MIDDLE ALBIAN AMMONITES FROM EL MADERO, WEST-CENTRAL CHIHUAHUA

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ABSTRACT.—A small ammonite fauna is herein reported from Cerro Madero, west-central Chihuahua. It includes species of the genera *Beudanticeras* Hitzel, *Desmoceras* Zittel, *Lyelliceras* Spath, and *Tegoceras* Hyatt. The latter genus has not been reported previously from North America, and the other three genera only rarely. The fauna is from a Cretaceous inlier in the eastern edge of the volcanics of the Sierra Madre Occidental, is Middle Albian, and emphasizes that the many inliers of Cretaceous rocks along the eastern edge of the Sierra Madre Occidental should be examined much more closely. *Key words:* ammonites; Cretaceous; west-central Chihuahua, México.

Approximately 25 years ago, I traded some rudists to Geological Enterprises of Ardmore, Oklahoma, for a small collection of Albian ammonites. The ammonites were obtained from a collector in Ciudad Juárez, who claimed they came from Cerro Madero, about 75 miles northwest of Ciudad Chihuahua. El Madero (a village) is about 2.5 kilometers northwest of Mesa del Huracan (another village) at the end of an abandoned railroad near El Gato. El Madero is at 29° 41′ N, 108° 16.5′ W; it does not appear in the gazetteer of Hendrickson and Straw (1976), but neither do the villages of Madera and Nueva Madera of the Madera 1/250,000 sheet (Dirección General de Geografía del Territorio Nacional, 1982). El Madero is approximately 80 kilometers west-northwest of Ciudad Chihuahua, straight line (Fig. 1). This agrees reasonably with the estimate of distance by the collector. Cerro Madero is a small mountain near the village of El Madero.

Although Cretaceous rocks are shown to crop out farther west according to the geologic map of the Madera sheet (Dirección General de Geografía del Territorio Nacional, 1982), such rocks are not shown to crop out in this area. However, Peter Megaw and David Wark informed me that there are indeed Cretaceous shales beneath the volcanics of the Sierra Madre Occidental at El Madero.

When dealing with purchased collections one must always be careful. I at first doubted the authenticity of the locality of this collection. However, more detailed study revealed that the collection contains South American, perhaps Arizonan, and European affinities. Therefore, I have concluded that the Chihuahua locality is reasonable, and that more attention should be paid to the many inliers of Cretaceous rocks that occur along the eastern, northern, and western margins, of the volcanic terrain of the Sierra Madre Occidental.

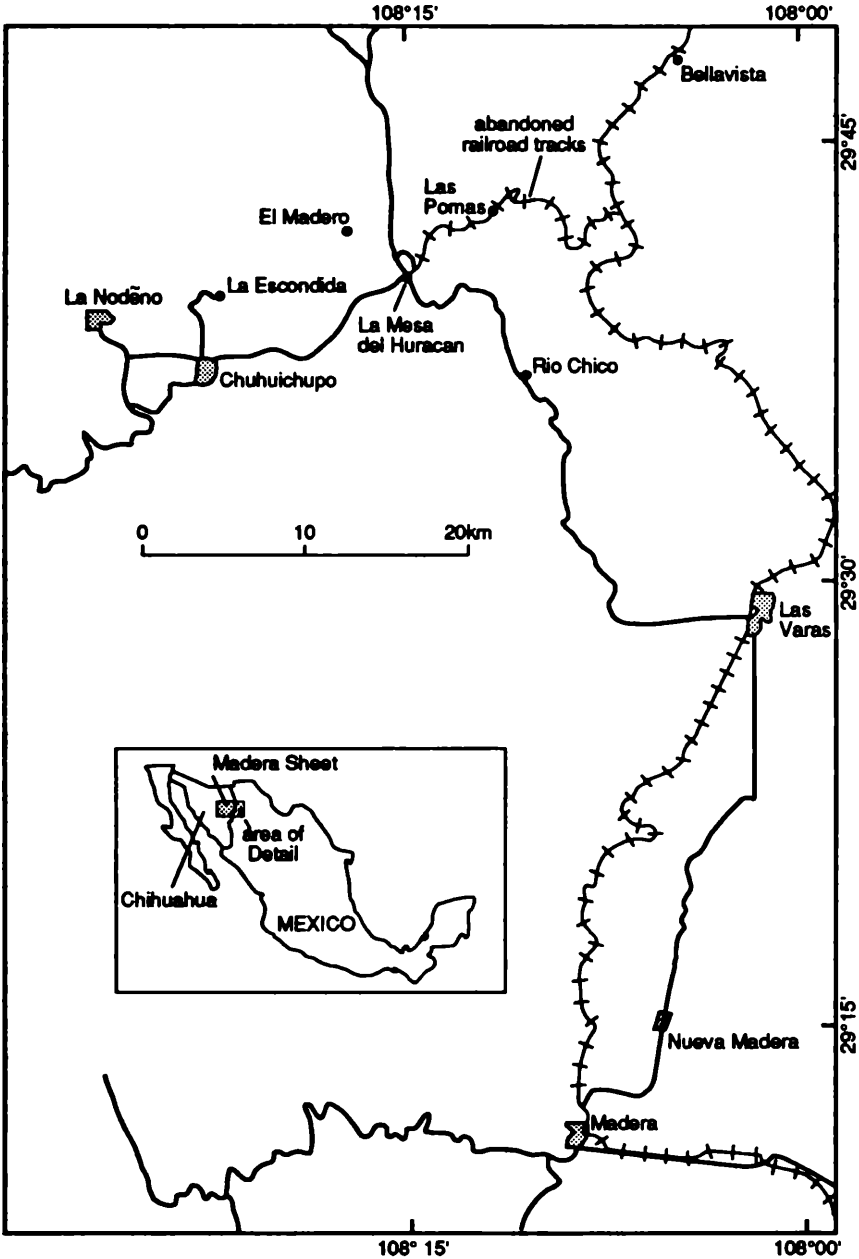


FIGURE 1. Location of El Madero in the eastern half of the Madera Sheet, Chihuahua, México. From Dirección General de Geografía del Territorio Nacional, 1982.

TAXONOMY

Measurements are in millimeters, with percentages of D in parentheses. D is diameter of conch, U is width of umbilicus, H is whorl-height, and W is whorl-width. H/W is a ratio.

Order AMMONOIDEA
Suborder AMMONITINA Hyatt, 1889
Superfamily DESMOCERATACEAE Zittel, 1895
Family DESMOCERATIDAE Zittel, 1895
Subfamily BEUDANTICERATINAE Breistroffer, 1953

Genus *Beudanticeras Hitzel, 1902*

Type species.—Ammonites beudanti Brongniart, 1822.

Beudanticeras cf. *hatchetense* Scott, 1940

Figs. 2:4-6, 14, 15; 3:5, 7.

Material.—One specimen, UT-8294, from Middle Albian shale at Cerro Madero, Chihuahua.

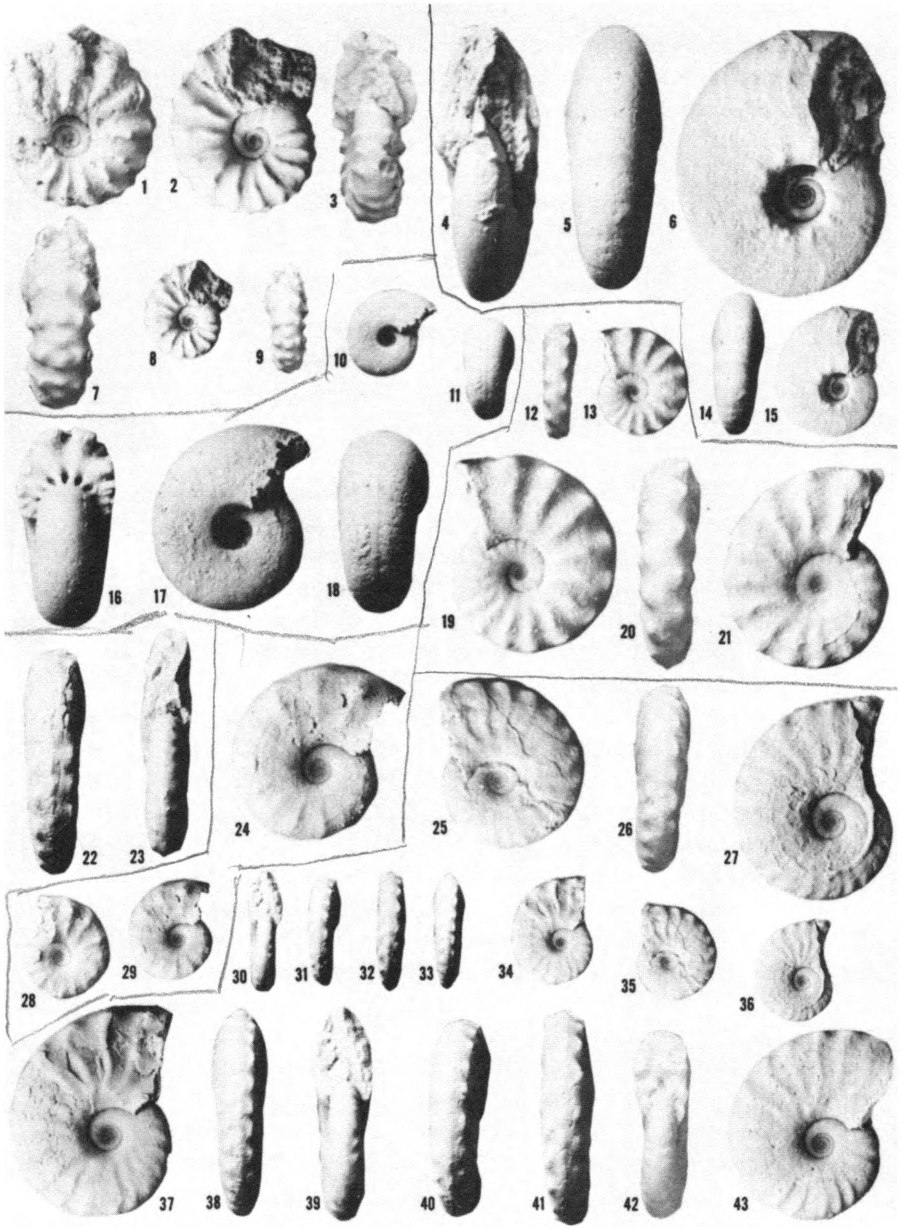
Remarks.—UT-8294 is a high-whorled ammonite with about 12 shallow, sigmoid constrictions per whorl at a diameter of 20 mm. Constrictions extend from the umbilical wall across the venter and are not as strong as on some species of *Beudanticeras*. There are faint, incomplete ribs intercalated between constrictions; most of the ribs do not extend onto the venter nor to the umbilicus. The whorl-section is oval with flanks tapering only slightly ventrad. The umbilical wall is vertical, and the conch is near involute, each whorl overlapping nearly all of the preceding whorl. The specimen is septate throughout.

Measurements.—D, 20.8 (100); U, 4.8 (23.0); H, 9.2 (44.2); W, 7.1 (34.1); H/W, 1.30.

Comparisons.—Most species of *Beudanticeras*, like *B. beudanti* (Brongniart) are higher-whorled than is UT-8294. Exceptions include some interpretations of *Beudanticeras dupinianum* (d'Orbigny) (see Spath, 1923, text figs. 4a-d), *B. besairiei* Breistroffer in Besairie (1936:pl. 15, figs. 17-18), *B. convergens* (Jacob, 1907: pl. 2, figs. 24-26), *B. victoris* Stoyanow (1949:pl. 18, figs. 18-21), *B. arduennense* Breistroffer (Casey, 1961:pl. 27, figs. 9-11), and *B. hatchetense* Scott (1940:pl. 56, figs. 3-5).

Beudanticeras dupinianum (d'Orbigny) is usually, but not always, more strongly ornamented than UT-8294, and as illustrated by Avram et al. (1988:pl. 5, figs. 1a-b), Föllmi (1989:pl. 9, figs. 13a-b), and Casey (1961:pl. 26, fig. 11) the constrictions are more strongly projected on the venter, and the umbilicus is more open. *B. besairiei* Breistroffer has ribs extending across the venter during at least part of the ontogeny.

B. convergens (Jacob) has the narrow umbilicus of UT-8294, and has a similar conformation, but constrictions and ornament do not show, at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least on his illustrations (1907: pl. 2, figs. 24-26). *B. victoris* Stoyanow has a slightly more open umbilicus than UT-8294, but the ornamentation is similar. *B. arduennense* Breistroffer seems to be slightly higher-whorled, but otherwise comparable. Although the form illustrated by Avram et al. (1990:pl. 4, fig. 7), as *B.* cf. *arduennense*, has a comparable whorl-section to UT-8294, it has much deeper constriction than UT-8294, and it lacks umbilical nodes. *B.* cf. *laevigatum* (Sowerby) in Avram et al. (1990:pl. 4, figs. 5-6), is higher-whorled than UT-8294. *B. hatchetense* Scott also may be a little higher-whorled, but ornamentation and umbilicus are comparable.

Scott (1940) thought that *B. hatchetense* was from the *Douvilleiceras* zone. According to Föllmi (1989), *B. arduennense* is Middle Albian. *B. victoris* Stoyanow is from the *nolani* zone, and *B. convergens* (Jacob) is Aptian, both too old to occur with *Lyelliceras*.

Subfamily DESMOCERATINAE Zittel, 1895

Genus *Desmoceras* Zittel, 1884

Type species.—*Ammonites latidorsatus* Michelin, 1838, subsequently designated by Boule et al. (1906).

Synonymy.—See Arkell et al. 1957.

Desmoceras cf. *latidorsatum* (Michelin, 1838)

Figs. 2:10-11, 16-18; 3:1.

Material.—One specimen, UT-8292, from Middle Albian shale at Cerro Madero, Chihuahua.

Remarks.—UT-8292 is a specimen about 15.2 mm in maximum diameter. It is septate throughout. The conch is regularly expanding, nearly involute with a moderately narrow umbilicus. The whorl-section is almost circular and the height-width ratio is slightly less than 1.0. There is no ornamentation on the pyritized internal mold. A suture was not recovered.

Measurements.—D, 14.1 (100); U, 3.1 (22.0); H, 6.2 (43.9); W, 7.1 (50.4); H/W, 0.87.

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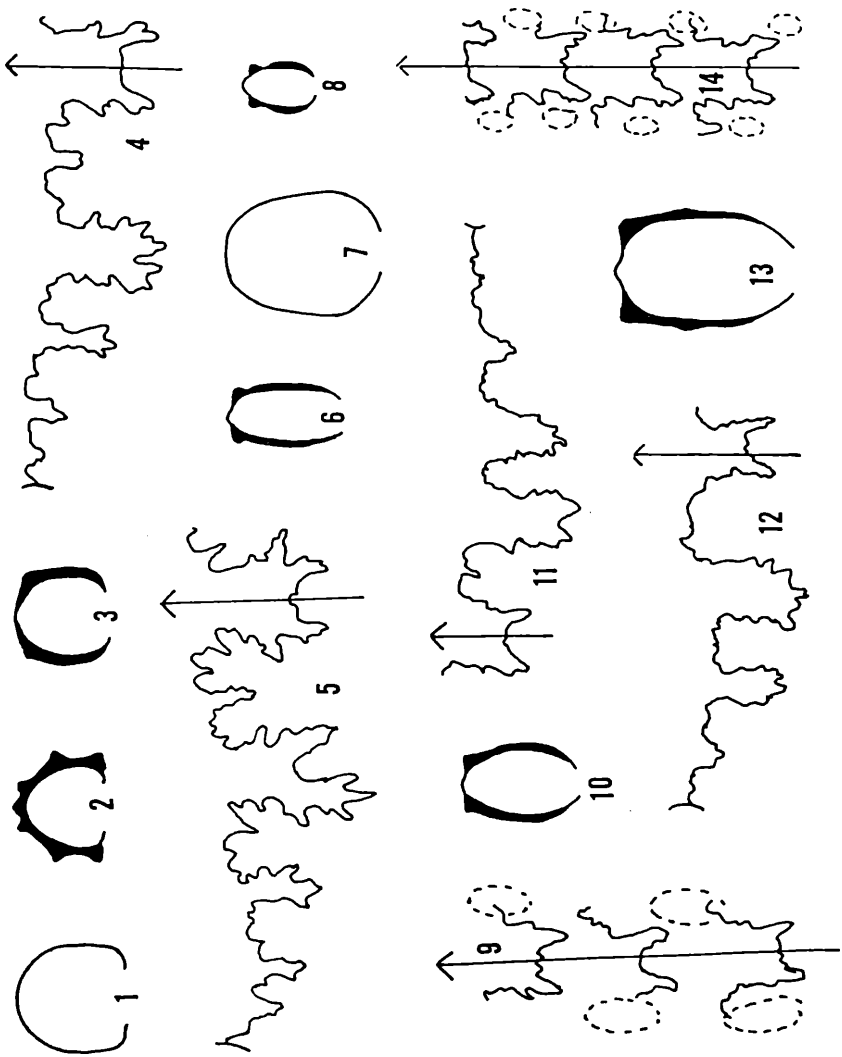
FIGURE 2. *1-3, 7-9.*—*Lyelliceras* aff. *carvajalorum* Etayo-Serna, 1979. UT-8290; *1-3*, 7 X 1.8; *8, 9*, X 0.9. *4-6, 14, 15.*—*Beudanticeras* cf. *hatchetense* Scott, 1940. UT-8294; *4-6*, X 1.8; *14, 15*, X 0.9. *10, 11, 16-18.*—*Desmoceras* cf. *latidorsatum* (Michelin, 1838). UT-8292; *10, 11*, X 0.9; *16-18*, X 1.8. *12, 13, 19-21.*—*Tegoceras* sp. no. 1. UT-8296; *12, 13*, X 0.9; *19-21*, X 1.8. *24, 28, 29.*—*Tegoceras* n. sp. aff. *gladiator* (Bayle, 1878). UT-8293; *24*, X 1.8; *28, 29*, X 0.9. *22, 23, 25-27, 30-43.*—*Tegoceras maderoense*, n. sp. UT-8295; *22*. UT-8295-A; *23, 34, 37, 41*. UT-8295-C, the holotype; *25, 26, 31, 35, 40, 42, 43*. UT-8295-E; *27, 36*. UT-8295-B; *30, 32, 33, 38, 39. 22, 23, 25-27, 37-43*, X 1.8; *30-36*, X 0.9.

All specimens are Middle Albian and are from an unnamed shale formation near the village of El Madero, central-western Chihuahua.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Comparisons.—*Desmoceras latidorsatum* (Michelin, 1838) var. *media* Wiedmann and Dieni (1968:pl. 12, figs. 8a-b) has a slightly more rapidly expanding conch than does UT-8292, and there are faint ribs on the flank that do not appear to cross the venter. It is Upper Albian. UT-8292 is intermediate between the two dimorphs illustrated by Jacob (1907:pl. 4, figs. 10-13), and the forms illustrated by Boule et al. (1906:pl. 2, figs. 4, 4a-b, 5) appear to be similar to Jacob's less obese dimorph, which has an height-width ratio of about 1.0. Spath's (1923:pl. 2, figs. 2a-b) specimen from an unknown Folkstone level is much more like UT-8292, with no observable ornament and a height-width ratio of less than 1.0. *D. latidorsatum* (Michelin) in Marek et al. (1989:pl. 44, figs. 2a-b) is similar to UT-8292, except the umbilicus may be narrower. Stoliczka's (1865:pl. 59, figs. 14a-b) has a more squarish whorl-section, whereas the specimen of his figures 13a-b has the greatest width much more dorsad than is that of UT-8292. Kossmat's (1898:pl. 19, figs. 6a-c, 7a-b) and Crick's (1907:pl. 14, figs. 2, 2a, 3, 3a) specimens also have the greatest width much more dorsad. *D. latidorsatum* (Michelin) *complanata* Jacob in Avram et al. (1990:pl. 4, fig. 2) is not as fully rounded on the flanks as UT-8292, and is older. Anderson's (1938: figs. 3, 3a) illustrations of Stoliczka's species are more involute than either Stoliczka's specimen or UT-8292. Spath (1923:42) cited *D. latidorsatum* (Michelin) as ranging from Lower Albian into the Cenomanian.

Family LYELLICERATIDAE Spath, 1921

Genus *Lyelliceras* Spath, 1921

Type species.—*Ammonites lyelli* Leymerie in d'Orbigny, 1841

Lyelliceras aff. *carvajalorum* Etayo-Serna, 1979

Figs. 2: 1-3, 7-9, 3: 2.

Material.—One specimen, UT-8290, from the Middle Albian of Cerro Madero, Chihuahua.

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FIGURE 3. *1.*—*Desmoceras* cf. *latidorsatum* (Michelin, 1838). UT-8292; whorl-section X 2.9 at D = 14.1 mm. *2.*—*Lyelliceras* aff. *carvajalorum* Etayo-Serna, 1979. UT-8290; whorl section X 1.95 at D = 11.0 mm. *3, 4.*—*Tegoceras* n. sp. aff. *gladiator* (Bayle, 1878), UT-8293; *3*, whorl-section X 1.75 at D = 14.8 mm; *4*, suture, X 4.75 at D = 17.5 mm. *5, 7.*—*Beudanticeras* cf. *hatchetense* Scott, 1940, UT-8294; *5*, whorl-section X 2.25 at D = 20.8 mm; *7*, suture X 5.0 at D = 17.5 mm. *6, 8-11.*—*Tegoceras maderoense*, n. sp., *6, 11*, UT-8295-C, the holotype, *6*, whorl-section X 2.25 at D = 17.0 mm, and *11*, suture X 5.9 at D = 13.8 mm; *8, 9*. UT-8295-A, *8*, whorl-section X 1.95 at D = 15.0 mm, and *9*, suture X 6.5 at D = 17.0 mm, the suture varying in position at mid-venter according to the position of the large ventrolateral clavae; *10*, UT-8295-E, whorl-section X 1.45 at D = 13.6 mm. *12-14.*—*Tegoceras* sp. no. 1, UT-8296; *12*, suture X 4.8 at D = 15.0 mm, *13*, whorl-section X 2.45 at D = 15.1 mm, and *14*, three successive ventral saddles X 4.4 at D = 15.0±, illustrating the asymmetry of the ventral lobe to the mid-line.

Remarks.—UT-8290, the only specimen from the Chihuahuan locality, is moderately involute, but the umbilicus widens a little during growth, overlap being to about half of the flank at a diameter of 15 mm. Interrib height-width ratio is about 1.2 at a diameter of 13 mm.

There are about 15 rectiradiate ribs at a diameter of 15 mm, of which some are faintly sigmoid. There are more ventral tubercles than there are ribs, but less than two ventral tubercles per rib. Most species of *Lyelliceras* show four lateral tubercles per rib, plus the ventral tubercle, but UT-8290 has only three tubercles per rib, plus the ventral tubercle.

Measurements.—D, 13.0 (100); U, 4.1 (31.5); H, 4.5 (34.6); W, 3.8 (29.2); H/W, 1.18.

Comparisons.—Most of the species of *Lyelliceras* of which I am aware have four tubercles at some part of the growth stage in addition to the ventral tubercle. The single exception is *L. carvajalorum* Etayo-Serna (1979:figs. 8h-i and pl. 11, fig. 5). Therefore I have compared UT-8290, with three lateral tubercles on each flank and one ventral tubercle, to Etayo-Serna's specimen, but on UT-8290 the umbilical tubercles are at the umbilical shoulder instead of removed therefrom as in Etayo-Serna's species. *L. pseudolyelli* (Parona and Bonarelli, 1896) in Benavides-Caceres (1956:pl. 52, fig. 3) also has only three lateral tubercles, but their disposition is different and the specimen is more flat-sided than UT-8292. *L. pseudolyelli* (Parona and Bonarelli, 1896:pl. 14, figs. 1 and 2) also has umbilical tubercles removed from the umbilical shoulder. The same can be said for *Ammonites lyelli* Pictet and Campiche (1858-1864:pl. 14, figs. 7a-b, only), which would appear to be a *Prolyelliceras*.

According to Etayo-Serna (1979:16), if I read him correctly, *L. carvajalorum* should represent some part of the Middle Albian above the lower zone.

Genus *Tegoceras* Hyatt, 1900

Type species.—*Ammonites mosensis* d'Orbigny, 1841.

Remarks.—The whorl-sections (Fig. 3) are drawn as though the ribs were opposed across the venter. This is for convenience, because opposite ribs, of course, alternate in ventral view in the genus *Tegoceras*.

Tegoceras n. sp. aff. *gladiator* (Bayle, 1878)

Figs. 2:24, 28, 29; 3:3, 4.

Material.—One specimen, UT-8293, from Middle Albian shale, Cerro Madero, Chihuahua.

Remarks.—This specimen is moderately involute for the genus *Tegoceras*, with sloping umbilical wall poorly delineated from the flank. There are about 17 ribs in the outer whorl. Ribs are well spaced with interribs wider than ribs. Ribs are generally rectiradiate with no sinuosity.

There are low shoulder clavae that do not rise ventrad of the venter, and there are low, umbilical swellings at the umbilical ends of the ribs. The height-width ratio is about 1.0.

Measurements.—D, 14.5 (100); U, 4.3 (29.7); H, 4.8 (33.1); W, 4.8 (33.1); H/W, 1.00.

Comparisons.—Although perhaps related to *Tegoceras gladiator* (Bayle, 1878), UT-8293 has a number of distinct differences, including interribs that are wider than ribs, much smaller umbilical swellings on the ribs, and a less accentuated zigzag pattern of the alternating ventrolateral clavae in ventral view. Furthermore these clavae are not as well developed, so that there is no recession of the height of the ribs at the mid-flank position. The first lateral saddle is relatively less wide than is that of the specimen illustrated by Casey (1978: fig. 238f), but this could result from the small size of UT-8293. Etayo-Serna (1979:83) compares the specimen figured by Benavides-Caceres (1956:pl. 52, fig. 3) as *Lyelliceras pseudolyelli* (Parona and Bonarelli) to his species, emphasizing that the whorl-section of the specimen of Benavides-Caceres is unlike the Parona and Bonarelli (1896) specimen.

Tegoceras sp. 1

Figs. 2:12, 13, 19-21; 3:12-14.

Material.—One specimen, UT-8296, from Middle Albian shale, Cerro Madero, Chihuahua.

Remarks.—A relatively high-whorled species of *Tegoceras* with H/W around 1.6. The specimen is relatively involute and shows a small node just ventrad of mid-flank. There are approximately 17 ribs on the outer whorl, and ribs and interribs are about the same width. Width of ribs and interribs expands equally ventrad, and each rib ends in a strong ventrolateral clava. Ventro-lateral clavae alternate on opposite flanks. The suture does not have exceptionally wide saddles or lobes.

Measurements.—D, 15.1 (100); U, 5.4 (35.8); H, 6.0 (39.7); W, 3.6 (23.8); H/W, 1.66.

Comparisons.—UT-8296 has a height-width ratio similar to the specimen of diverse *Ammonites lyelli* of Pictet and Campiche (1858-1864: pl. 24, figs. 8a-d) and probably the specimen of *Tegoceras benavidescaceresi* Etayo-Serna (1979:pl. 11, fig. 8). Etayo-Serna's species and the illustrations of Pictet and Campiche mentioned above also have the minor node at mid-flank, but otherwise the specimen of *Tegoceras benavidescaceresi* is much too large to compare readily with UT-8296. The specimens (figs. 8a-d) illustrated by Pictet and Campiche (1858-64) have a much more evenly tabulate venter than does UT-8296, and the ribs do not start as early in the ontogeny, but this could be due to artistic license in Pictet and Campiche. On UT-8296 ventrolateral nodes are more

pronounced and the venter, therefore, appears to vary in width, unlike the specimen illustrated by Pictet and Campiche.

Tegoceras maderoense, n. sp.
Figs. 2:22, 23, 25-27, 30-43; 3:6, 8-11.

Material.—Five specimens, UT-8295-C, the holotype, and four paratypes (UT-8295) from Middle Albian shale, Cerro Madero, Chihuahua.

Remarks.—Suite UT-8295 represents a widely involute (overlap is more than one-half of the flank), more densely costate (20 to 24 ribs per whorl) species. Ribs are markedly sigmoid, and on the ventral half of the flank interribs are much wider than ribs. Interribs widen markedly ventrad, whereas ribs are about the same width across the flank. H/W ranges from about 1.6 to over 2.0, but the higher figures may be due to preservation. However, the species is relatively high-whorled. There appears to be the remnant of a ventral tubercle on all specimens. The suture is typical of those species of *Tegoceras* with the narrower first lateral saddles. Four specimens show an asymmetry of the ventral saddle according to its position in relation to the ventrolateral clavae, a condition most markedly expressed by UT-8295-A (fig. 3.9). Only one specimen, UT-8295-D, does not show this asymmetry.

Measurements.—UT-8295-A: D, 17.8 (100); U, 5.1 (28.7); H, 6.7 (37.6); W, 4.0 (22.5); H/W, 1.67. UT-8295-B: D, 15.9 (100); U, 3.6 (22.6); H, 7.1 (44.7); W, 3.2 (20.2); H/W, 2.22. UT-8295-C: D, 17.0 (100); U, 4.2 (24.7); H, 6.6 (38.8); W, 3.3 (19.4); H/W, 2.00. UT-8295-D: D, 15.9 (100); U, 4.1 (25.8); H, 6.0 (37.7); W, 3.5 (22.0); H/W, 1.71. UT-8295-E: D, 13.6 (100); U, 4.0 (29.4); H, 5.2 (38.2); W, 3.3 (24.3); H/W, 1.58.

Comparisons.—*Tegoceras maderoense*, n. sp., is more densely costate than other high-whorled species of *Tegoceras*, except for *T. benavidescaceresi* Etayo-Serna (1979:pl. 11, fig. 8), which has even more ribs, upwards of 26 per volution, but they are rectiradiate. *T. maderoense*, n. sp., differs from *T. benavidescaceresi* in the markedly sigmoid ribbing of the former. The sutures are similar to the group of *T. gladiator* (Bayle), although the specimens are small, which may account for their narrower first lateral saddles.

Acknowledgments

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