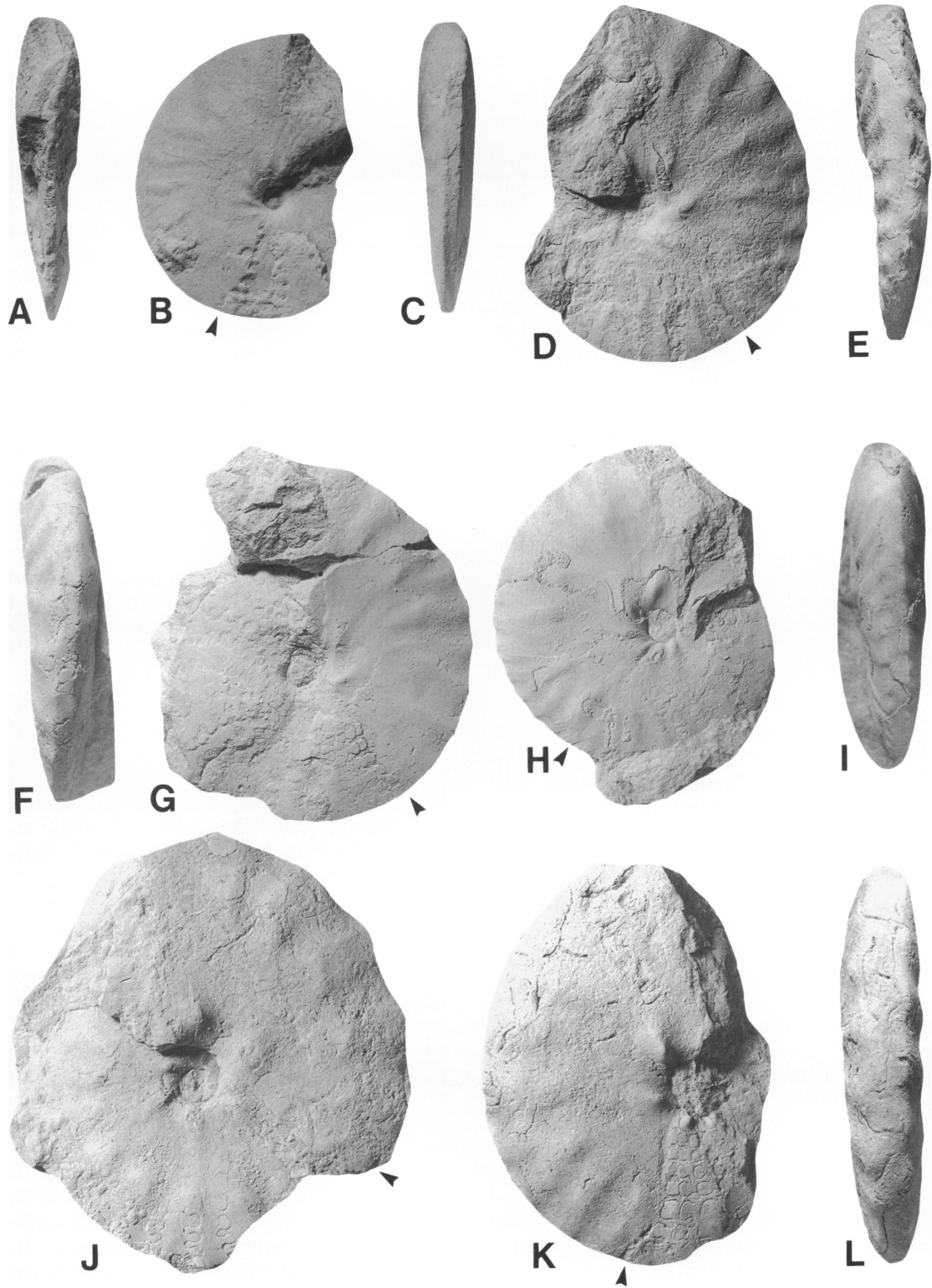
**DESCRIPTION:** Early whorls are represented by the holotype, a phragmocone 49.5 mm in diameter (figs. 2C–E, 3). Coiling is very involute, with a small, shallow umbilicus comprising 13% of the diameter. The umbilical wall is low and flattened, and the umbilical shoulder is narrowly rounded. The whorl section is compressed, with an intercostal ratio of whorl breadth to whorl height of 0.52. The inner- to mid-flank region is broadly

rounded and the outer flanks are flattened and converge to a narrow tabulate venter with narrowly rounded ventrolateral shoulders. The greatest whorl breadth is on the inner flanks.

Ornament is well-preserved on the last half-whorl of the holotype. Eight narrow, distant, straight prorsiradiate ribs arise at or close to the umbilical shoulder. Five of them strengthen markedly on the inner flanks, and all ribs strengthen across the middle and outer flanks to terminate in delicate short ventral clavi, each of which is linked across the venter by a low, broad, blunt transverse rib. There are one or two very short secondary ribs between the primary ribs, which are weaker than or equal to the primary ribs on the flanks, but are comparably developed over the venter, where there is a total of 16 ribs on the last half-whorl.

The paratype is a completely septate fragment with a maximum preserved whorl height of 37 mm and an intercostal ratio of whorl breadth to whorl height of 0.54 (figs. 1A, B, 4). The inner- to mid-flank region is very broadly rounded and the outer flanks are feebly convergent. The ventrolateral shoulders are more broadly rounded, and the venter is broader than in the holotype. There are two strong primary ribs and one weak primary rib plus five short secondary ribs on the third of a whorl preserved. The primary ribs are straight, distant, and barlike, strengthening progressively across the flanks, attaining a maximum elevation close to mid-flank, and broadening on the outer flank. There are very feeble to obsolete ventral clavi, each of which is linked across the venter by a blunt transverse, barlike rib.

The sutures have numerous auxiliary and adventive elements (figs. 3, 4). The saddle between the externalmost of the adventive lobes and the external lobe is asymmetrically trifid. The adventive lobes have narrow necks and few or no incisions; the adventive sad-



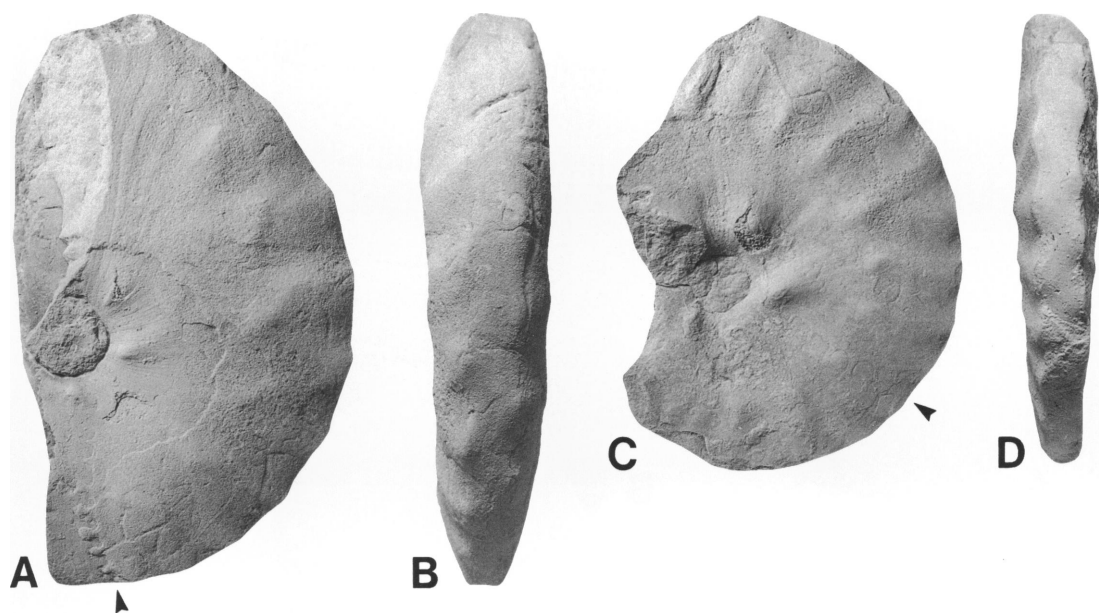


Fig. 8. *Engonoceras stolleyi* Böhm, 1898. A, B. USNM 486483, Comanche Peak Limestone, Mustang Creek, southwest Tarrant County, Texas. C, D. USNM 486474, Goodland Limestone, USGS Mesozoic locality 22333. All figures are  $\times 1$ .

dles have near-entire terminations. The auxiliary lobes are entire, and the auxiliary saddles are bifid or entire.

**DISCUSSION:** The ornament of *Engonoceras elegans*, n. sp. recalls that of *Parengonoceras* Spath, 1924 (see illustrations in Renz, 1970, 1982), but the suture, with entire or near-entire saddles, is that of *Engonoceras*. The unique combination of ornament and suture serves to distinguish this species from all others occurring in the Texas Albian.

**OCCURRENCE:** As for types.

#### *Engonoceras gibbosum* Hyatt, 1903

Figures 5, 6

*Engonoceras gibbosum* Hyatt, 1903: 171, pl. 22, figs. 6–10; pl. 23, figs. 1–6.

*Engonoceras gibbosum* Hyatt, 1903. Adkins, 1928: 263.

*Engonoceras gibbosum* Hyatt, 1903. Emerson et al., 1994: 91.

**TYPE:** The holotype, by original designation, is the specimen figured by Hyatt (1903: pl. 23, figs. 1–3) and said to be from Cook County, Texas.

**DESCRIPTION:** Twelve generally poorly preserved, composite or internal molds are referred to this species. The earliest growth stages observed are 55 mm in diameter; phragmocones show whorl heights of as much as 39.5 mm. Coiling is involute, with a small, shallow umbilicus comprising 12.5% of the diameter. The umbilical wall is low, narrowly rounded, and merges with a broadly rounded umbilical shoulder, which is inclined outward. The whorl section is compressed, becoming progressively broader to-

←

Fig. 7. *Engonoceras stolleyi* Böhm, 1898. A–C. USNM 486468, Comanche Peak Limestone, Mustang Creek, southwest Tarrant County, Texas. D, E. USNM 486469, Goodland Limestone, USGS Mesozoic locality 22320. F, G. USNM 486470, Goodland Limestone, west of Sunset Drive, southwest Fort Worth, Tarrant County, Texas. H, I. USNM 486471, Goodland Limestone, USGS Mesozoic locality 22333. J. USNM 486472, same locality as A–C. K, L. USNM 486473, same locality as A–C. All figures are  $\times 1$ .

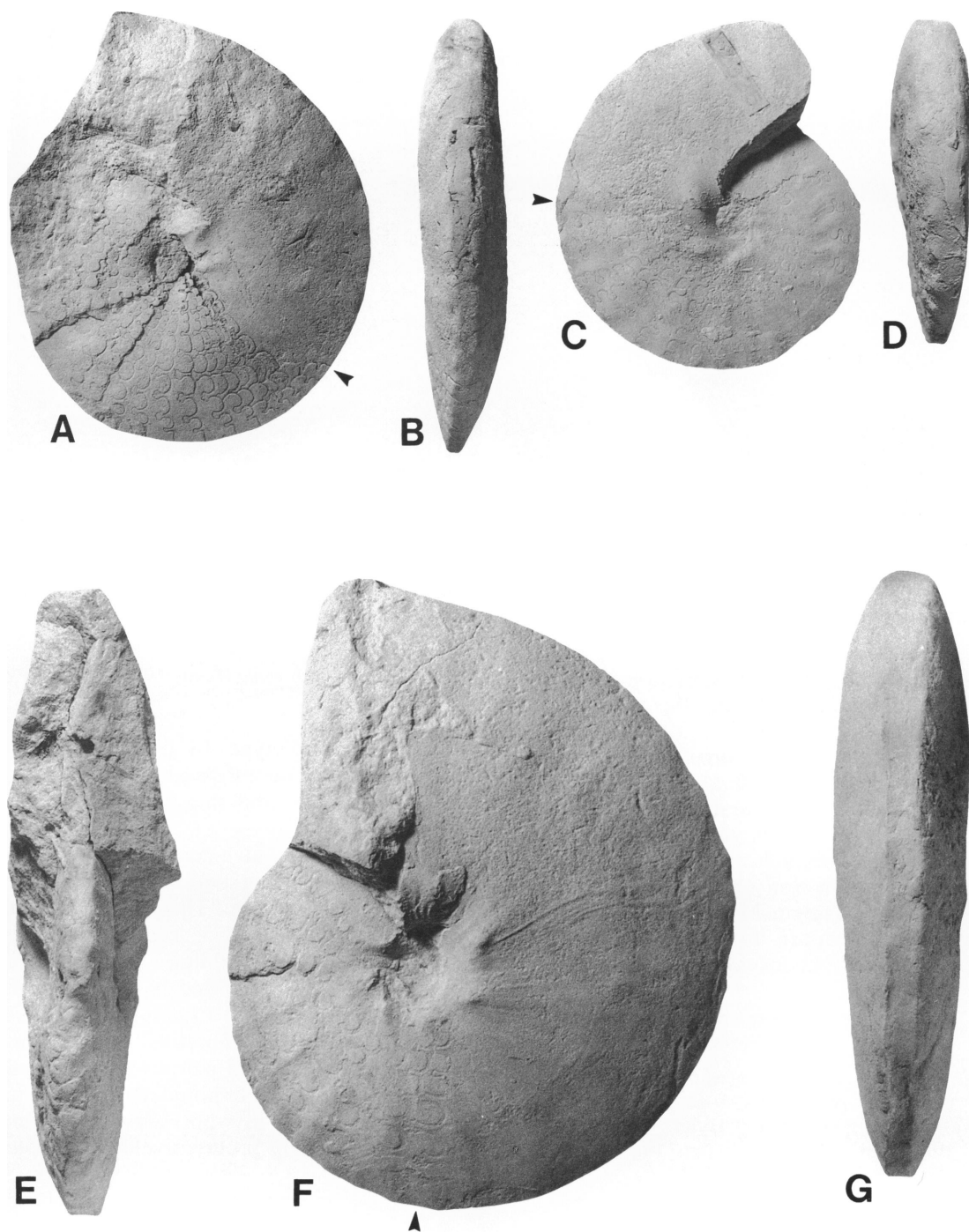


Fig. 9. *Engonoceras stolleyi* Böhm, 1898. A, B. USNM 486475, Comanche Peak Limestone, Mustang Creek, southwest Tarrant County, Texas. C, D. USNM 486476, Goodland Limestone, USGS Mesozoic locality 22324. E–G. USNM 486477, same locality as A, B. All figures are  $\times 1$ .



Fig. 10. *Engonoceras stolleyi* Böhm, 1898. USNM 486478, Comanche Peak Limestone, west Fort Worth, Tarrant County, Texas. All figures are  $\times 1$ .

ward the end of the adult phragmocone, where the ratio of whorl breadth to whorl height is as much as 0.42; the greatest breadth is close to the umbilical shoulder. The inner- and mid-flanks are broadly rounded, the outer flanks are flattened and convergent, the ventrolateral shoulders are broadly rounded, and the venter is relatively broad and flattened.

In juveniles, as many as six umbilical bullae per half whorl give rise to low, blunt, flexuous primary ribs that terminate in blunt ventral clavi, which alternate on either side of the venter. With increasing diameter, ornament coarsens and blunt outer lateral bullae appear. These bullae are linked by low,

blunt, weak ribs to coarse ventral clavi, which alternate on either side of the venter. Ornament of this type persists onto the adult body chamber.

The suture has numerous adventive and auxiliary elements. The adventive saddles are entire, the adventive lobes are moderately incised, the auxiliary saddles are simple or bifid, and the auxiliary lobes are entire (fig. 6).

DISCUSSION: A stout whorl section and coarsening and persistence of the lateral bullae distinguish this species from *Engonoceras belviderense* Cragin, 1894 (pl. 1, figs. 3–5). *Engonoceras stolleyi* Böhm, 1898 (p. 188, fig. 3a–c, pl. 6, figs. 1, 1a; text-figs. 2–4) appears to be a more compressed species,

TABLE 2  
Dimensions (mm) of *Engonoceras gibbosum* Hyatt, 1903<sup>a</sup>

Specimen	D	Wb	Wh	Wb:Wh	Ud
USNM 486465	91.7 (100)	20.3 (22.1)	48.5 (52.9)	0.42	11.5 (12.5)

<sup>a</sup> See table 1 for explanation of symbols.



Fig. 11. *Engonoceras stolleyi* Böhm, 1898. USNM 486479, Walnut Clay, 5 km (3 mi) northwest of Valley Hills on the Clifton Highway, Bosque County, Texas. All figures are  $\times 1$ .

with sharp edges to the venter; the specimen figured by Lasswitz (1904: pl. 13(1), fig. 3) may be better referred to *E. gibbosum*, but the boundary between the two species is diffuse.

**OCCURRENCE:** Walnut Clay, Parker, Tarrant, Somervell, and Wise counties; Goodland Limestone, Scurry County.

*Engonoceras stolleyi* Böhm, 1898

Figures 7–14

*Engonoceras stolleyi* Böhm, 1898: 188, pl. 5, fig. 3a–c; pl. 6, fig. 1, 1a; text-figs. 2–4.

*Engonoceras stolleyi* Böhm. Hyatt, 1903: 175, pl. 23, figs. 7–9; pl. 24, figs. 1–5.

*Engonoceras G. stolleyi* Boehm emend. Lasswitz, 1904: 233 (13), pl. 13 (1), fig. 3.

*Engonoceras stolleyi* Böhm. Douvillé, 1907: 153, pl. 2, figs. 3, 5; pl. 3, figs. 2–4; pl. 4, fig. 2; text-fig. 5.

*Engonoceras stolleyi* (Böhm). Grabau and Shimer, 1910: 213, fig. 1487i–k.

*Engonoceras stolleyi* Böhm. Böse, 1910: 81, pl. 11, figs. 4–16.

*Engonoceras stolleyi* Boehm. Diener, 1925: 228.

*Engonoceras stolleyi* Boehm. Adkins, 1927: pl. 2, fig. 5.

*Engonoceras stolleyi* Böhm. Adkins, 1928: 263, pl. 3, fig. 5.

*Engonoceras stolleyi*. Emerson et al., 1994: table 37.

**TYPES:** Böhm (1898) based *Engonoceras stolleyi* on several specimens. The original of his pl. 6, fig. 1a, b, in the Geological and Palaeontological Collection of the University of Breslau, is here designated lectotype of the species.

**DESCRIPTION:** We have more than 100 specimens, all of which are composite internal molds. Coiling is very involute, with a small umbilicus comprising 8.8–12% of the diameter; this percentage increases slightly through ontogeny. The whorl section is com-



Fig. 12. *Engonoceras stolleyi* Böhm, 1898. USNM 486480, Comanche Peak Limestone, Mustang Creek, southwest Tarrant County, Texas. All figures are  $\times 1$ .

pressed, with a ratio of whorl breadth to whorl height of as little as 0.26 in the smallest specimens (diameter less than 40 mm); this ratio increases to 0.42–0.50 at the end of the phragmocone; the greatest breadth is at or below mid-flank. The umbilical wall is low, flattened, and inclined outward, and the umbilical shoulder is broadly rounded. The inner- and mid-flanks are flattened, and sub-parallel, the outer flanks are broadly rounded and convergent, the ventrolateral shoulders are narrowly rounded to acute, and the venter is concave.

The early growth stages (up to a diameter of 20–25 mm) are nearly smooth on the steinkern; beyond this diameter, umbilical bullae, flank ribs, ventral clavi, and outer lateral tubercles appear over a short sector of whorl to

produce the characteristic ornament of the later phragmocone. There are generally 8 or 9 sharp bullae perched on the umbilical shoulder. These give rise to pairs of delicate prorsiradiate ribs that are straight on the inner flanks but flex forward and are convex across the mid-flanks, strengthening into outer lateral tubercles. The ribs flex backward and are concave, broad, and flat on the outer flanks. There are some additional short intercalated ribs. All ribs terminate in small, sharp ventral clavi that alternate in position across the venter. The ventrolateral shoulders are sharp, and the venter is smooth and concave at the beginning of the ornamented stage. As size increases, the ventrolateral shoulders become rounded, and low, blunt ribs, which efface at mid-venter, zigzag between clavi.



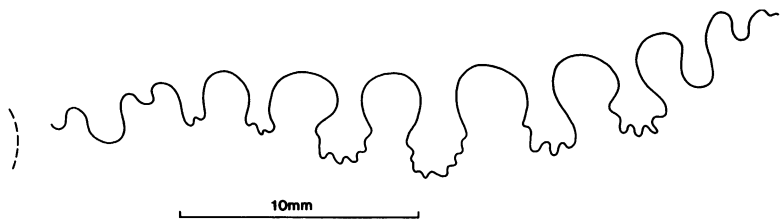


Fig. 13. *Engonoceras stolleyi* Böhm, 1898. External suture of USNM 486481.

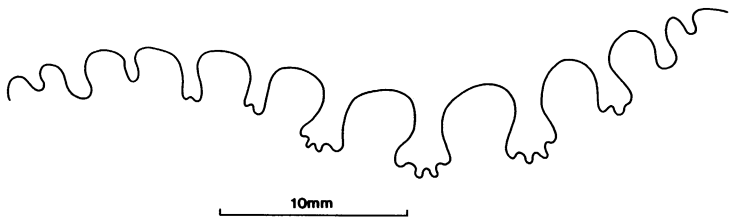


Fig. 14. *Engonoceras stolleyi* Böhm, 1898. External suture of USNM 486482.

On adult body chambers, the umbilical seam uncoils, the whorl section broadens (as does the venter), flank ornament effaces (as do ventral clavi), but umbilical bullae persist. Where well-preserved, the body chamber and late phragmocone are ornamented by narrow, dense, falcoid growth lines, lirae, and striae.

The suture line consists of numerous adventive and auxiliary elements. The externalmost adventive saddle is trifid; the remainder are broad-stemmed with entire terminations. The adventive lobes show only minor incisions. The auxiliary saddles are bifid and the auxiliary lobes are entire (figs. 13, 14).

DISCUSSION: *Engonoceras stolleyi* is abundant in the Texas Albian and shows some variation in the strength of ornament in middle and later growth. Specimens with complete adult body chambers range from 84 to

120 mm in diameter, and there is some indication of size dimorphism. This species most closely resembles *Engonoceras gibbosum* Hyatt, 1903 (p. 171, pl. 22, figs. 6–10; pl. 23, figs. 1–6; see above), but is more compressed, has more numerous ribs and delicate ventral clavi, and loses most of its ornament on the adult body chamber. *E. gibbosum* is much more robust with persistent ornament.

OCCURENCE: Walnut Clay, Comanche Peak Limestone, and Goodland Limestone; Bosque, Hill, Parker, Somervell, Tarrant, and Wise counties, Texas.

*Engonoceras hilli* Böhm, 1898  
Figures 15–21

*Engonoceras hilli* Böhm, 1898: 192, text-fig. 5.  
*Engonoceras hilli* Boehm, emend. Lasswitz, 1904: 223 (13), pl. 13 (1), fig. 4; text-fig. 2.

TABLE 3  
Dimensions (mm) of *Engonoceras stolleyi* Böhm, 1898<sup>a</sup>

Specimen	D	Wb	Wh	Wb:Wh	Ud
USNM 486484	39.5 (100)	— (—)	21.6 (54.7)	— (—)	3.5 (8.8)
USNM 486485	64.5 (100)	17.0 (26.3)	34.0 (52.7)	0.50	7.0 (10.8)
USNM 486486	84.5 (100)	18.0 (21.3)	43.0 (50.9)	0.42	— (—)
USNM 486477	107.5 (100)	23.2 (21.6)	51.5 (47.9)	0.45	12.0 (11.6)

<sup>a</sup> See table 1 for explanation of symbols.



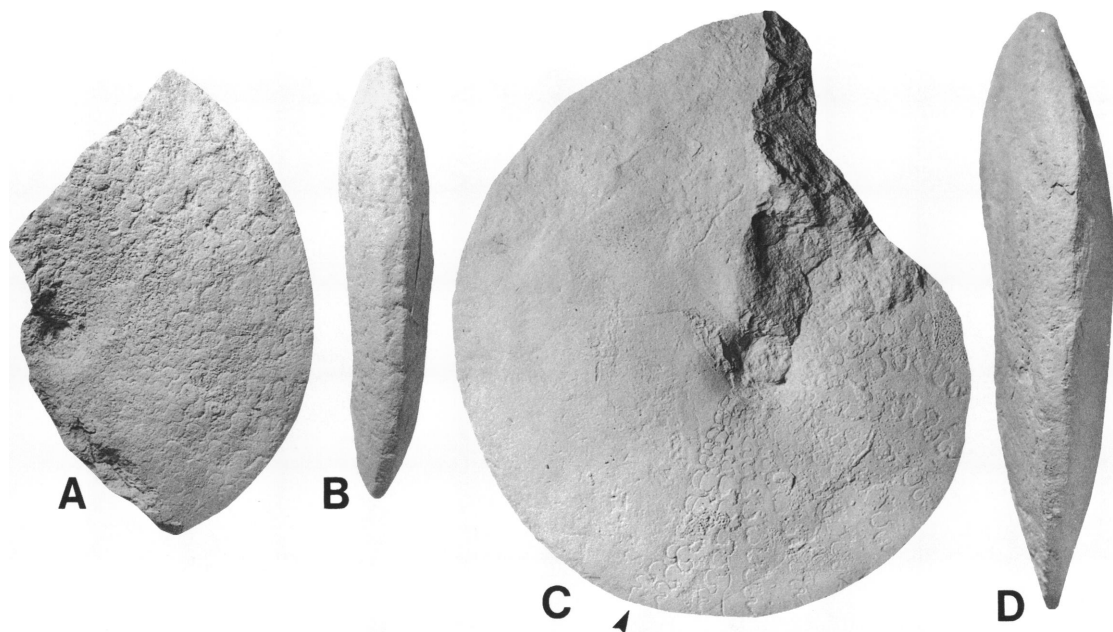


Fig. 15. *Engonoceras hilli* Böhm, 1898. A, B. USNM 486487, Walnut Clay, USGS Mesozoic locality 22193. C, D. USNM 486488, Goodland Limestone, USGS Mesozoic locality 22322. All figures are  $\times 1$ .

*Engonoceras hilli* Böhm. Grabau and Shimer, 1910: 214, fig. 1488.

*Engonoceras hilli*. Grabau, 1921: fig. 914.

*Metengonoceras hilli* Boehm. Adkins, 1927: pl. 2, fig. 3.

*Metengonoceras hilli* Böhm, 1898. Adkins, 1928: 264, pl. 3, fig. 3.

*Metengonoceras hilli*. Emerson et al., 1994: fig. 39.

**TYPE:** The holotype, by monotypy, is the original of Böhm, 1898, text-fig. 5, said to be from the Comanche Peak Limestone of Benbrook, Texas.

**DESCRIPTION:** We have 22 specimens, all of which are composite molds. Phragmocone fragments have whorl heights of up to 65 mm; adult specimens with body chambers range from 75 to 120 mm in diameter, suggesting a poorly defined size dimorphism. Coiling is very involute, the umbilicus comprising 8–10% of the diameter. The umbilical wall is low, flattened, and inclined outward, and the umbilical shoulder is broadly rounded. The whorl section is very compressed on phragmocones, the ratio of whorl breadth to whorl height averaging approximately 0.5; the inner- and mid-flanks are feebly convex,

and the outer flanks are flattened and convergent. The venter is narrow and concave, and the ventrolateral shoulders are sharp on the phragmocone.

Early and middle growth stages are smooth, succeeded by a stage with feeble umbilical bullae, four per half whorl, and, in well-preserved specimens, delicate, flexuous, prorsiradiate growth lines, lirae, and striae. Ornament strengthens on the later phragmocone whorls and long, low ventral clavi appear, alternating on opposite sides of the venter. Ornament of this type persists onto the early part of the adult body chamber, where the ventral clavi become coarse and blunt, and the venter broadens.

The suture consists of numerous adventive and auxiliary elements. The externalmost saddle is asymmetrically bifid, and the remaining saddles are entire, with broad stems. The majority of the lobes are narrow and little-incised, with the auxiliary lobes closest to the umbilicus being entire.

**DISCUSSION:** Late appearance of ventral clavi, persistence of a sulcate venter with sharp shoulders, plus flank ornament limited

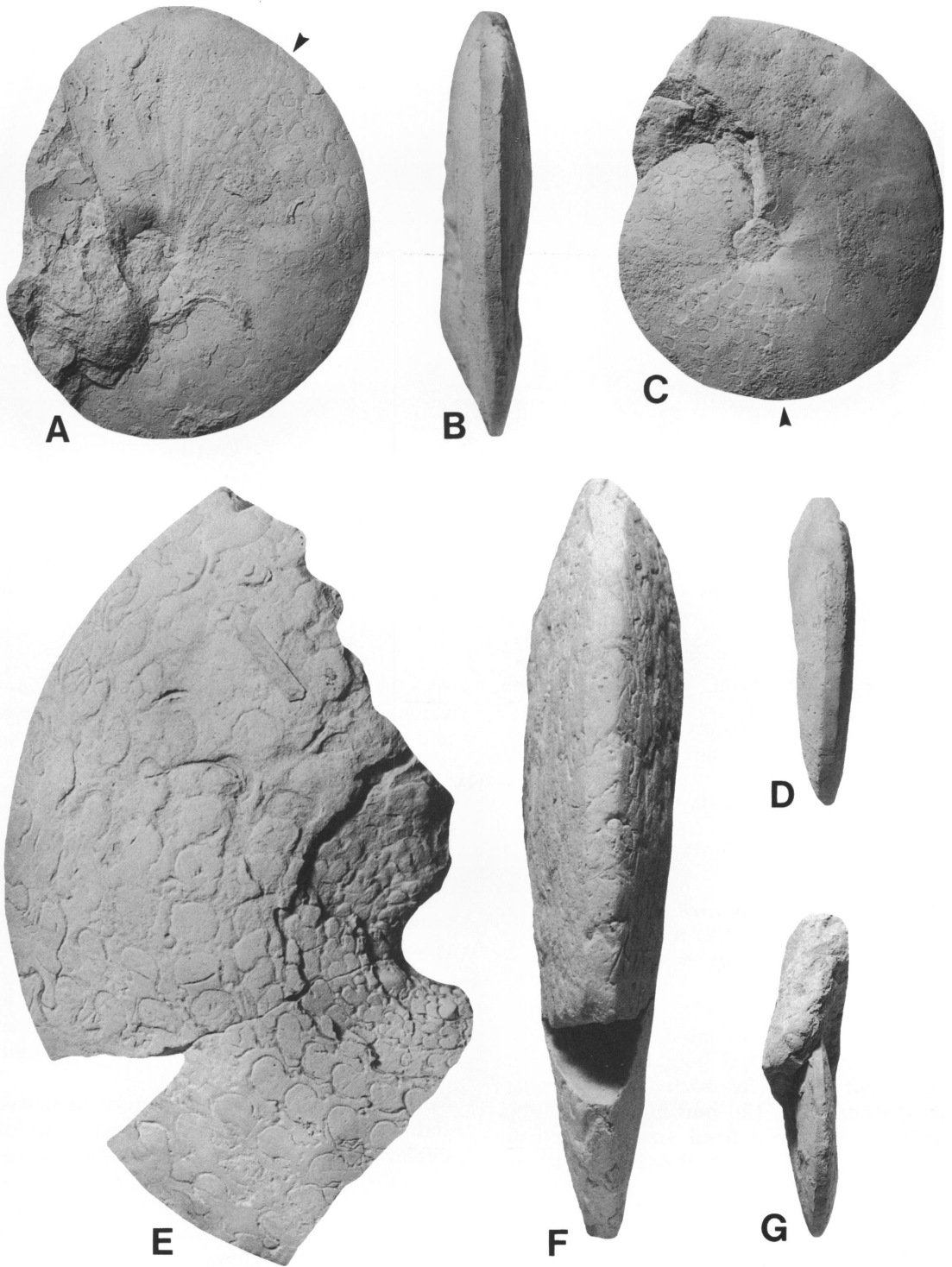


Fig. 16. *Engonoceras hilli* Böhm, 1898. A, B. USNM 486489, Goodland Limestone, USGS Mesozoic locality 22333. C, D, G. USNM 486491, Comanche Peak Limestone, Mustang Creek, southwest Tarrant County, Texas. E, F. USNM 486490, Goodland Limestone, USGS Mesozoic locality 22324. All figures are  $\times 1$ .

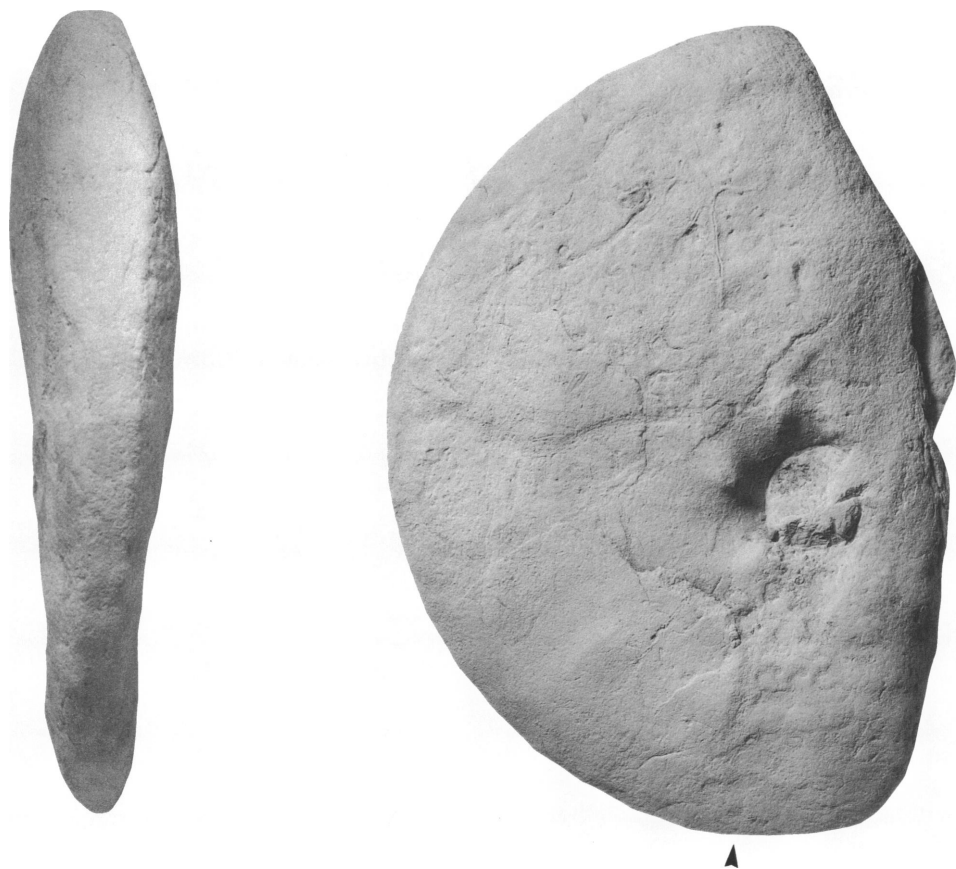


Fig. 17. *Engonoceras hilli* Böhm, 1898. USNM 486492, Comanche Peak Limestone, Mustang Creek, southwest Tarrant County, Texas. Figures are  $\times 1$ .

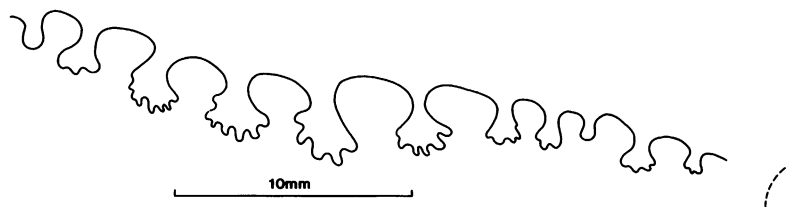


Fig. 18. *Engonoceras hilli* Böhm, 1898. External suture of USNM 486488.

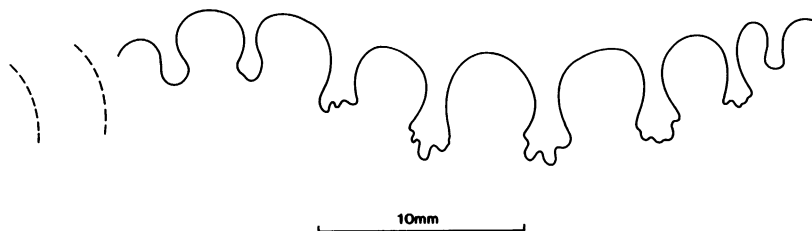


Fig. 19. *Engonoceras hilli* Böhm, 1898. External suture of USNM 486493.

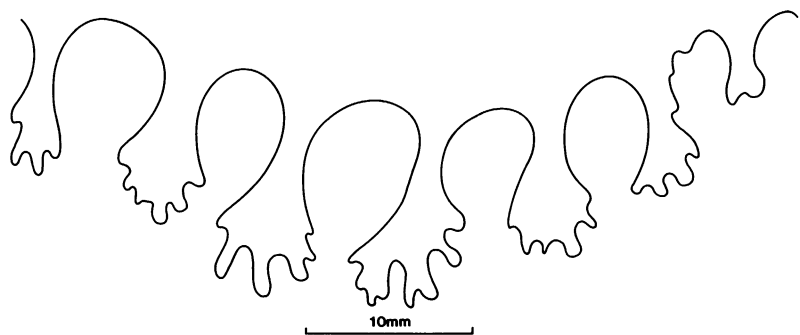


Fig. 20. *Engonoceras hilli* Böhm, 1898. External suture of USNM 486494.

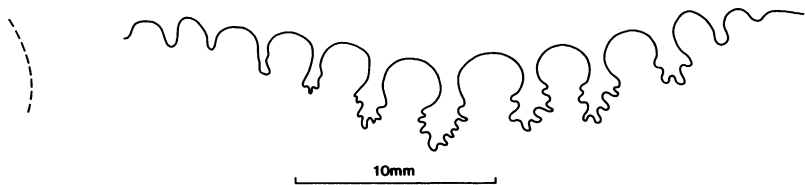


Fig. 21. *Engonoceras hilli* Böhm, 1898. External suture of USNM 486495.

to sparse umbilical bullae (and weak, outer lateral ribs in later ontogeny) as well as a suture with entire saddles and little-subdivided lobes distinguish *Engonoceras hilli* from *E. stolleyi* and *E. gibbosum*, and the presence of entire saddles separates it from *E. complicatum*.

OCCURRENCE: Goodland and Comanche Peak limestones; Hood, Mills, Parker, and Tarrant counties, Texas.

*Engonoceras complicatum* Hyatt, 1903  
Figures 22–24

*Engonoceras complicatum* Hyatt, 1903: 175, pl. 24, figs. 6–8.  
*Engonoceras complicatum* Hyatt, 1903. Adkins, 1928: 263.

*Engonoceras complicatum*. Emerson et al., 1994: fig. 36.

TYPE: The holotype, by monotypy, is the original figured in Hyatt (1903, pl. 24, figs. 6–8), said to be from the Comanche Peak Limestone near Austin, Travis County, Texas.

DESCRIPTION: We have two specimens. USNM 486496 is a fragment of phragmocone with a maximum preserved whorl height of 75 mm (fig. 22). Coiling is very involute, with a shallow umbilicus. The umbilical wall is low, and the umbilical shoulder is flattened and inclined outward, producing a conical circumbilical pit. The whorl section is very compressed, with a ratio of whorl breadth to whorl height of approximately

TABLE 4  
Dimensions (mm) of *Engonoceras hilli* Böhm, 1898<sup>a</sup>

Specimen	D	Wb	Wh	Wb:Wh	Ud
USNM 486491	62.7 (100)	14.7 (23.1)	31.5 (50.2)	0.47	6.2 (9.8)
USNM 486498	59.3 (100)	14.7 (24.8)	30.1 (50.8)	0.49	— (—)
USNM 486488	81.5 (100)	17.0 (20.9)	41.3 (50.6)	0.41	7.2 (8.8)
USNM 486499	85.8 (100)	18.5 (21.5)	45.0 (52.4)	0.41	8.7 (10.1)

<sup>a</sup> See table 1 for explanation of symbols.



Fig. 22. *Engonoceras complicatum* Hyatt, 1903. USNM 486496, Comanche Peak Limestone, Highview Ranch, 6.6 km (4 mi) south of Clifton, Bosque County, Texas. All figures are  $\times 1$ .

0.3; the greatest breadth is below mid-flank. The whorl section is lanceolate with a relatively broad, feebly concave to tabulate venter with sharp ventrolateral edges.

Distant, elongate umbilical bullae give rise to bunches of feebly prorsiradiate growth lines, striae, and lirae, while others arise low on the flanks. Growth lines, striae, and lirae are straight on the inner flanks, feebly convex across the mid-flanks, and concave on the outer flanks, where they decline and disappear. There are no indications of ventral clavi.

USNM 486497 consists of the last few camerae of an adult phragmocone with a maximum preserved whorl height of 70 mm, and half a whorl of body chamber (fig. 23). This specimen is smooth, with a relatively

broad, feebly concave venter with sharp edges.

The suture consists of numerous auxiliary and adventive elements (fig. 24). The externalmost saddle is asymmetrically bifid and broad. The adventive saddles are narrow and little-incised; the intervening adventive lobes have broad stems and entire terminations. The auxiliary saddles are broad-stemmed and bifid and the intervening lobes are narrow and little-incised.

DISCUSSION: The present fragments are much larger than the holotype, which is mostly septate and has a maximum diameter of 73 mm. The holotype differs in possessing ventral clavi, lost in our specimens; we presume this to be a juvenile feature. Other elements of ornament in the present specimens

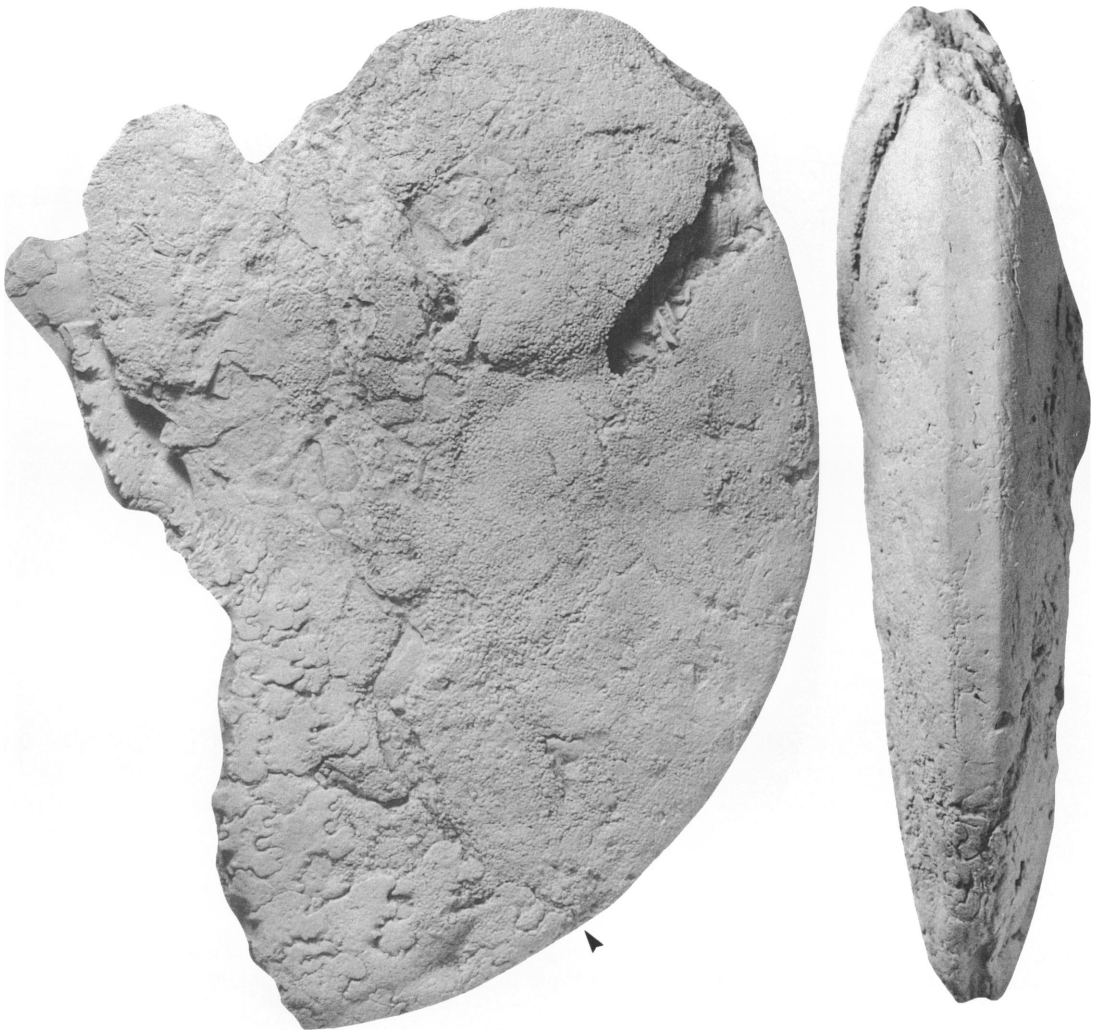


Fig. 23. *Engonoceras complicatum* Hyatt, 1903. USNM 486497, Glen Rose Limestone, 3.3 km (2 mi) south of Bandera, Bandera County, Texas. All figures are  $\times 1$ .



Fig. 24. *Engonoceras complicatum* Hyatt, 1903. External suture of USNM 486496.

Fig. 25. *Parengonoceras roemeri* (Cragin, 1893). A–C. USNM 486500, Goodland Limestone, 13.7 km (8.3 mi) south of Glen Rose, Somervell County, Texas. D, E, I. USNM 486501, same locality as A–C. F–H. USNM 486502, same locality as A–C. J–L. USNM 486503, same locality as A–C. All figures are  $\times 1$ .

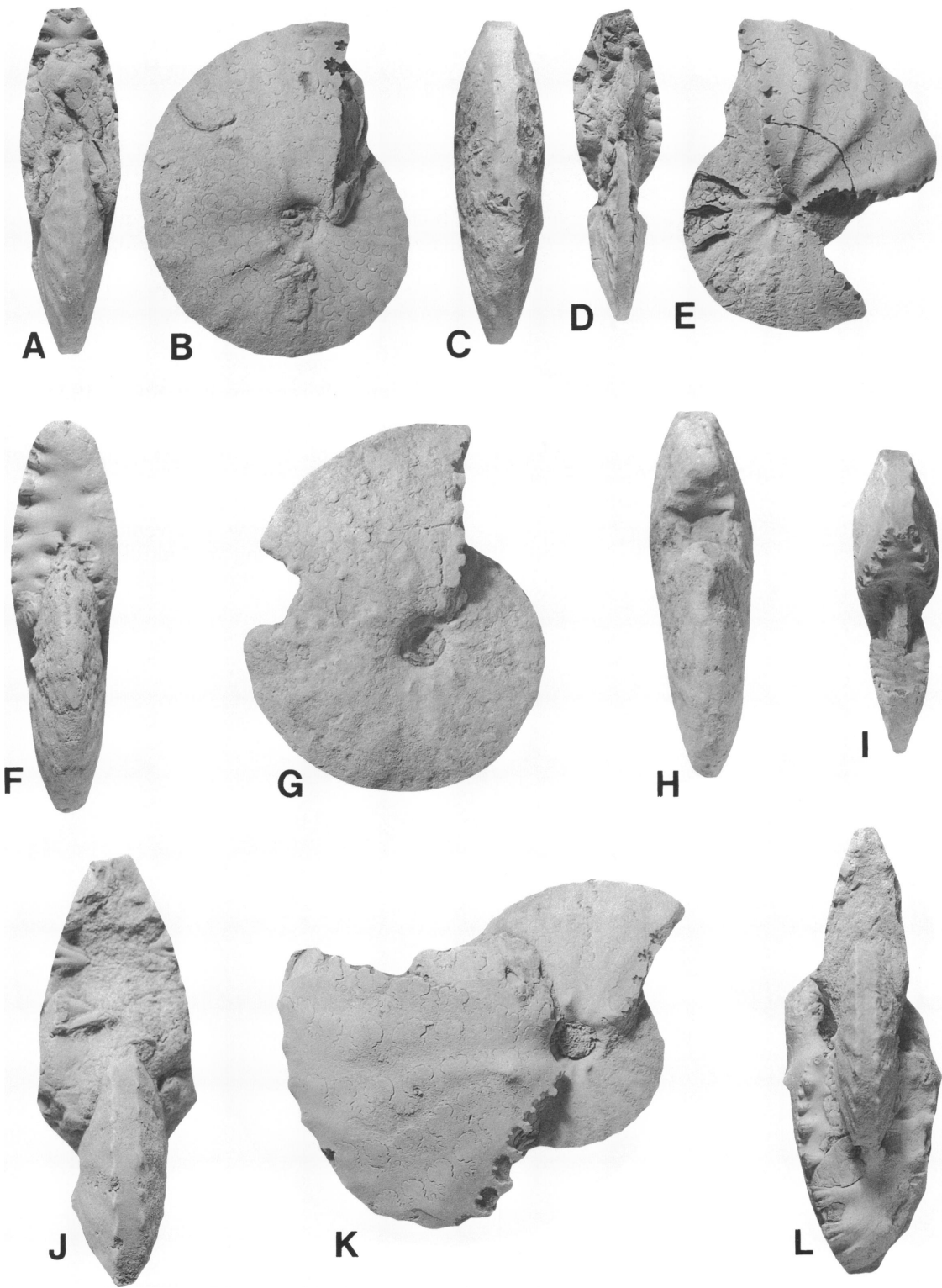






Fig. 26. *Parengonoceras roemeri* (Cragin, 1893). USNM 486504, Glen Rose Limestone, Ash Creek, 400 m (440 yards) southeast of Azle, Tarrant County, Texas. All figures are  $\times 1$ .

are identical to those in the holotype. The sutures of the present specimens also agree closely with those shown in Hyatt (1903: pl. 24, fig. 6), where the two ventral adventive saddles are entire, although these saddles are shown elsewhere as incipiently bifid (Hyatt, 1903: pl. 24, fig. 8). Early loss of ventral clavi, the shape of the umbilical region, and bifid auxiliary saddles serve to distinguish *E. complicatum* from other contemporary species from the Albian of Texas.

OCCURRENCE: Comanche Peak Limestone, Bosque County, Texas; Glen Rose Limestone, Bandera County, Texas.

#### Genus *Parengonoceras* Spath, 1924

TYPE SPECIES: *Amaltheus ebrayi* de Loriol, 1882 (p. 7, pl. 1) by original designation of Spath (1924, p. 508).

DIAGNOSIS: "Early whorls with flat sides converging to narrow, flat venter and with indistinct ribs ending in ventrolateral clavi; later whorls with subrectangular section and



Fig. 27. *Parengonoceras roemeri* (Cragin, 1893). USNM 486505, Goodland Limestone, 13.7 km (8.3 mi) south of Glen Rose, Somervell County, Texas. All figures are  $\times 1$ .





Fig. 28. *Parengonoceras roemeri* (Cragin, 1893). USNM 486506, Goodland Limestone, 13.7 km (8.3 mi) south of Glen Rose, Somervell County, Texas. All figures are  $\times 1$ .

with 1, then 2 rows of lateral bullae appearing; finally ventrolateral clavi disappearing and venter becoming rounded” (Wright, 1996: 130).

**DISCUSSION:** See Casey (1978: 586) for the most comprehensive discussion of *Parengonoceras*. The four species of “*Knemiceras*” recognized by Scott (1940) are no more than intraspecific variants of a single species, which has the diagnostic features of *Parengonoceras*, as described below.

**OCCURRENCE:** Lower and middle Albian; southern England, France, Algeria, Venezuela, Colombia, Peru, and Texas.

*Parengonoceras roemeri* (Cragin, 1893)

Figures 25–30

*Sphenodiscus roemeri* Cragin, 1893: 235, pl. 46, fig. 1.

*Engonoceras roemeri* (Cragin). Hyatt, 1903: 177.

*Engonoceras roemeri* (Cragin). Adkins, 1928: 261.

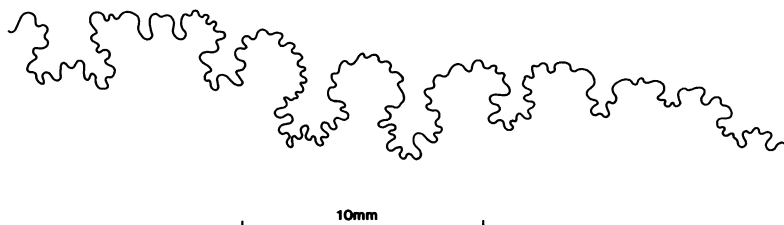


Fig. 29. *Parengonoceras roemeri* (Cragin, 1893). External suture of USNM 486500.

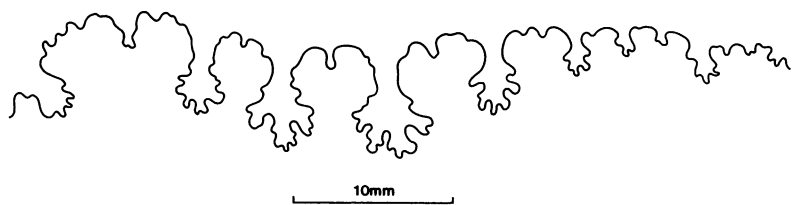


Fig. 30. *Parengonoceras roemeri* (Cragin, 1893). External suture of USNM 486503.

*Knemiceras roemeri* (Cragin). Scott, 1940: 1067; text-fig. 174.  
*Knemiceras nodosum* Scott, 1940: 1069, pl. 67, fig. 6; pl. 68, fig. 6; text-fig. 175.  
*Knemiceras azlense* Scott, 1940: 1070, pl. 66, figs. 5, 6, 10; pl. 68, fig. 2; text-fig. 176.  
*Knemiceras trinitense* Scott, 1940: 1071, pl. 66, fig. 7; pl. 68, fig. 3.  
*Knemiceras azlense* Scott, 1940. Emerson et al., 1994: 89, table 35.  
*Knemiceras nodosum*. Emerson et al., 1994: table 35.  
*Knemiceras roemeri*. Emerson et al., 1994: table 35.  
*Knemiceras trinitense*. Emerson et al., 1994: table 35.

TYPE: The holotype, by monotypy, is the original of Cragin (1893: 235, pl. 46, fig. 1) collected by J. A. Taff from the “alternating beds,” 50 or 60 ft below their upper limit, on the Bosque River, Iredell, Bosque County, Texas.

DESCRIPTION: We have seven specimens, ranging from 45.3 to 145 mm in diameter, the largest specimen being a nearly complete adult. Coiling is very involute with a small umbilicus comprising 9–14% of the diameter. The umbilicus is shallow, with a very low, flattened wall and narrowly rounded shoulder. The whorl section is compressed, with a ratio of whorl breadth to whorl height of 0.52–0.65; the greatest breadth is low on

the flanks in intercostal section and at the lateral tubercle (where present) in costal section. In intercostal section, the innermost flanks are divergent, the mid-flanks are broadly rounded, and the outer flanks are flattened and convergent, with a narrow tabulate venter. The venter is concave in costal section.

Feebly ornamented juveniles bear as many as eight primary ribs per whorl, which arise at the umbilical seam and develop into bullae; other long ribs arise at or outside the umbilical shoulder, but do not develop into bullae. Ribs broaden and are weakly concave on the mid-flanks, where shorter intercalated ribs arise. All ribs strengthen into sharp, elongate ventrolateral clavi, which alternate in position on either side of the venter, and total approximately 36–38 per whorl. With increasing strength of ornament, the ribs that arise from umbilical bullae differentiate; one rib becomes stronger than the other (and stronger than the nonbullate ribs), and develops into a feeble outer lateral tubercle. Transitions lead to individuals with very strong barlike inner flank ribs and lateral tubercles, the latter giving rise to pairs of secondary ribs, with additional short intercalatories.

The largest phragmocones observed are 105–115 mm in diameter and belong to fee-

TABLE 5  
Dimensions (mm) of *Parengonoceras roemeri* (Cragin, 1893)<sup>a</sup>

Specimen	D	Wb	Wh	Wb:Wh	Ud
USNM 486501	45.3 (100)	14.3 (31.6)	25.5 (56.3)	0.56	4.2 (9.3)
USNM 486500	52.5 (100)	15.7 (29.9)	28.0 (53.3)	0.56	5.5 (10.5)
USNM 486503	— (—)	20.5 (—)	37.0 (—)	0.55	— (—)
USNM 486505	82.8 (100)	28.0 (33.8)	43.0 (51.9)	0.65	11.7 (14.1)
USNM 486507	108.5 (100)	31.2 (28.7)	53.5 (49.3)	0.58	10.5 (9.7)

<sup>a</sup> See table 1 for explanation of symbols.

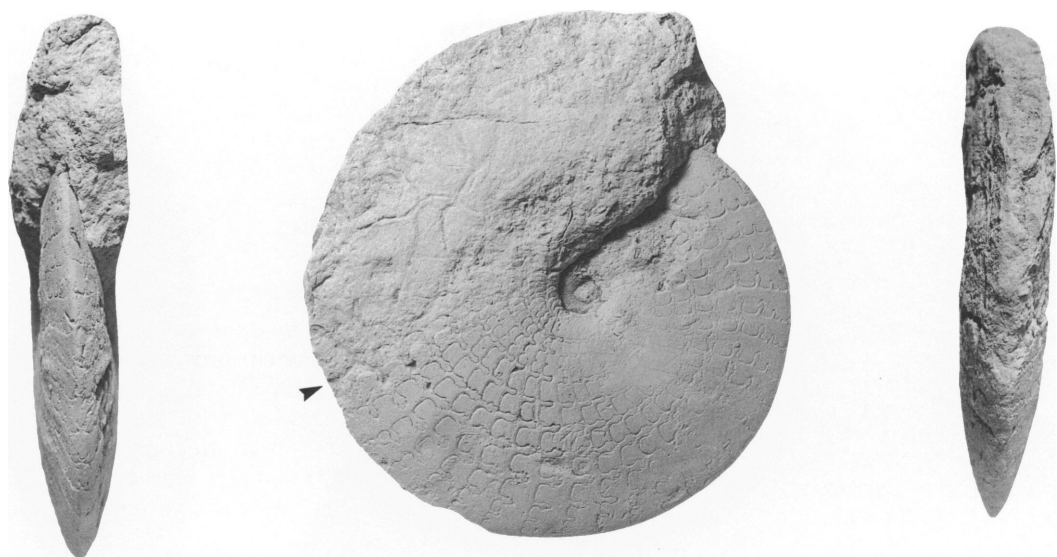


Fig. 31. *Metengonoceras inscriptum* Hyatt, 1903. USNM 486508, Walnut Clay, 11.5 km (7 mi) southwest of Glen Rose on the road to Stephenville, Somervell County, Texas. All figures are  $\times 1$ .



Fig. 32. *Metengonoceras inscriptum* Hyatt, 1903. USNM 486509, Walnut Clay, 11.5 km (7 mi) southwest of Glen Rose on the road to Stephenville, Somervell County, Texas. All figures are  $\times 1$ .



Fig. 33. *Metengonoceras inscriptum* Hyatt, 1903. USNM 486510, Walnut Clay, 11.5 km (7 mi) southwest of Glen Rose on the road to Stephenville, Somervell County, Texas. All figures are  $\times 1$ .

bly ornamented variants; flank ornament weakens markedly and ventrolateral clavi decline progressively, leaving a broad tabulate venter with sharp edges and smooth flanks.

Sutures are variable in the degree of incision of the numerous adventive and auxiliary elements. The lobes are narrow-necked with small incisions, and the saddles are narrow stemmed with minor incisions (figs. 29, 30).

DISCUSSION: According to Scott (1940: 1067), the holotype of *Sphenodiscus roemeri* is lost. It was illustrated in side view only, and appears to have been somewhat worn. No mention was made of the nature of the

ornament. Scott (1940: 1068) described the species as having umbilical, very weak lateral, and ventrolateral tubercles, as is shown by the majority of the present specimens, and he also named three additional species with a coarser but same style ornament: *Knemiceras azlense* Scott, 1940 (p. 1070, pl. 66, figs. 5, 6, 10; pl. 68, fig. 2), *K. trinitense* Scott, 1940 (p. 1071, pl. 66, fig. 7; pl. 68, fig. 3), and *K. nodosum* Scott, 1940 (p. 1069, pl. 67, fig. 6; pl. 68, fig. 6). All come from the same locality, and we regard them as no more than variants of *Parengonoceras roemeri*.



Fig. 34. *Metengonoceras inscriptum* Hyatt, 1903. USNM 486511, Walnut Clay, 11.5 km (7 mi) southwest of Glen Rose on the road to Stephenville, Somervell County, Texas. All figures are  $\times 1$ .



Fig. 35. *Metengonoceras inscriptum* Hyatt, 1903. USNM 486512, Walnut Clay, roadcuts on Cleburne-Glen Rose Highway, 2.3 km (1.4 mi) east of junction with Texas Farm Highway 99, Somervell County, Texas. All figures are  $\times 1$ .

**OCCURRENCE:** Lower Albian; Glen Rose Limestone; Bosque, Somervell, and Tarrant counties, Texas.

**Genus *Metengonoceras* Hyatt, 1903**

(= *Epengonoceras* Spath, 1924: 508)

**TYPE SPECIES:** *Metengonoceras inscriptum* Hyatt, 1903 (p. 180, pl. 25, figs. 5–9; pl. 26, figs. 1–4), by the subsequent designation of Roman (1938: 491).

**DIAGNOSIS:** “Very compressed, almost smooth ammonites that have tiny umbilici and narrow, flattened venters, which may

round on the adult body chamber. Ornament consists of falcoid growth lines and, on some specimens, weak arcuate ribs a little above the middle of the flank and rarely faint umbilical bullae. Sutures are very closely spaced and have numerous auxiliary and adventive elements with most saddles undivided and the larger lobes moderately frilled” (Cobban, 1987: 2).

**DISCUSSION:** See Cobban (1987) and Kennedy (1988) for recent discussions of Cenomanian species referred to *Metengonoceras*. Cobban and Kennedy (1989) described the species from the Mowry Shale of the Western Interior.





Fig. 36. *Metengonoceras inscriptum* Hyatt, 1903. USNM 486513, Walnut Clay, roadcuts on Cleburne-Glen Rose Highway, 2.3 km (1.4 mi) east of junction with Texas Farm Highway 99, Somervell County, Texas. All figures are  $\times 1$ .

**OCCURRENCE:** Middle Albian to upper Cenomanian; France, Niger, Nigeria, Texas, New Mexico, Colorado, Wyoming, Montana, Iowa, and Minnesota.

*Metengonoceras inscriptum* Hyatt, 1903

Figures 31–40

*Metengonoceras inscriptum* Hyatt, 1903: 180, pl. 25, figs. 5–9; pl. 26, figs. 1–4.

*Metengonoceras inscriptum* var? Hyatt, 1903: 183.

*Metengonoceras inscriptum* var. Hyatt, 1903. Adkins, 1928: 264.

*Metengonoceras inscriptum* Hyatt. Roman, 1938: 491, pl. 50, fig. 470, 470a.

*Metengonoceras inscriptum* Hyatt. Basse, 1952: pl. 23, fig. 1.

*Metengonoceras inscriptum* (Hyatt). Wright, 1957: 388, fig. 507.4.

*Metengonoceras inscriptum* Hyatt. Luppov and Mikhailov, 1958: 126.

*Metengonoceras inscriptum* Emerson et al., 1994: table 39.

*Metengonoceras inscriptum* Hyatt, 1903. Wright, 1996: 132, fig. 101.1.

**TYPE:** The lectotype, here designated, is the original of Hyatt (1903: pl. 25, fig. 9; pl. 26, figs. 1–3) from the Fredericksburg Group, 19.8 km (12 mi) northeast of Decatur, Wise County, Texas.

**DESCRIPTION:** We have 30 whole and fragmentary molds that can be referred to this species. Complete phragmocones are up to 160 mm in diameter, with whorl heights of up to 90 mm; other fragments are septate to a whorl height of 110 mm. Coiling is very involute and oxyconic; the umbilicus is small, comprising 9–14% of the diameter, and shallow, with a low, rounded wall and narrowly rounded shoulder. The ratio of

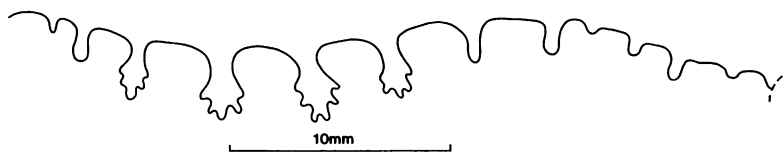


Fig. 37. *Metengonoceras inscriptum* Hyatt, 1903. External suture of USNM 486508.

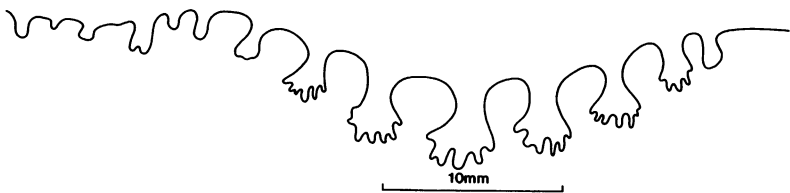


Fig. 38. *Metengonoceras inscriptum* Hyatt, 1903. External suture of USNM 486511.

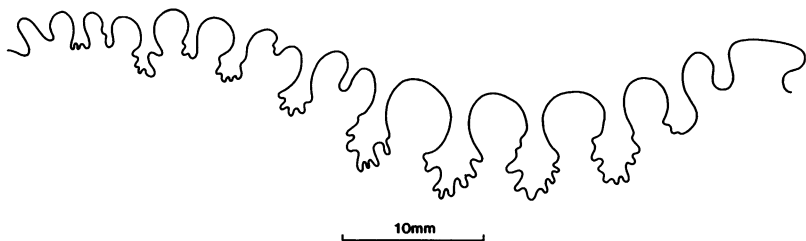


Fig. 39. *Metengonoceras inscriptum* Hyatt, 1903. External suture of USNM 486509.

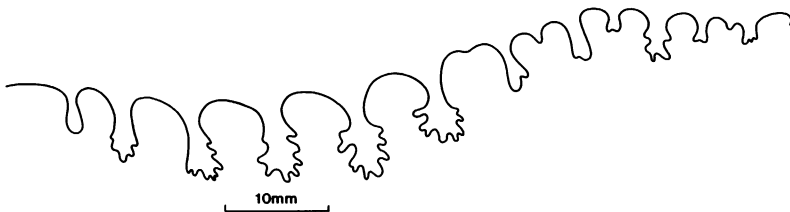


Fig. 40. *Metengonoceras inscriptum* Hyatt, 1903. External suture of USNM 486510.

TABLE 6  
Dimensions (mm) of *Metengonoceras inscriptum* Hyatt, 1903<sup>a</sup>

Specimen	D	Wb	Wh	Wb:Wh	Ud
USNM 486508	61.3 (100)	12.7 (20.7)	33.2 (54.1)	0.38	5.9 (9.6)
USNM 486509	100.0 (100)	21.5 (21.5)	53.2 (53.2)	0.40	13.7 (13.7)
USNM 486510	133.0 (100)	— (—)	74.0 (55.6)	0.56	12.3 (9.2)
USNM 486511	150.0 (100)	29.2 (19.5)	85.7 (57.1)	0.57	— (—)

<sup>a</sup> See table 1 for explanation of symbols.



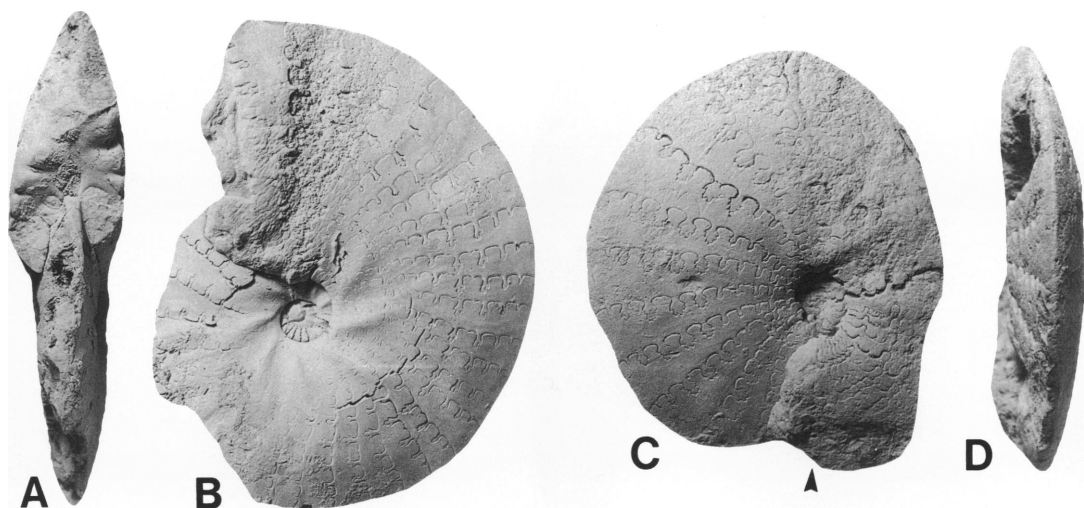


Fig. 41. *Metengonoceras ambiguum* Hyatt, 1903. A, B. USNM 486514, Walnut Clay, 11.5 km (7 mi) southwest of Glen Rose on the road to Stephenville, Somervell County, Texas. C, D. USNM 486515, same locality as A, B. All figures are  $\times 1$ .

whorl breadth to whorl height is as little as 0.38 in the smallest specimens observed, increasing to as much as 0.57 in the largest, with the greatest breadth dorsal of mid-flank. The inner- and mid-flanks are slightly convex, and the outer flanks are flattened and convergent. The venter is initially sharp on molds, but becomes narrowly tabulate with narrowly rounded ventrolateral shoulders, broadening progressively on the last part of the phragmocone. All body chambers are poorly preserved, but show occasional, irregular foldlike ribs on the inner flanks (figs. 35, 36).

The suture has numerous adventive and auxiliary elements, following a feebly sinuous course. The ventralmost adventive saddle is asymmetrically bifid; the other adventive saddles have narrow stems and entire terminations. The adventive lobes are narrow-necked with few minor incisions. The auxiliary saddles are bifid, and the auxiliary lobes are narrow with few minor incisions (figs. 37–40).

DISCUSSION: *Metengonoceras inscriptum* is the most common engonoceratid in the Walnut Clay. It differs from co-occurring *Metengonoceras ambiguum* in lacking umbilical bullae, primary and secondary ribs, and ventral clavi on the phragmocone, although ir-

regular primary ribs may appear on the adult body chamber.

OCCURRENCE: Walnut Clay; Somervell and Wise counties, Texas.

*Metengonoceras ambiguum* Hyatt, 1903

Figures 41–48

*Metengonoceras ambiguum* Hyatt, 1903: 183, pl. 26, figs. 5–7.

?*Engonoceras ambiguum* Hyatt. Lasswitz, 1904: 12, pl. 13 (1), fig. 1.

*Metengonoceras ambiguum* Hyatt, 1903. Adkins, 1928: 264.

*Metengonoceras ambiguum*. Emerson et al., 1994: table 39.

TYPE: The holotype, by monotypy, is the original of Hyatt, 1903 (pl. 26, figs. 5–7) said to be from the Comanche Peak Limestone, but actually from the Walnut Clay (personal commun., K. Young, 1997), 14.9 km (9 mi) from Austin on the Beecaves Road, Travis County, Texas.

DESCRIPTION: We have more than 20 specimens; all are internal molds. The earliest growth stages observed are represented by USNM 486515, which is 55 mm in diameter (fig. 41C, D); phragmocones extend to 165 mm in diameter. Coiling is involute. The umbilicus is small and shallow, comprising 9% of diameter, with a low, flattened wall and narrowly rounded shoulder. The whorl sec-

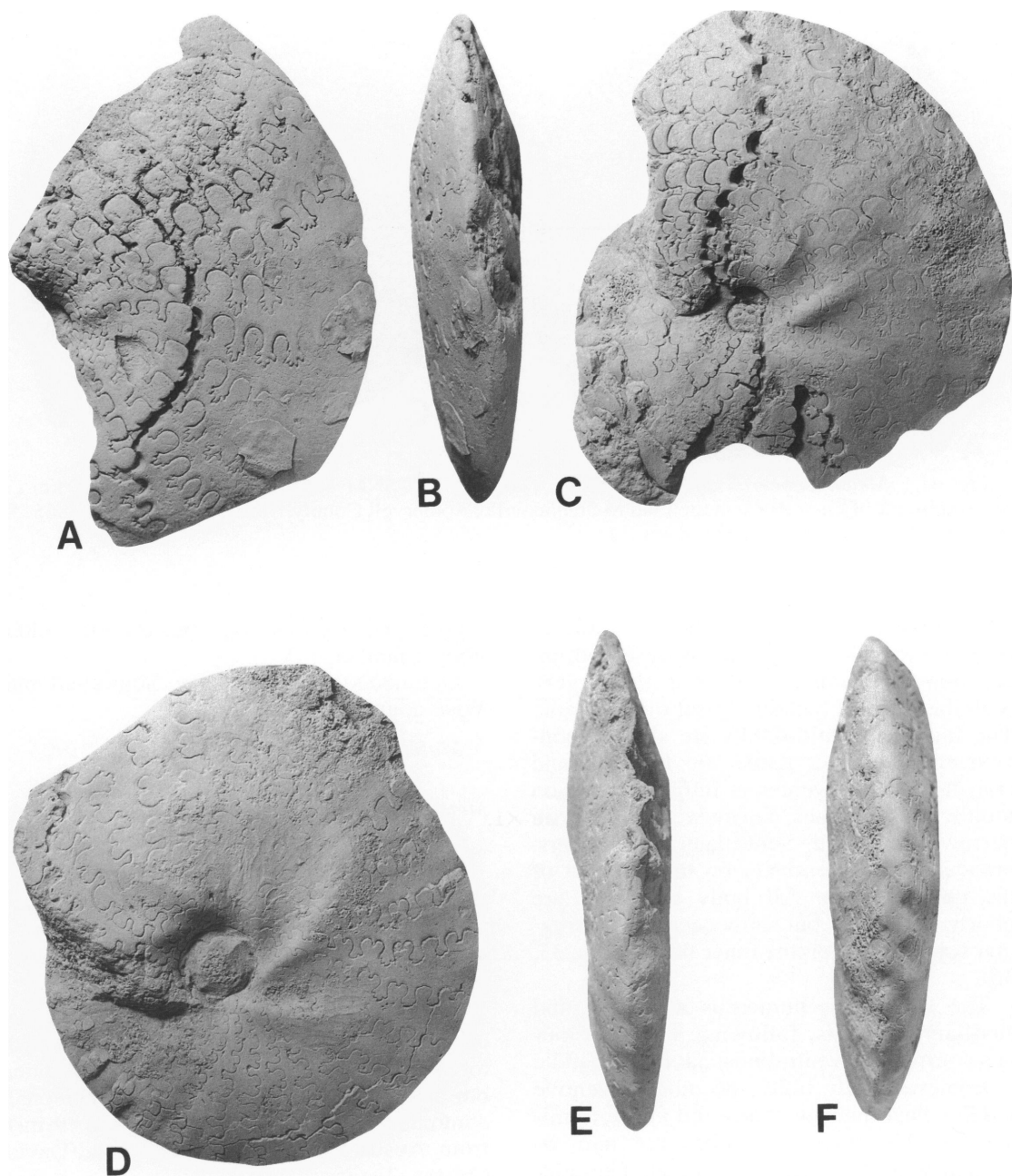


Fig. 42. *Metengonoceras ambiguus* Hyatt, 1903. **A, B.** USNM 486516, Walnut Clay, USGS Mesozoic locality 22191. **C, F.** USNM 486517, same locality as A, B. **D, E.** USNM 486518, Walnut Clay, 11.5 km (7 mi) southwest of Glen Rose on the road to Stephenville, Somervell County, Texas. All figures are  $\times 1$ .



Fig. 43. *Metengonoceras ambiguum* Hyatt, 1903. USNM 486519, Walnut Clay between Evant and Gatesville, Coryell County, Texas. All figures are  $\times 1$ .

tion is compressed and lanceolate, with a ratio of whorl breadth to whorl height of approximately 0.5, the greatest breadth occurring dorsal of mid-flank. The inner- and mid-flanks are feebly convex, the outer flanks are flattened and convergent, the ventrolateral shoulders are sharp, and the venter is narrow and tabulate.

The earliest growth stages observed are very feebly ribbed to smooth. The later phragmocone whorls bear seven or eight elongate and markedly prorsiradiate umbilical bullae per whorl. These give rise to low, broad, straight prorsiradiate ribs that efface on the outer flank. Each rib is tenuously linked to two or more low, broad, weak, feebly concave secondary ribs; additional, short ribs intercalate, yielding a total of 16–18 ribs per whorl. All ribs terminate in blunt, elongate ventral clavi that alternate in position on

either side of the venter, across which they may be connected by blunt zigzag ribs. Where the surface of the mold is well-preserved, flank ribs are accompanied by delicate, parallel riblets and striae.

The venter broadens on adult body chambers, loses its sharp edges, but remains tabulate throughout. The secondary and intercalated ribs are lost, but strong, blunt, distant prorsiradiate primary ribs, plus growth lines and striae persist.

The suture consists of numerous adventive and auxiliary elements, and follows a feebly sinuous course. The adventive saddles have entire terminations except the externalmost, which is bifid. The adventive lobes are narrow-necked with minor incisions. The auxiliary elements are very simple (figs. 47, 48).

**DISCUSSION:** The presence of umbilical bullae, flank ribs, and ventral clavi immedi-

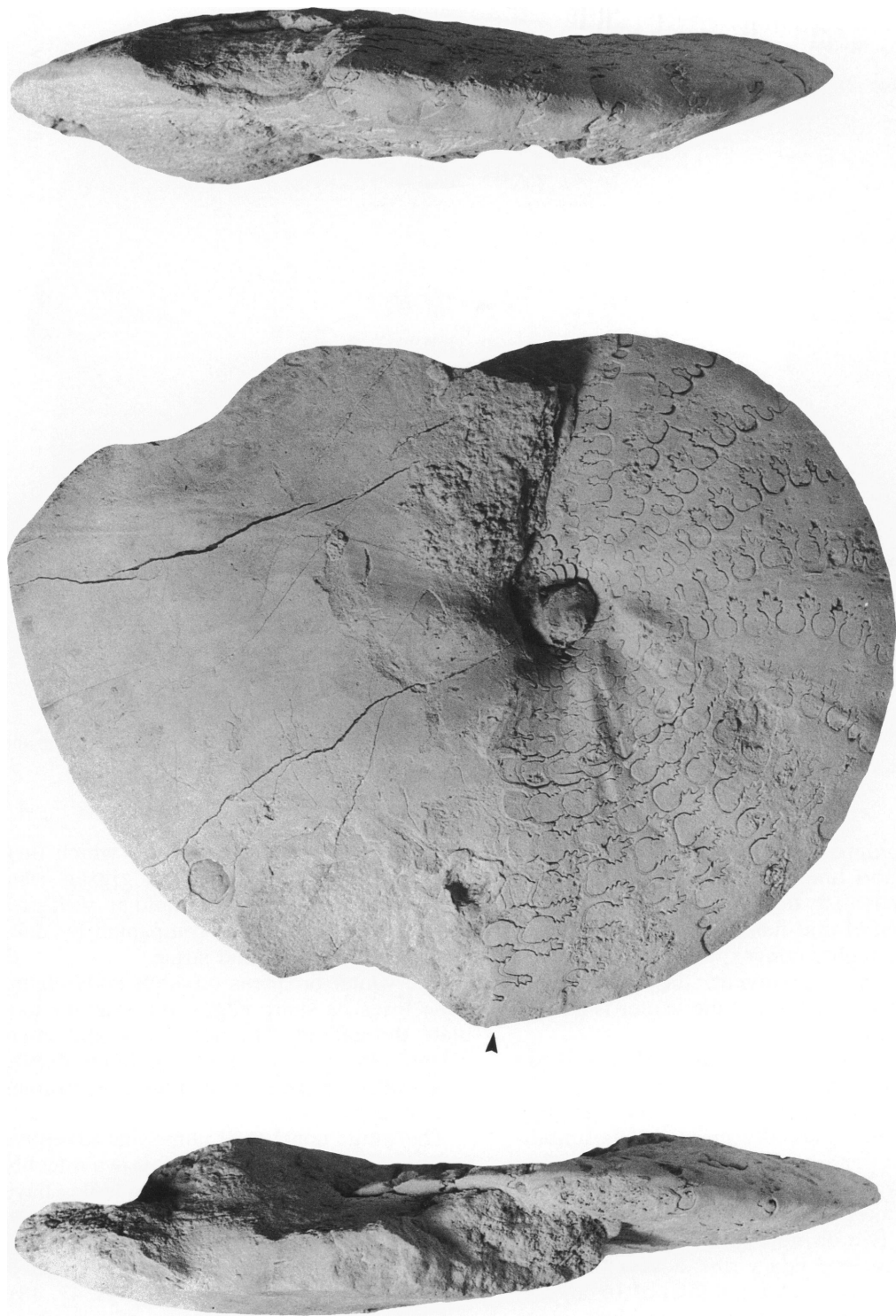


Fig. 44. *Metagonoceras ambiguum* Hyatt, 1903. USNM 486520, Walnut Clay, 11.5 km (7 mi) southwest of Glen Rose on the road to Stephenville, Somervell County, Texas. All figures are  $\times 1$ .



Fig. 45. *Metengonoceras ambiguum* Hyatt, 1903. USNM 486521, Walnut Clay, east of Farm Road 203, 5 km (3 mi) approximately north of the Somervell-Bosque County Line, Somervell County, Texas. All figures are  $\times 1$ .

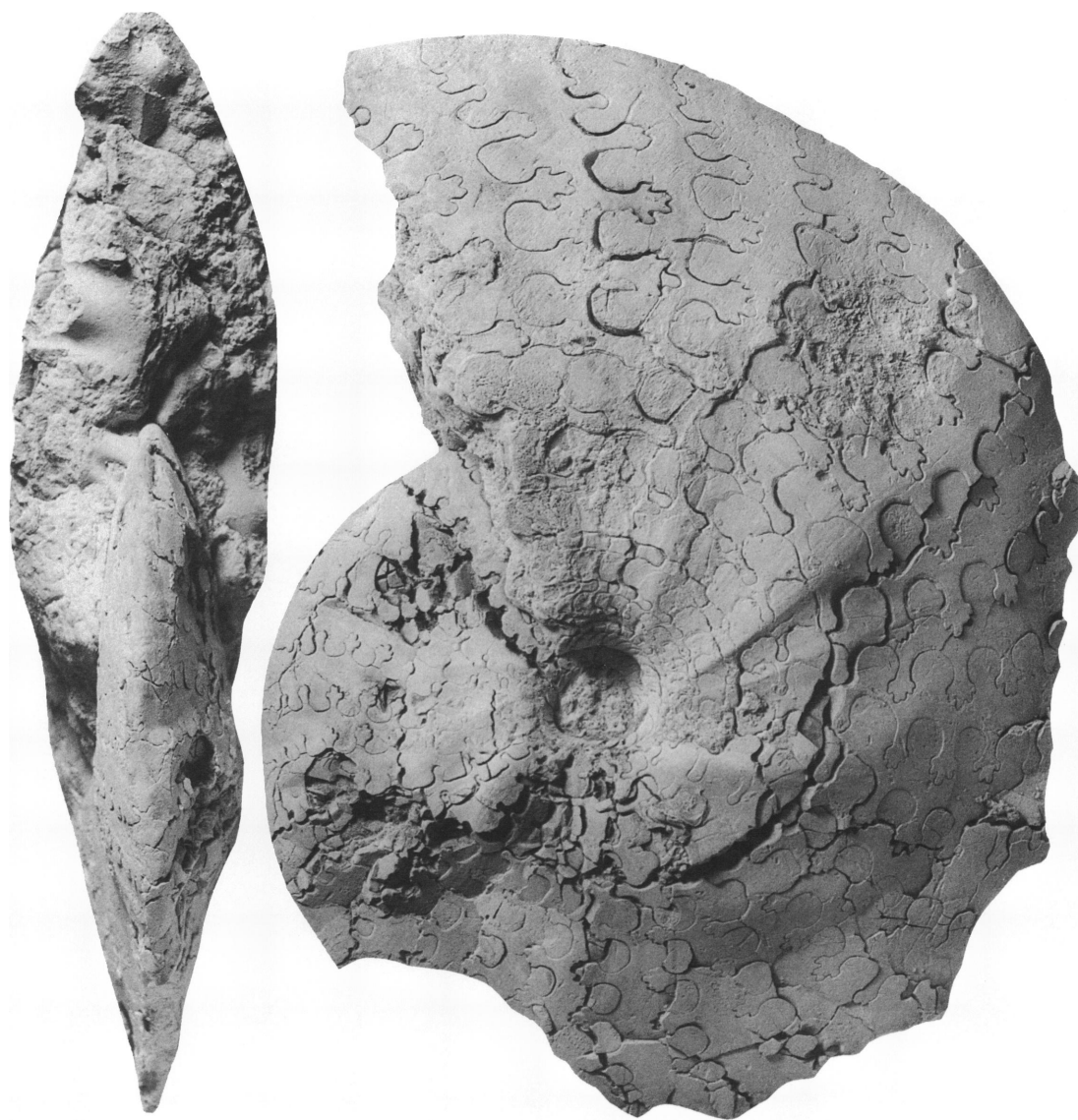


Fig. 46. *Metengonoceras ambiguum* Hyatt, 1903. USNM 486522, Walnut Clay, USGS Mesozoic locality 21585. All figures are  $\times 1$ .



Fig. 47. *Metengonoceras ambiguum* Hyatt, 1903. External suture of USNM 486517.



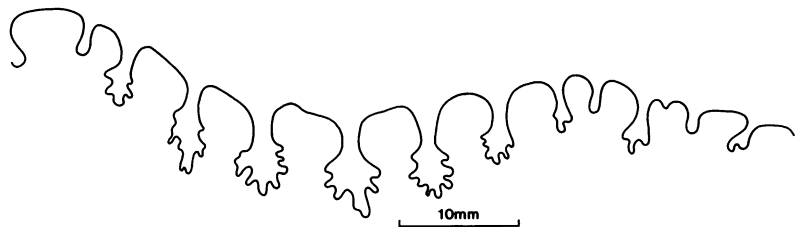


Fig. 48. *Metengonoceras ambiguum* Hyatt, 1903. External suture of USNM 486520.

ately distinguishes *M. ambiguum* from *M. inscriptum*, although the sutures are much more similar than Hyatt suggested. There are superficial similarities to *Protengonoceras gabbi* (Böhm, 1898), but this species lacks ventral clavi and has a distinctive and simpler suture line.

OCCURRENCE: Walnut Clay; Coryell, Parker, Somervell, and Travis counties, Texas.

Genus *Protengonoceras* Hyatt, 1903

TYPE SPECIES: *Engonoceras gabbi* Böhm, 1898: 197, by original designation of Hyatt, 1903: 153.

DIAGNOSIS: “Like *Engonoceras* but lacking tubercles at any stage and having ribs only on the body chamber” (Wright, 1996: 131).

OCCURRENCE: Middle Albian; Texas and northern Mexico.

*Protengonoceras gabbi* (Böhm, 1898)  
Figures 49, 50

*Ammonites pederalis* Gabb, 1869: 258, pl. 35, fig. 1.

*Engonoceras gabbi* Böhm, 1898: 197.

*Protengonoceras gabbi* (Böhm). Hyatt, 1903: 153, pl. 17, figs. 16–20.

*Protengonoceras gabbi* (Böhm). Grabau and Shimer, 1910: 212, fig. 1486a–c.

*Protengonoceras gabbi*. Grabau, 1921: fig. 1756k–m.

*Protengonoceras gabbi* (Böhm). Roman, 1938: 490, pl. 50, fig. 471.

*Protengonoceras gabbi* Böhm, 1898. Wright, 1957: 388, fig. 509.1.

*Protengonoceras gabbi* Böhm. Wright, 1996: 130, fig. 100.2.

TYPE: The holotype, by monotypy, is the original of Gabb, 1869 (pl. 35, fig. 1) from Arivechi, Sonora, Mexico.

DESCRIPTION: The earliest growth stages observed are represented by USNM 486523, where parts of the inner whorls, at an estimated whorl height of 30 mm, are visible. At this stage the whorl section is very compressed (as in Hyatt, 1903: pl. 17, fig. 17) and the flanks are smooth, with a narrow concave venter and sharp ventrolateral shoulders where the shell is preserved. The outer whorl of this specimen is a fragmentary mold of the adoral part of the phragmocone, with a maximum preserved whorl height of 56.5 mm, and the adapical part of the body chamber. The whorl section is compressed, with a ratio of whorl breadth to whorl height of 0.44, the greatest breadth occurring around mid-flank. The inner and mid-flanks are broadly rounded, the outer flanks are flattened and convergent, and the ventrolateral shoulders are narrowly rounded. The venter is narrow on the phragmocone but broadens markedly on the body chamber, and is flat to feebly concave.

TABLE 7  
Dimensions (mm) of *Metengonoceras ambiguum* Hyatt, 1903<sup>a</sup>

Specimen	D	Wb	Wh	Wb:Wh	Ud
USNM 486519	108.5 (100)	29.8 (27.5)	60.5 (55.8)	0.49	10.0 (9.2)
USNM 486520	130.9 (100)	— (—)	74.3 (56.8)	—	12.8 (9.8)
USNM 486521	143.0 (100)	35.5 (24.8)	79.0 (55.2)	0.55	12.8 (9.0)

<sup>a</sup> See table 1 for explanation of symbols.

TABLE 8  
Dimensions (mm) of *Protengonoceras gabbi* (Böhm, 1898)<sup>a</sup>

Specimen	D	Wb	Wh	Wb:Wh	Ud
USNM 486524	102.0 (100)	34.2 (33.5)	53.5 (52.4)	0.64	12.5 (12.3)

<sup>a</sup> See table 1 for explanation of symbols.

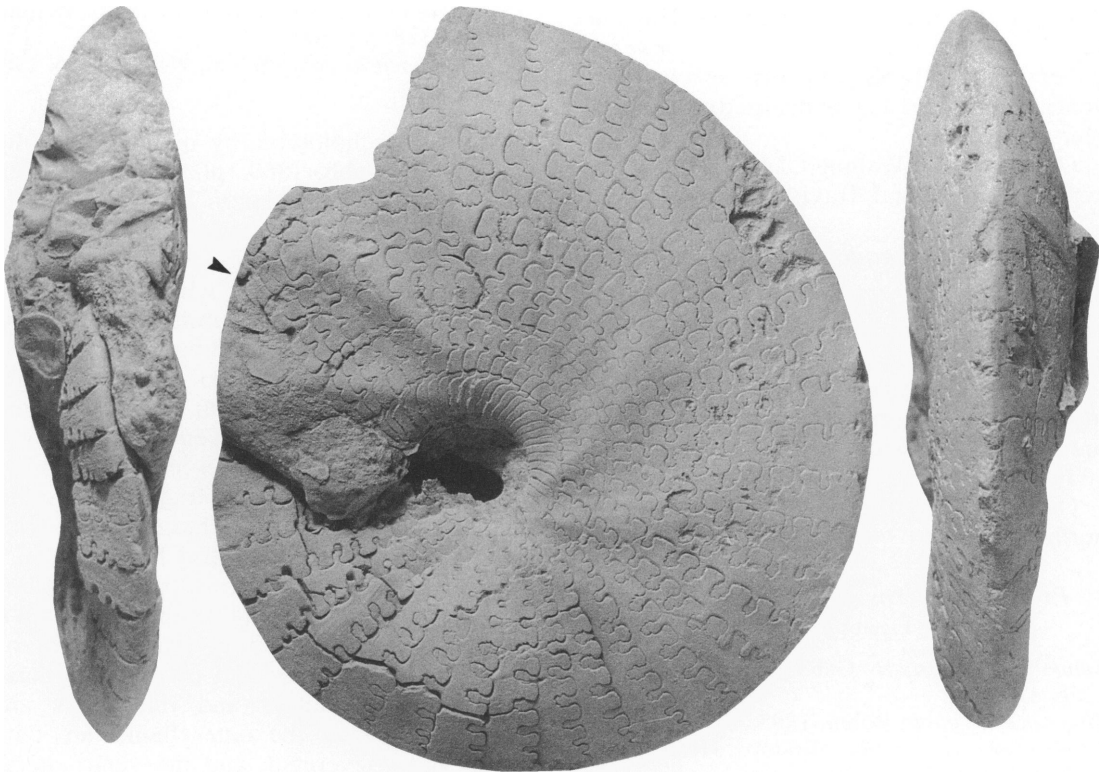


Fig. 49. *Protengonoceras gabbi* (Böhm, 1898). USNM 486524, Walnut Clay, ?Somervell County, Texas. All figures are  $\times 1$ .

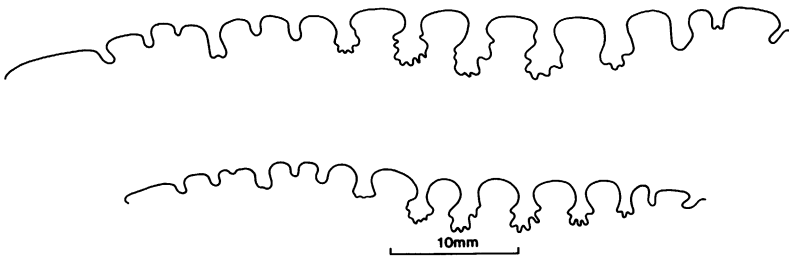
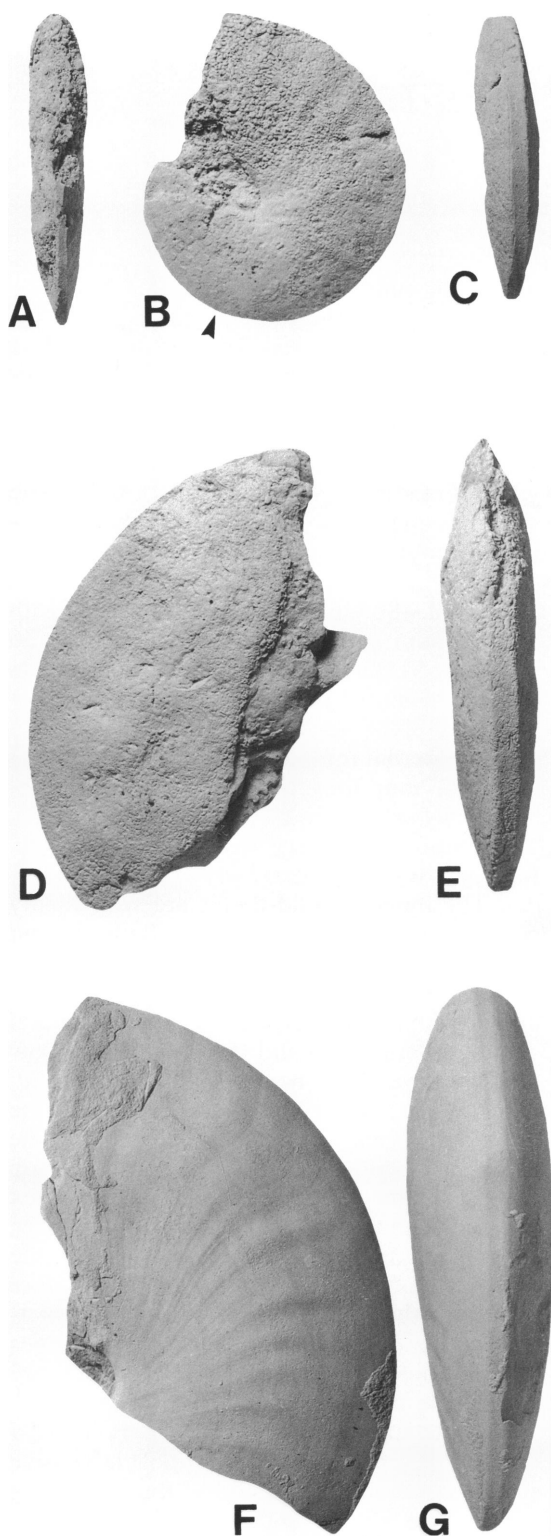


Fig. 50. *Protengonoceras gabbi* (Böhm, 1898). External suture of USNM 486524.





Better preserved is USNM 486524, an internal mold of a phragmocone 102 mm in diameter (fig. 49). Coiling is involute. The shallow umbilicus comprises 12% of diameter, with a low wall and narrowly rounded shoulder. The whorl section is compressed and lanceolate, with a ratio of whorl breadth to whorl height of 0.64, the greatest breadth occurring dorsal of mid-flank; the venter is narrowly rounded. Low, blunt, distant, feebly concave prorsiradiate ribs, five on the last half whorl, arise at the umbilical seam and strengthen across the inner and middle flanks, thereafter declining and disappearing on the outer flanks. The earlier growth stages appear to have been smooth.

The suture follows a near-straight course. There are numerous low adventive saddles with flat-topped entire terminations; the intervening adventive lobes are small and little incised. The auxiliary elements consist of two broad, low, trifid saddles separated by very narrow lobes, and a very broad, low, entire saddle that covers the innermost flank, umbilical shoulder, and wall (fig. 50).

**DISCUSSION:** The absence of ventrolateral tubercles and the presence of a distinctive suture line immediately distinguish *Protengonoceras gabbi* from the superficially similar *Metengonoceras ambiguum* Hyatt, 1903 (p. 183, pl. 26, figs. 5–7), which has very similar flank ornament in middle growth.

**OCCURRENCE:** Walnut Clay; Somervell and Tarrant counties, Texas and Sonora, northern Mexico.

#### Genus *Platiknemiceras* Bataller, 1954

(= *Platiknemiceras* Bataller, 1959: 1–77; *nom. null.*)

**TYPE SPECIES:** *Knemiceras* (*Platiknemiceras*) *bassei* Bataller, 1954: 174.

←

Fig. 51. *Platiknemiceras flexuosum*, n. sp. A–C. Paratype, USNM 486525, Glen Rose Limestone, 8.25 km (5 mi) south of Bandera on the Hondo Road, Bandera County, Texas. D, E. Paratype, USNM 486526, same locality as A–C. F, G. Holotype, USNM 486527, Glen Rose Limestone, Ash Creek, Azle, Tarrant County, Texas. All figures are  $\times 1$ .

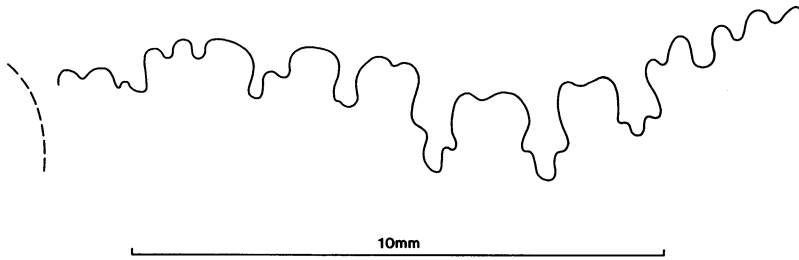


Fig. 52. *Platiknemiceras flexuosum*, n. sp. External suture of USNM 486525.

**DIAGNOSIS:** Involute, compressed, with narrow, initially concave venter, becoming tabulate in later growth; ornamented by fine flexuous striae; suture with moderately incised lobes and little incised saddles.

**DISCUSSION:** Casey (1961) provided a review of the then obscure genus *Platiknemiceras*, restricting it to a group of species characterized by very feeble ornament, including the then undescribed Texas form described below as *Platiknemiceras flexuosum*, n. sp.

**OCCURRENCE:** Lower and middle Albian; France, Spain, Algeria, Iran, Lebanon, Egypt, Japan, Texas, Peru, and Colombia.

***Platiknemiceras flexuosum*, new species**

Figures 51, 52

*Knemiceras* sp. nov. Casey, 1961: 355.

**TYPES:** The holotype is USNM 486527, from the Glen Rose Limestone, on Ash Creek, Azle, Tarrant County, Texas; paratypes USNM 486525 and USNM 486526 are from the Glen Rose Limestone 8.25 km (5 mi) south of Bandera on the Hondo Road, Bandera County, Texas.

**DERIVATION OF NAME:** Latin, *flexuosus*, "with many bends," after the flexuous ribbing.

**DIAGNOSIS:** Very compressed, involute *Platiknemiceras* with sharp ventrolateral edges and concave venter; flanks ornamented by delicate falcoid ribs, riblets, and striae.

**DESCRIPTION:** The earliest growth stages observed are represented by USNM 486525, a phragmocone 39 mm in diameter (fig. 51A–C). Coiling is very involute, with a tiny shallow umbilicus comprising approximately 6% of diameter, with a low wall and narrowly rounded umbilical shoulder. The whorl

section is very compressed, with feebly inflated inner- to mid-flanks and flattened, convergent outer flanks. The maximum whorl breadth is around mid-flank, and the ratio of whorl breadth to whorl height is 0.36. The venter is markedly concave, and the ventrolateral edges sharp. No ornament is preserved.

USNM 486526 is a larger fragment, with a maximum preserved whorl height of 36 mm (fig. 51D, E); it differs in no significant respects from the previous specimen. The holotype, USNM 486527, is a beautifully preserved internal mold of a body chamber fragment 72 mm long, with a maximum preserved whorl height of 39 mm (fig. 51F, G). The umbilicus is very shallow, with a low, flattened wall and narrowly rounded shoulder. The inner- to mid-flanks are very feebly convex, and the outer flanks are flattened and convergent; the ratio of whorl breadth to whorl height is 0.44, the greatest breadth occurring dorsal of mid-flank. The ventrolateral shoulders are sharp and the venter is narrow and concave. Bunches of delicate, straight, prorsiradiate riblets and striae arise at the umbilical shoulder and strengthen across the inner- and mid-flanks, where they develop into low, flat, distant ribs. These ribs flex backward and are initially convex; thereafter, they strengthen and sweep forward on the outer flanks, and decline and efface before reaching the ventrolateral shoulder. Interspaces are covered in delicate growth lines that parallel the ribs, and all of the flanks are covered in delicate spiral striae.

The juvenile suture is shown by USNM 486525 (fig. 52). The externalmost adventive saddle is broad and trifold and the remaining saddles are simple and bifid; the lobes are narrow and bifid to entire.

OCCURRENCE: As for types.

#### ACKNOWLEDGMENTS

Kennedy acknowledges the financial support of the Natural Environment Research Council (U.K.) and the staff of the Geological Collections, University Museum, Oxford, and the Department of Earth Sciences,

Oxford. The U.S. Geological Survey provided the specimens for study. Glenn R. Scott (USGS, Denver) and Keith Young (University of Texas) kindly reviewed an earlier draft of this manuscript and made many helpful suggestions. Landman acknowledges the assistance of Barbara Worcester, Stephanie Crooms, and Bushra Hussaini (all AMNH).

#### REFERENCES

- Adkins, W. S.  
1927. Geology and mineral resources of the Fort Stockton Quadrangle. Univ. Tex. Bull. 2738: 166 pp.  
1928. Handbook of Texas Cretaceous fossils. Ibid. 2838: 385 pp.
- Basse, E.  
1940. Les céphalopodes crétacés des massifs côtiers syriens, pt. 2. Notes Mém. Ht.-Comm. Syrie-Liban 3: 411–472.  
1952. Ammonoïdes s. str. In J. Piveteau (ed.), *Traité de paléontologie*, 2: 581–688. Paris: Masson.
- Bataller, J. R.  
1954. Los Engonoceratidos en España. *Homage postuma Dr. Vaquer*: 173–178. Barcelona: Univ. Barcelona.  
1959. Primer suplemento a la “Sinopsis de las especies nuevas del Cretáceo de España.” *Bol. Inst. Geol. Min. España* 70: 1–77.
- Böhm, J.  
1898. Über Ammonites pedernalis v. Buch. *Z. D. Geol. Ges.* 1898: 183–201.
- Böse, E.  
1910. Monografía geológica y paleontológica del Cerro de Muleros cerca de Ciudad Juárez, Estado de Chihuahua y descripción de la fauna cretácea de la Encantada, Placer de Guadalupe, Estado de Chihuahua. *Bol. Inst. Geol. Méx.* 25: 1–193 [in two volumes].
- Buch, L. von  
1848–1850. Über Ceratiten. *Phys. Abh. K. Akad. Wiss. Berlin* for 1848: 1–33 [issued in parts in 1848, volume published 1850].
- Casey, R.  
1961. The Cretaceous (Albian) ammonite *Platynemiceras* Bataller. *Ann. Mag. Nat. Hist.* (13)4: 353–357.  
1978. A monograph of the Ammonoidea of the Lower Greensand. Part 8. *Monogr. Palaeontogr. Soc.* pp. 583–632.
- Cobban, W. A.  
1987. The Upper Cretaceous (Cenomanian) ammonites *Metengonoceras dumbli* (Cragin) and *M. acutum* (Hyatt). *U.S. Geol. Surv. Bull.* 1690: C1–C7.
- Cobban, W. A., and W. J. Kennedy  
1989. The ammonite *Metengonoceras* Hyatt, 1903, from the Mowry Shale (Cretaceous) of Montana and Wyoming. *U.S. Geol. Surv. Bull., Shorter Contrib. Paleontol. Stratigr.* 1787-L: L1–L11.
- Cragin, F. W.  
1893. A contribution to the invertebrate paleontology of the Texas Cretaceous. *Texas Geol. Surv. 4th Annu. Rep.* (1892): 139–246.  
1894. New and little-known Invertebrata from the Neocomian of Kansas. *Am. Geol.* 14: 1–12.
- Diener, C.  
1925. Ammonoidea Neocretacea. *Fossilium Cat.* (1: Animalia) 29: 244 pp.
- Douvillé, R.  
1907. Sur des ammonites du Crétacé sud-américain. *Ann. Soc. R. Zool. Malac. Belgique* 41: 142–155.
- Emerson, B. L., J. H. Emerson, E. A. Akers, and T. J. Akers  
1994. Texas Cretaceous ammonites and nautiloids. *Texas Paleontol. Ser.* 5: 439 pp. Houston: Houston Gem and Mineral Society.
- Fischer, P.  
1880–1887. *Manuel de Conchyliologie*. Paris: Masson, 1369 pp.
- Gabb, W. M.  
1869. Cretaceous and Tertiary fossils. *Geol. Surv. California Paleontol.* 2: 1–299.
- Geyer, O. F.  
1995. *Knemiceras uhligi* (Choffat) dans la Chaîne Ibérique méridionale (Albien supérieur, Espagne). *Batalleria* 5: 5–17.
- Grabau, A. W.  
1921. A textbook of geology, 2. New York: D. C. Heath, 976 pp.

- Grabau, A. W., and H. W. Shimer  
1910. North American Index Fossils: Invertebrates, 2. New York: A. G. Seiler. xv + 909 pp.
- Hyatt, A.  
1900. Cephalopoda. In K. A. von Zittel, 1896–1900, Textbook of paleontology, pp. 502–604. London: Macmillan [transl. C. R. Eastman].  
1903. Pseudoceratites of the Cretaceous. U.S. Geol. Surv. Monogr. 44: 351 pp.
- Kennedy, W. J.  
1988. Late Cenomanian and Turonian ammonite faunas from north-east and central Texas. Spec. Pap. Palaeontol. 39: 131 pp.
- Lasswitz, R.  
1904. Die Kreide-Ammoniten von Texas (Collection F. Roemer). Geol. Palaeontol. Abh. n. ser. 6(10): 221–259.
- Loriol, P. de  
1882. Études sur la faune des couches du Gault de Cosne (Nièvre). Mém. Soc. Paléontol. Suisse 9: 118 pp.
- Luppov, N. P., and N. P. Mikhailov  
1958. Nadsemejstvo Engonocerataceae. In N. P. Luppov and V. V. Drushchits (eds.), Osnovy paleologii: mollyuski—go-lovonogie II, 125–128. Moskva: Gosgeoltekhizdat [In Russian].
- Neumayr, M., and V. Uhlig  
1881. Ueber Ammoniten aus den Hilsbildung Norddeutschlands. Palaeontographica 27: 129–203.
- Pervinquier, L.  
1907. Études de paléontologie tunisienne. 1. Céphalopodes des terrains secondaires. Carte Géol. Tunisie. Paris: de Rudeval, v + 438 pp.
- Renz, O.  
1970. Über die Gattung *Parengonoceras* Spath, *Knemiceras* Böhm und *Neophlycticeras* Spath (Ammonoidea) aus den Anden Venezuelas. Eclogae. Geol. Helv. 63: 1021–1057.
1982. The cretaceous ammonites of Venezuela. Basel: Maraven, 132 pp.
- Roman, F.  
1938. Les ammonites jurassiques et crétacées. Essai de genera. Paris: Masson, 554 pp.
- Scott, G.  
1940. Cephalopods from the Cretaceous Trinity Group of the south-central United States. Univ. Tex. Publ. 3945: 969–1106.
- Spath, L. F.  
1924. On a new ammonite (*Engonoceras iris* n. sp.) from the Gault at Folkestone. Ann. Mag. Nat. Hist. (9) 14: 504–508.  
1931. A monograph of the Ammonoidea of the Gault. Part 8. Monogr. Palaeontogr. Soc. pp. 313–378.
- Wright, C. W.  
1957. [Cretaceous Ammonoidea]. In R. C. Moore (ed.), Treatise on invertebrate paleontology. Pt. L, Mollusca 4, Cephalopoda, Ammonoidea. Lawrence: Geol. Soc. Am. and Univ. Kansas Press, xxii + 490 pp.
1963. Cretaceous ammonites from Bathurst Island, Northern Australia. Palaeontology 6: 597–614.
1996. Treatise on invertebrate paleontology, Pt. L, Mollusca. 4: Cretaceous Ammonoidea. [with contributions by J. H. Calloman (*sic*) and M. K. Howarth]. Geol. Soc. Am. and Univ. Kansas Press, xx + 362 pp.
- Young, K.  
1967. Ammonite zonations, Texas Comanchean (Lower Cretaceous). In L. Hendricks (ed.), Comanchean (Lower Cretaceous) stratigraphy and paleontology of Texas, pp. 65–70. Soc. Econ. Paleontol. Mineral. Permian Basin Section Publ. 67–68: 410 pp.

Recent issues of the *Novitates* may be purchased from the Museum. Lists of back issues of the *Novitates* and *Bulletin* published during the last five years are available at World Wide Web site <http://nimidi.amnh.org>. Or address mail orders to: American Museum of Natural History Library, Department D, Central Park West at 79th St., New York, N.Y. 10024. TEL: (212) 769-5545. FAX: (212) 769-5009. E-MAIL: [scipubs@amnh.org](mailto:scipubs@amnh.org)