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AN AMMONOID FAUNA FROM THE GLENCAIRN SHALE MEMBER OF THE LOWER CRETACEOUS PURGATOIRE FORMATION, BACA COUNTY, COLORADO

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Abstract—Ammonites found in a thin unit of claystone and shale along Horse Creek in northern Baca County, Colorado include flattened specimens of *Goodhallites* and *Idiohamites*, genera previously unrecorded from the Western Interior. An associated ammonite is *Engonoceras uddeni* (Cragin). A solitary coral, at least a dozen species of bivalves and a small gastropod are associated with the ammonites. A late Albian age is assigned to the assemblage.

INTRODUCTION

Ammonites not previously known from the Western Interior of the United States were discovered in Baca County, Colorado in 1955 by T. G. McLaughlin of the U.S. Geological Survey and me. The specimens are from the Glencairn Shale Member of the Purgatoire Formation on the south side of Horse Creek, 3.5 mi (5.8 km) south of the village of Two Buttes in the SE¼ sec. 19, T29S, R44W. Unusual ammonites found at this locality include small planospiral forms (*Goodhallites*) and various uncoiled forms (*Idiohamites*). The Purgatoire Formation is of late Albian age (Scott, 1970).

Ammonites illustrated in this report were photographed by R. E. Burkholder of the U.S. Geological Survey. These specimens are kept at the National Museum of Natural History, Washington, D.C., where they have USNM (U.S. National Museum) catalog numbers.

STRATIGRAPHY

McLaughlin (1954, table 1), in his investigation of water resources of Baca County, divided the Purgatoire Formation into a lower Cheyenne Sandstone Member and an upper Kiowa Shale Member. The Cheyenne consists of 10–100 m of white to buff, fine-grained, crossbedded sandstone that locally contains petrified wood. The Kiowa is a 13–27-m-thick marine sequence of interbedded gray shale and fine-grained sandstone. Scott (1970), who made a regional investigation of the Lower Cretaceous rocks of southeastern Colorado, northeastern New Mexico, southern Kansas and norrthwestern Oklahoma, recommended that Glencairn replace Kiowa in southeastern Colorado inasmuch as the Kiowa Member of McLaughlin is sandy like the Glencairn Shale Member farther west and lacks many characteristics of the Kiowa Shale of Kansas. This recommendation is accepted herein.

The outcrops along Horse Creek were mapped by McLaughlin (1954, pl. 1) as Dakota Sandstone. Scott (1968) later assigned them to undifferentiated Dakota Sandstone and Purgatoire Formation.

Rocks exposed at the fossiliferous locality on Horse Creek are shown in Figure 1. Beds, numbered 1–23, are on the left side of the stratigraphic column, and bed thicknesses are on the right side. Fossils were collected from beds 9, 11–13, 19 and 22. Bed 9 (USGS Mesozoic locality D12701) is a 7.5-cm-thick, very fine-grained, thick- to thin-bedded brown sandstone that contains abundant *Inoceramus bellvuensis* Reeside, *Ostrea larimerensis* Reeside, *O. noctuensis* Reeside and rare *Idiohamites* sp. Beds 11–13 (USGS D8007), the main ammonite beds, consist of 51 cm of white to tan claystone and shale that contain *Yoldia? septariana* Cragin, *Phelopteria salinensis* (White) (Fig. 3La), *Inoceramus bellvuensis* Reeside (Fig. 3Lb), *Ostrea larimerensis* Reeside, *O. noctuensis* Reeside, *Plicatula incongrua* Conrad?, *Pholadomya* sp., *Anchura kiowana* Cragin (Fig. 3Ha), *Goodhallites* cf. *G. minima* (Lasswitz), *Engonoceras uddeni* (Cragin), *Idiohamites fremonti* (Marcou) and *Idiohamites* sp. In addition, beds 11–13 contain small, thin-shelled bivalves that have not been identified, as well as fish bones and scales. Bed 19 (USGS D12702) is a 10-cm-thick tan, very fine-grained sandstone that contains *Inoceramus bellvuensis*. Bed 22 (USGS D12703) is a 1.5-m-thick unit of brown, very fine-grained, poorly bedded, ledge-

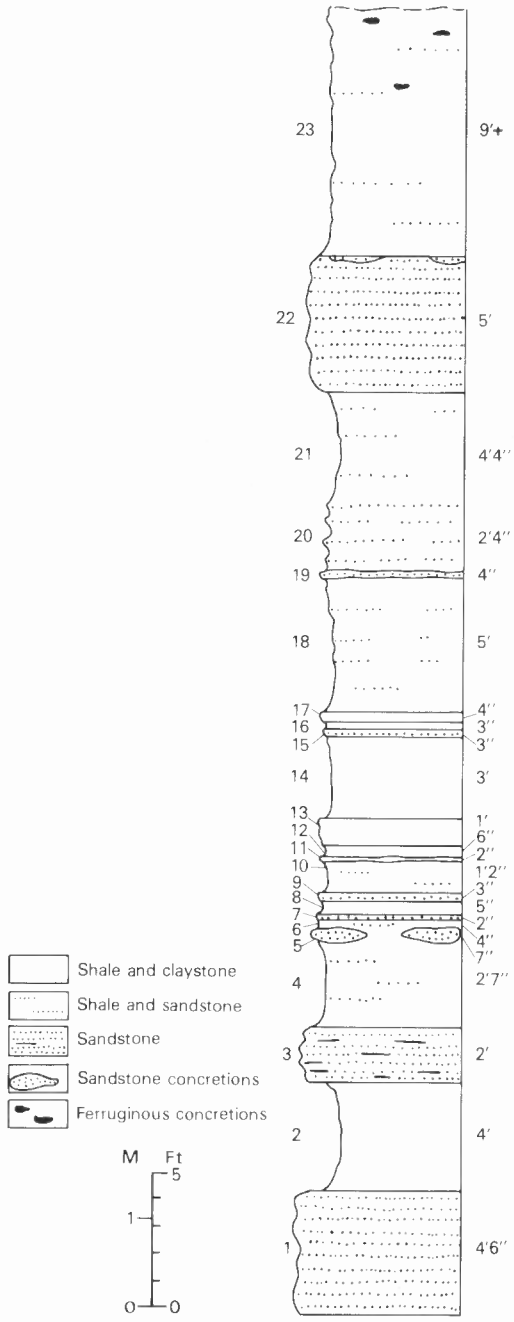

FIGURE 1. Columnar section of part of the Glencairn Shale Member of the Purgatoire Formation on the east side of Horse Creek near center of SE¼ sec. 19, T29S, R44W, Baca County, Colorado. Bed numbers are on the left side and bed thicknesses are on the right side.

forming sandstone that contains abundant poorly preserved *Texigryphaea tucumcarii* (Marcou) and occasional *Inoceramus bellvuensis, Scabrotrigonia emoryi* (Conrad), *Eopachydiscus marcianus* (Shumard) and calcareous worm tubes.

SYSTEMATIC PALEONTOLOGY

Family **Pachydiscidae** Spath, 1922
Genus ***Eopachydiscus*** Wright, 1955

Type species—*Pachydiscus laevicaniculatus* Lasswitz, 1904 (=*Ammonites marcianus* Shumard, 1854).

Diagnosis—Kennedy et al. (1983, p. 656) gave the following concise diagnosis of this genus: "Large, rather inflated to compressed, moderately involute. Sides convex, venter more or less narrowly rounded. Nuclei depressed, with primary ribs, bullate or not, and associated constrictions, with or without intercalated ribs. This variable ornament persists into middle growth, when the whorls become progressively higher. Ornament may decline on the body chamber. Suture with broad, open, minutely frilled elements and numerous auxiliaries." *Eopachydiscus* occurs in the upper Albian and possibly in the Cenomanian.

Eopachydiscus marcianus (Shumard)
Fig. 2

1854 *Ammonites marciana* Shumard, p. 197, pl. 4, fig. 5.
1860 *Ammonites brazoensis* Shumard, p. 594.
1904 *Pachydiscus laevicaniculatus* F. Roemer manuscript; Lasswitz, p. 236, pl. 15, fig. 2a, b, text figs. 8, 9.

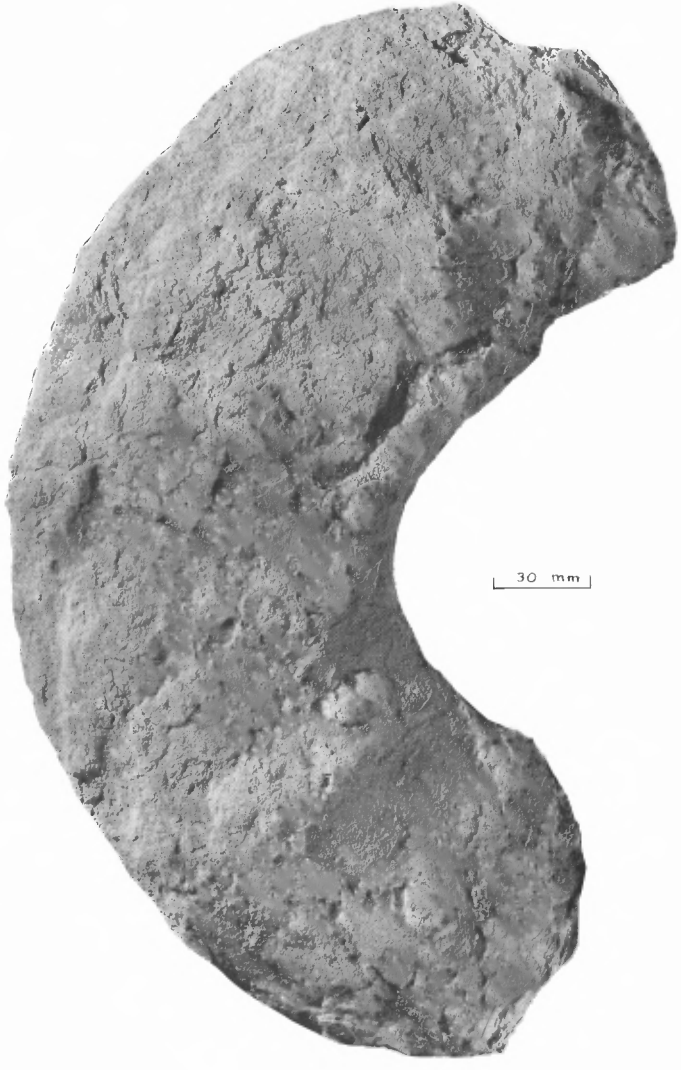

FIGURE 2. *Eopachydiscus marcianus* (Shumard), from bed 22 of the measured section of the Glencairn Member of the Purgatoire Formation at Horse Creek in Baca County, Colorado. Hypotype USNM 410135.

1983 *Eopachydiscus marcianus* (Shumard). Kennedy, Wright and Chancellor, p. 656, pls. 67, 68, text fig. 1b, c (with full synonymy).

Types—Holotype: Shumard (1854, p. 197, pl. 4, fig. 5); hypotype: USNM 410135, from bed 22 at Horse Creek.

Description—This large, moderately involute species has stout whorls with rounded flanks and venter. Ornament consists of sparse, rounded primary and secondary ribs. Primary ribs, which number about 11–13 per whorl, arise from umbilical bullae and cross the flank and venter. The primary ribs are usually bounded by weak constrictions and separated by one or two weak secondary ribs. The suture is fairly simple for a pachydiscid and has a broad, trifid lateral lobe. This species attains a diameter of as much as half a meter.

A single, poorly preserved, crushed specimen (Fig. 2) was collected from bed 22 at the Horse Creek locality. This specimen, 350 mm in diameter, has an umbilical width estimated to be 110 mm (ratio to diameter of 0.31). The flanks are broadly rounded, and the umbilical shoulder is narrowly rounded. Details of the venter cannot be determined because of poor preservation. Seven low, broad, rectiradiate ribs per half whorl arise at the umbilicus and cross most of the flank before weakening and disappearing. Sutures are not preserved.

Remarks—*Eopachydiscus marcianus* was recorded as *Pachydiscus brazoensis* Shumard by Stanton (1905, p. 663) somewhere in the Two Buttes area, 12–17 mi north of Horse Creek. G. R. Scott, of the U.S. Geological Survey, collected several large specimens of *E. marcianus* as much as 400 mm in diameter from very fine grained concretionary sandstone at a locality (USGS D7250) on Two Butte Creek in sec. 23, T27S, R45W, Prowers County, Colorado.

Family **Engonoceratidae** Hyatt, 1900
Genus ***Engonoceras*** Neumayr and Uhlig, 1881

Type species—*Ammonites pierdenalis* von Buch, 1849.

Diagnosis—Compressed, involute ammonites that have flattened flanks, a truncated venter and a pseudoceratitic suture. The venter is either flat or concave on the inner whorls and either flat or rounded on the body chamber. The shell may be smooth with only falcoid growth lines or striae, or the shell may have ribs that flatten on the outer part of the flank where they support lateral and ventrolateral clavi. Ventrolateral clavi, when present, are arranged alternately and may be connected across the venter by broad, zigzagging ribs. Umbilical bullae may be present.

Engonoceras uddeni (Cragin)
Figs. 3K, M, O, P, 4H

1900 *Sphenodiscus belviderensis* var. *uddeni* Cragin, p. 30, pl. 1, figs. 3, 4.
1903 *Engonoceras uddeni* (Cragin): Hyatt, p. 159, pl. 19, figs. 1–6.

Types—Holotype from the Kiowa Shale near Lindsborg, Kansas; hypotypes: USNM 410136–410140, from beds 11–13 at Horse Creek.

Description—The holotype is part of a phragmocone that encloses part of the next earlier whorl. The earlier whorl is slender with flattened flanks and flat or slightly concave venter; the outer whorl has more rounded flanks and a narrowly rounded venter. Dimensions were not provided, but from Hyatt's illustration, the holotype has a whorl height of about 48 mm and a width of about 21 mm.

Twelve flattened specimens in claystone from Horse Creek can be assigned to *Engonoceras uddeni*. Venters are narrow and concave (Figs. 3M, 4H). Flanks are smooth except for falcoid growth lines (Fig. 3K, O). Umbilical bullae are present on a few specimens (Fig. 3P). Sutures are not preserved on any specimen.

Family **Brancoceratidae** Spath, 1934
Subfamily **Mortoniceratinae** Spath, 1925
Genus ***Goodhallites*** Spath, 1932

Type species—*Ammonites goodhalli* J. Sowerby, 1820.

Diagnosis—*Goodhallites* includes fairly evolute, compressed, keeled ammonites that have flexuous ribs and reduced tuberculation. The genus is known only from upper Albian rocks.

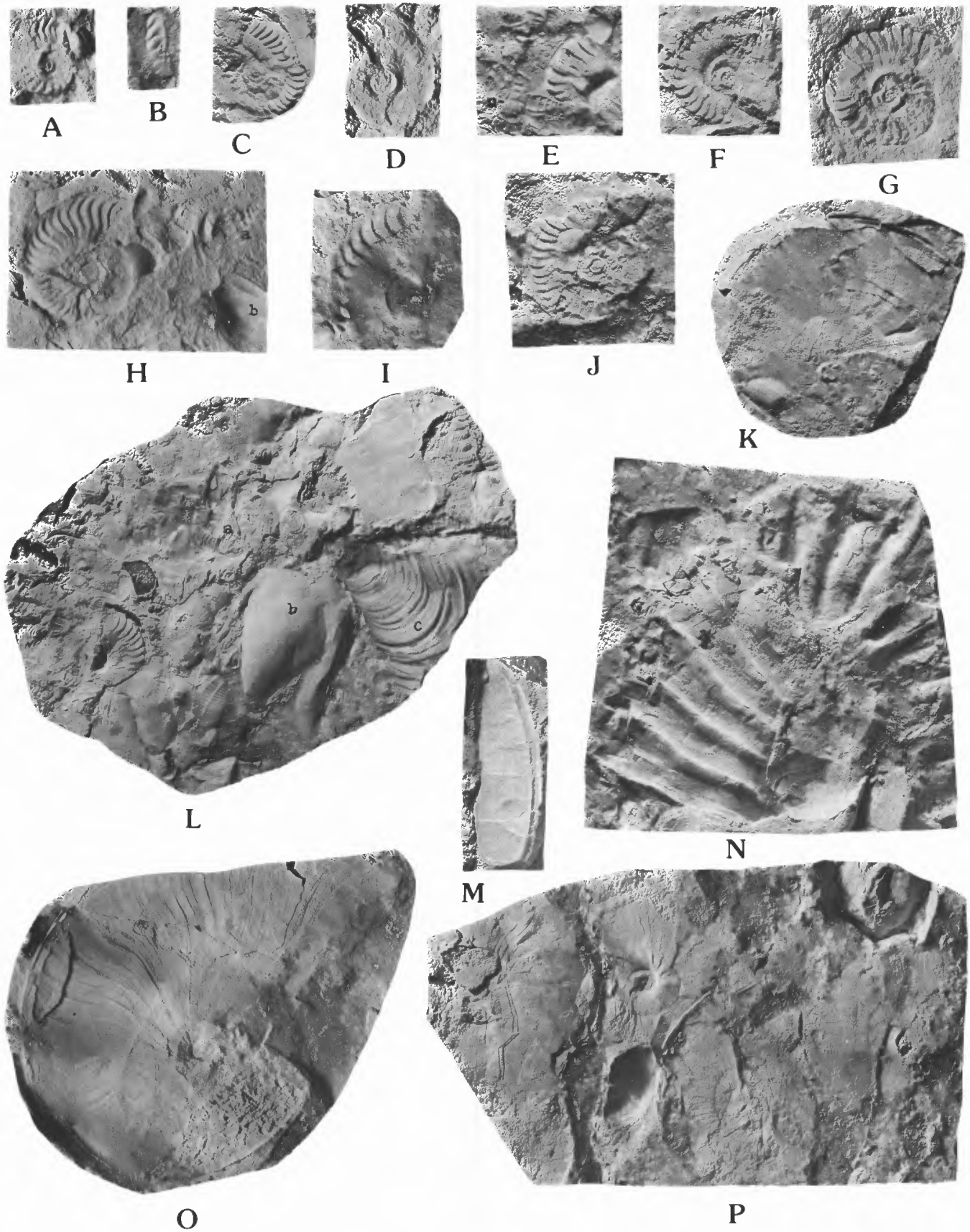

FIGURE 3. Ammonites, bivalves and gastropods (all natural size) from beds 11–13 of the measured section of the Glencairn Member of the Purgatoire Formation at Horse Creek in Baca County, Colorado. A–J, L, *Goodhallites* cf. *G. minima* (Lasswitz), figured specimens USNM 410141–410151. E includes specimens of *Anchura kiowana* Cragin (a); H includes specimens of *A. kiowana* (a) and *Phelopteria salinensis* (White) (b); and L includes specimens of *A. kiowana* (a), *P. salinensis* (b) and *Inoceramus bellvuensis* Reeside (c). K, M, O, P, *Engonoceras uddeni* (Cragin), hypotypes USNM 410136–410139. N, *Idiohamites fremonti* (Marcou), hypotype USNM 410152, part of the U-shaped body chamber.

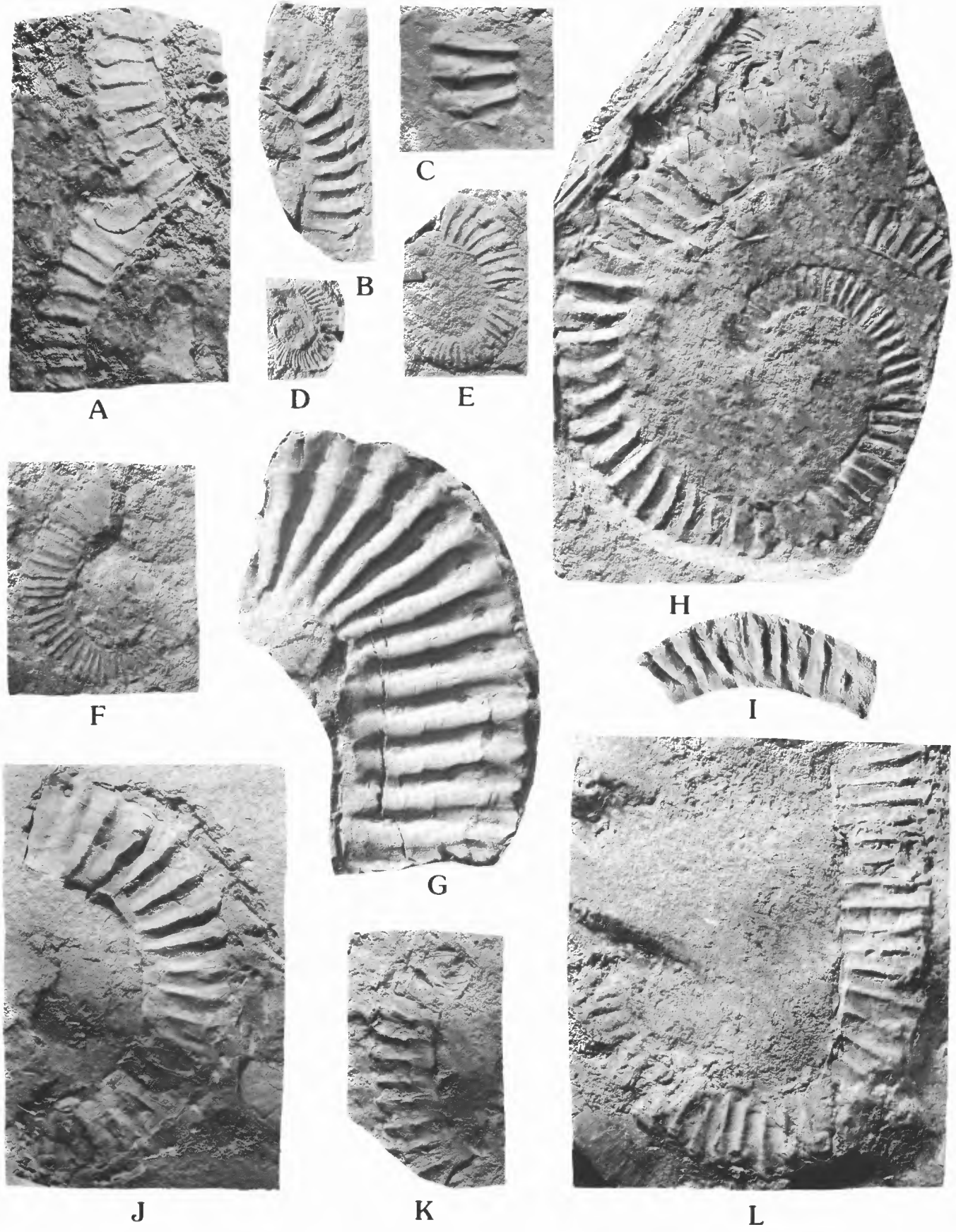

FIGURE 4. Ammonites, natural size, from beds 11–13 of the measured section of the Glencairn Member of the Purgatoire Formation at Horse Creek in Baca County, Colorado. A–J, L, *Idiohamites fremonti* (Marcou), hypotypes USNM 410153–410163. K, *Idiohamites* sp., figured specimen USNM 410164. The venter of a specimen of *Engonoceras uddeni* (Cragin) is visible in the upper left of H.

Goodhallites cf. *G. minima* (Lasswitz)
Fig. 3A–J, L

Types—Figured specimens: USNM 410141–410151, from beds 11–13 at Horse Creek.

Description—Eighteen crushed specimens in claystone resemble the small, keeled ammonite that was described as *Schloenbachia austinensis* Roemer var. *minima* Lasswitz (1904, p. 245, pl. 18, fig. 1) from the Lower Cretaceous Georgetown Limestone at Austin, Texas. Lasswitz's variety was later raised to species rank and assigned to *Goodhallites* by Young (1957, p. 22). Lasswitz's illustration shows a phragmocone about 28 mm in diameter with an umbilical ratio of 0.27. Ornament consists of about 36 flexuous ribs per whorl that are strongest at the ventrolateral shoulder.

The Horse Creek specimens are small, and none has a diameter that exceeds 32 mm. Umbilical ratios range from 0.21 to 0.33. Flanks are flattened, and venters are narrowly rounded. A small, smooth keel is present. Ribs usually arise at some diameter from 16–18 mm, but some specimens are ribbed at diameters as small as 8 mm (Fig. 3A). The ribs are closely spaced and flexuous; they become thickened and highest at the ventrolateral shoulder, where they bend forward and then disappear on the venter. Ribs form on the outer part of the flank first and then gradually extend to the umbilicus as the shell enlarges. Ribs are poorly differentiated into primaries and secondaries. On the only completely ribbed whorl in the collection (Fig. 3G), ribs number 32. Small nodate to bullate umbilical tubercles form early, and these may be separated from the ribs by a smooth area on the lower part of the flank. There are about 10 tubercles per whorl. Sutures are not visible.

Remarks—In their small size and in their ornament, the Horse Creek specimens also resemble the juvenile whorls of *Goodhallites goodhalli* (J. Sowerby) figured by Sowerby (1824, p. 74, pl. 451, fig. 4 only) as his new species *Ammonites varicosus* from the Gault Clay of England. Sowerby's specimen, refigured by Spath (1934, figs. 155a–c), also resembles the Horse Creek specimens in having a smooth area between the umbilical tubercles and the ribs. The English specimen has about 12 umbilical tubercles and about 30 ribs per whorl. According to Spath (1934, p. 448), the umbilical ratio is 0.33, which is larger than all but one ratio for the Horse Creek specimens.

Family **Anisoceratidae** Hyatt, 1900
Genus ***Idiohamites*** Spath, 1925

Type species—*Hamites tuberculatus* J. Sowerby, 1818.

Diagnosis—This uncoiled genus, named by Spath in 1925 with very little description, was later described more completely by Spath (1939, p. 582) as follows: "Laterally flattened shells, with hamitid or ancyloceratid coiling, in which the ventro-lateral edges are provided with tubercles. Lateral tubercles present in some, but never strong. Ribbing radial or projected, intermediate ribs sometimes present between the tuberculate costae. Suture-line hamitid, with bifid lateral lobes and bifid saddles, but dorsal (internal) lobe sometimes subtrifid." The genus is known only from upper Albian to Cenomanian rocks.

Idiohamites fremonti (Marcou)
Figs. 3N, 4A–J, L

1858 *Hamites fremonti* Marcou, p. 36, pl. 1, fig. 3.
1894 *Exiteloceras? fremonti* (Marcou): Hyatt, p. 577.
1919 [1920] *Hamites comanchensis* Adkins and Winton, p. 38, pl. 6, fig. 10.
1932 [1933] *Idiohamites comanchensis* (Adkins and Winton): Adkins, p. 353.
1962 *Idiohamites fremonti* (Marcou): Swensen, p. 72, pl. 2, fig. 11; pl. 3, figs. 5, 9; pl. 5, figs. 1–7 (with full synonymy).

Types—Holotype: British Museum (Natural History) 12667; hypotypes: USNM 410152–410163 from beds 11–13 at Horse Creek.

Description—This large, rather sparsely ribbed species has early whorls coiled in a regular plane open spiral, followed by a straight shaft, and then by a final U-shaped hook. The holotype, from rocks now assigned to the Lower Cretaceous Duck Creek Limestone of the Lower and Upper Cretaceous Washita Group of northern Texas, is part of a U-shaped body chamber. Ornament on the holotype consists of prorsiradiate to rectiradiate, narrow, sharp ribs that number five along the venter in a distance equal to the whorl height at that point. Every third rib has a conspicuous, circular ventrolateral tubercle.

About 20 flattened specimens in claystone from Horse Creek can be referred to *Idiohamites fremonti*. Most consist of parts of the early open spiral whorls or parts of the straight shaft. Ribs are narrow, sharp and mostly rectiradiate. Most specimens have five ribs in a distance equal to the whorl height and are more closely spaced toward the apex (Fig. 4D, H). Ventrolateral tubercles, which are small and circular, have an irregular distribution; they may be present on every rib (Fig. 4C, G) or on every second (Fig. 4E) or third rib (Fig. 4F). A small, sharp lateral tubercle is occasionally present (Fig. 4I). Sutures are not visible on any of the specimens.

Remarks—The variability of tubercle distribution was noted by Swensen (1962, p. 72) on specimens of *Idiohamites fremonti* from Texas. Tubercles were observed on every rib or on every second, third or fourth rib. Some specimens have tubercles on several consecutive ribs followed or preceded by nontuberculate ribs. Similar features were observed on specimens from Horse Creek.

Idiohamites fremonti is abundant in the basal part of the Duck Creek Limestone of northern Texas, where Adkins and Winton (1919, p. 18) recognized a "zone of *Hamites comanchensis*." The namesake for that zone was determined to be a synonym of *I. fremonti* by Swensen (1962, p. 73). *Idiohamites fremonti* has been recorded in the Oklahoma Panhandle (Stanton, 1905).

Idiohamites sp.
Fig. 4K

Figured specimen—USNM 410164 from beds 11–13 at Horse Creek.

Description—A crushed planospiral fragment 39 mm in length with a whorl height of 13 mm differs from other specimens of *Idiohamites* in the collection in having a conspicuous, sharp, midflank tubercle on each rib. Ribs are sparse and number only three for the whorl height. The ribs are narrow, sharp, slightly prorsiradiate and much narrower than the interspaces.

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