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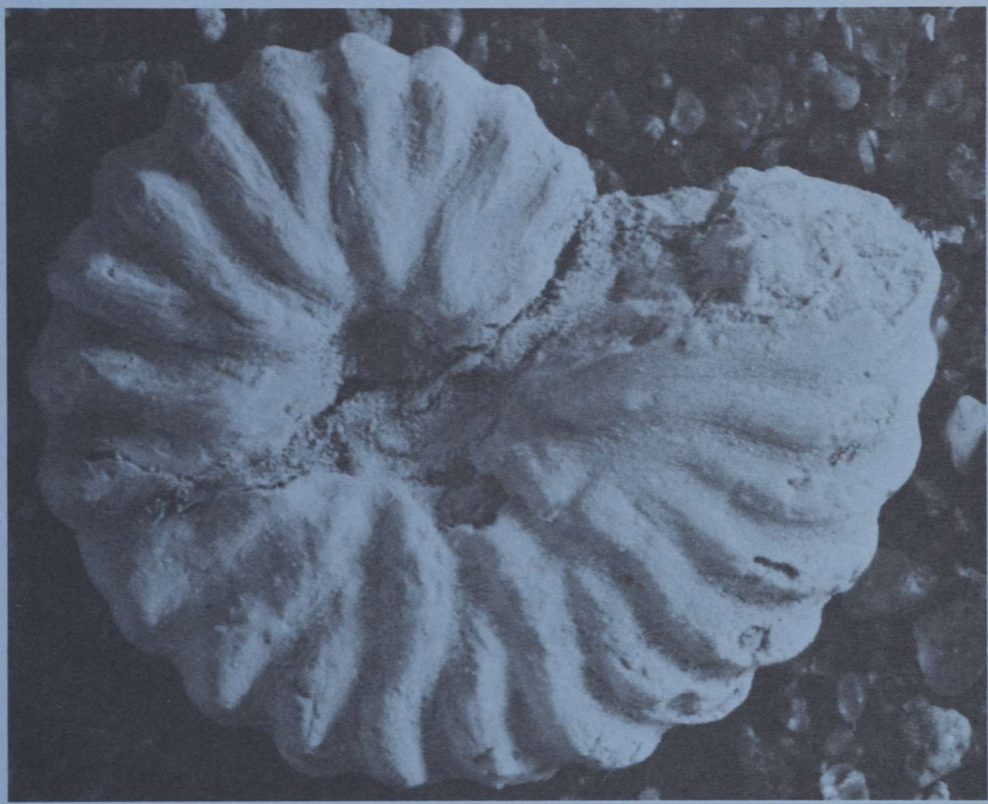

Lower Cenomanian and Late Albian (Cretaceous) Ammonites, Especially Lyelliceridae, of Texas and Mexico

By Keith Young

THE TEXAS MEMORIAL MUSEUM, 2400 TRINITY STREET, AUSTIN, TEXAS 78705
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WILLENA C. ADAMS
EDITOR

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EARLY CENOMANIAN AND LATE ALBIAN (CRETACEOUS) AMMONITES, ESPECIALLY LYELLICERIDAE, OF TEXAS AND MEXICO*

By Keith Young**

ABSTRACT

The Early Cenomanian of Texas and northern Mexico contains numerous species of lyellicerines, and the late Early Cenomanian Buda Limestone is especially dominated by them. The three lyellicerine genera are *Stoliczkaia, Faraudiella,* and *Budaiceras,* and the latter two are particularly abundant. The 50 species of Early Cenomanian ammonites are distributed among 28 genera, mostly heteromorphs, scaphitines, and lyellicerines.

Because of Tethyan faunal affinities the Early Cenomanian of Texas and northern Mexico can be correlated more easily with that of North Africa and Madagascar than with the more classical sections of northern Europe.

Unfortunately, no horizon-differentiation in the Buda Limestone can be ascertained by fossils. The Main Street Limestone and Del Rio Clay are correlatable with the *Hypoturrilites schneegansi* zone of North Africa, the Buda Limestone with the lower part of Zone II and the Woodbine with the upper part of Zone II and most of Zone III.

The *H. carcitanensis* zone of England would appear to be equivalent to the upper part of the Del Rio Formation, the *Mantelliceras saxbii* zone mostly equivalent to the Buda Limestone, and the *M. dixoni* zone equivalent to the Maness Shale and the lower part of the Woodbine Formation.

Lower Cenomanian strata thin onto the San Marcos Platform, the Devils River trend, the Sierra del Carmen trend, and the southern Coahuila platform. These strata, in turn, thicken into the North Texas Basin, the Maverick Basin, and the Chihuahua Trough.

INTRODUCTION

In the days before wide use of the automobile Professor F. L. Whitney took his paleontology class to Shoal Creek, which is only a few blocks from the campus of the University of Texas at Austin. Here his students collected fossils from the Buda Limestone only because the only other formation exposed along Shoal Creek is the Del Rio Claystone, and it does not yield abundant, good megafossils other than *Ilymatogyra arietina* (Römer, 1852). Thus, over those earlier years at the University of Texas, Professor Whitney accumulated an outstanding collection of fossils from the Buda Limestone.

That this formation remained his favorite throughout his active collecting career is indicated by the fossils from the Buda Limestone being far better curated than fossils he collected from other formations. The collection from the Buda Limestone is remarkable only because that formation is so difficult to collect. Whitney started collecting the Buda Limestone in 1909 and published two papers on its fossils (Whitney, 1911 and 1913; 1916). The 1913 date is a republication of his 1911 paper; Professor Whitney told me that when the first Texas Academy of Science became defunct in 1913, he was treasurer. He did not have enough manuscripts to deplete the treasury, so he republished his own paper in order to spend all of the money left in the treasury. Whitney con-

*This report is a contribution to the IGCP project "Mid-Cretaceous Events."

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tinued collecting the Buda Limestone, and many of the fossils were accumulated after 1913.

There are a number of ammonite species heretofore unknown from the Buda Limestone. This report is largely concerned with these species, plus an amplification of the knowledge of related ammonites from the Georgetown, Del Rio, and Grayson Formations. I have omitted the mantellicerines, most of which will be studied by W. J. Kennedy and J. M. Hancock. Except for two or three species, I leave the scaphitines to Jost Wiedmann for study.

In a letter from Emil Böse to W. S. Adkins (University of Texas at Austin archives), dated August 15, 1920, Böse stated that he had found a very interesting ammonite fauna near El Remolino, Coahuila, Mexico [from the Buda Limestone], but that he had not found time to study it; from this time on, Böse was interested in someone publishing the Buda fauna. In a letter to Adkins *(ibid.)* dated September 24, 1924, Böse reported that Señores Vivar and Hizazumi of the Instituto de Geología had returned with a beautiful ammonite from the Buda Limestone of northern Chihuahua, Mexico. He implied that it was the same as the new genus [later named *Budaiceras* by Böse (1928)] from El Remolino, and further stated that his new genus occurred at Shoal Creek, Austin, Texas.

In a letter from Böse to Adkins (University of Texas at Austin archives), dated October 15, 1924, Böse indicated that Adkins had been to El Remolino to collect, and further that he, Böse, knew of the Whitney collection and its value when he said:

> Have you prepared any of your Buda ammonites from the Buda of Remolino and what genera have you found there? I only want that somebody describes the Buda ammonites because that will furnish the finishing touch to the determination of the age of the Washita. I do not care who it is if he does the work well and I much fear that Whitney will not be able to do it.

Böse did not comment on why Whitney would be unable to do the Buda ammonites, but one feels in reading the correspondence that Böse understood the temperament that prevented Whitney from publishing but little of the great mass of geological data he accumulated during his 40-plus years at the University of Texas. The nearest Whitney ever came to working his Buda ammonite collection was to supervise a thesis by Katherine Archer (Mrs. Knox Tyson); although oversplit, her work was quite good and accurate, and especially her figures helped in identifying many of the better specimens in the collections. Unfortunately, this work was never published and is now outdated by a completely altered taxonomy. The absence of middle Cretaceous ammonites from El Remolino (fig. 1) in either the Adkins or the El Aguila collections (La Companía Shell de México, for which Adkins worked from early in 1921 until his year at the Sorbonne, now University of Paris, in 1924), now at the Texas Memorial Museum, sheds some doubt on any visit by Adkins to that area.

Although Böse (1928) cited the description of species of his new genus, *Budaiceras,* by Shattuck (1903) and Lasswitz (1904), he ignored their works. Perhaps he did not have a copy of Lasswitz, although that is doubtful since he did much of his library work at the Instituto de Geología in Mexico City. Certainly he knew enough to ignore Lasswitz's figures, since, in many letters, he remonstrated with Adkins to ignore the Lasswitz figures because they were so poor (e.g., letter from Böse to Adkins, dated September 30, 1926, in U. T. Austin archives). Perhaps Böse had seen the George Stolley collection, since he says *(op. cit.)* that he had been told by Clement Schlüter and by Frech that the originals of Römer's first (1852) publication were at Bonn and his second (1888) publication were at Breslau. This Breslau collection should contain the material that George Stolley, an early Austin, Texas school teacher,

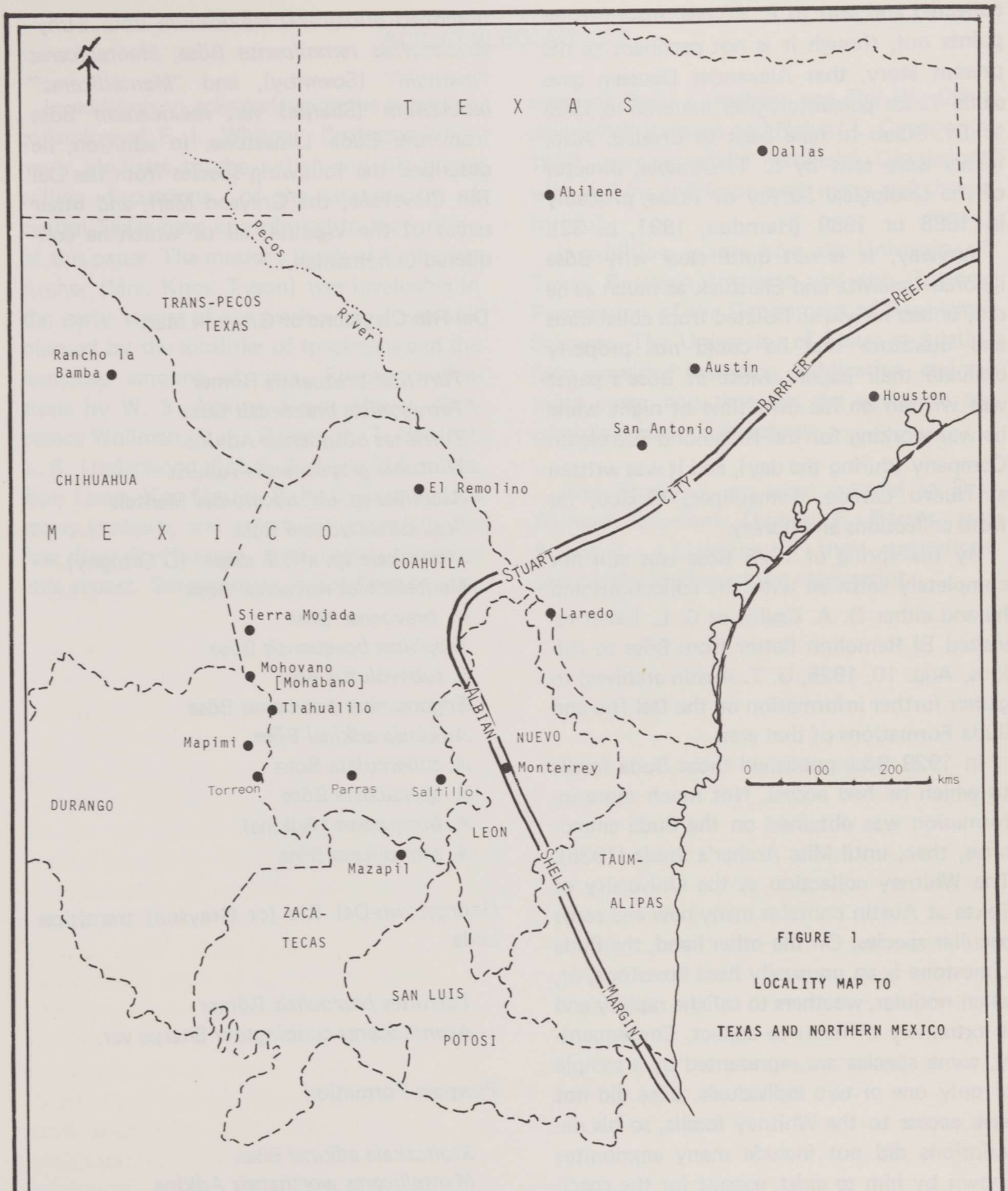

FIGURE 1

LOCALITY MAP TO

TEXAS AND NORTHERN MEXICO

collected and sent to F. Rőmer. Bőse further points out, though it is not pertinent to the present story, that Alexander Deussen gave some Texas paleontological material in 1906 to Dr. Staub to take back to Breslau. Also, fossils were sent by E. T. Dumble, director of the Geological Survey of Texas, probably in 1888 or 1889 (Herndon, 1891, p. 33).

Anyway, it is not quite clear why Bőse ignored Lasswitz and Shattuck as much as he did, unless he was so isolated from collections and literature that he could not properly evaluate their papers. Most of Bőse's paper was written on his own time at night while he was working for the Richmond Petroleum Company (during the day), and it was written at Nuevo Laredo, Tamaulipas, Mexico, far from collections and library.

By the spring of 1925 Bőse was still not completely satisfied with the collections and he and either O. A. Cavins or C. L. Baker revisited El Remolino (letter from Bőse to Adkins, Aug. 10, 1925, U. T. Austin archives) to gather further information on the Del Rio and Buda Formations of that area.

In 1928 Bőse published those Buda fossils to which he had access. Not much more information was obtained on the Buda ammonites, then, until Miss Archer's thesis (1936). The Whitney collection at the University of Texas at Austin contains many new and some peculiar species. On the other hand, the Buda Limestone is an unusually hard limestone, or, when nodular, weathers to caliche rapidly and is extremely difficult to collect. Consequently, some species are represented by a sample of only one or two individuals. Bőse did not have access to the Whitney fossils, so his descriptions did not include many ammonites known by him to exist, except for the specimen illustrated on plate 18, fig. 7 (Bőse, 1928) [herein illustrated as *Budaiceras elegantior* (Lasswitz) on pl. 8, fig. 9], which Adkins added editorially without Bőse's knowledge.

From this early work Bőse (1928) finally described *Budaiceras mexicanum* Bőse, *Euhystrichoceras remolinense* Bőse, *Mantelliceras "mantelli"* (Sowerby), and *"Mantelliceras" laticlavium* (Sharpe) var. *mexicanum* Bőse from the Buda Limestone. In addition, he described the following species from the Del Rio Claystone, the Grayson Marl, and other strata of the Washita, all of which he considered Cenomanian.

Del Rio Claystone or Grayson Marl

Turrilites brazoensis Römer
Tetragonites brazoensis Böse
Turrilites bosquensis Adkins
Wintonia graysonensis Adkins
Baculites sp. cfr. *baculoides* Mantell
Stoliczkaia uddeni Böse
Stoliczkaia sp. aff. *S. dispar* (D'Orbigny)
Mantelliceras wacoense Böse
M. bravoense Böse
Scaphites bosquensis Böse
S. subevolutus Böse
Engonoceras bravoense Böse
Adkinsia adkinsi Böse
A. tuberculata Böse
A. sparsicosta Böse
A. bosquensis (Adkins)
A. semiplicata Böse

Georgetown-Del Rio (or Grayson) transition beds

Turrilites brazoensis Römer
Acanthoceras cunningtoni Sharpe var.

Pawpaw Formation

Stoliczkaia adkinsi Böse
Mantelliceras worthensis Adkins

Much of Böse's collecting was incidental to his search for evidence for an ancient landmass that he called the Coahuila Peninsula (Böse, 1923a).

ACKNOWLEDGMENTS

In addition to acknowledging the extensive collection of F. L. Whitney, Professor Whitney's kindness to the writer and his many willing discussions of the stratigraphy of central Texas have contributed to the writing of this paper. The master's thesis of Katherine Archer (Mrs. Knox Tyson) was invaluable in the early stages of the work when I was still plagued by the localities of specimens and the immense amount of data. Further collections by W. S. Adkins, Grant Moyer, Constance Wollman, D. F. Reaser, W. T. Haenggi, J. R. Underwood, Bob F. Perkins, F. E. Lozo, Bob Lowe, Ken Martin, R. K. DeFord and his many students, and others, but especially the late Roy T. Hazzard, have been utilized in this report. Several days in the field on outcrops of Buda Limestone and Del Rio Claystone with Hazzard and Robert L. Cannon, in 1959, were especially beneficial. Discussions with Adkins and Lozo were many and always fruitful.

In addition, grants from the University of Texas Research Institute and the Geology Foundation of the Department of Geological Sciences, The University of Texas at Austin, have provided financing, publication, and reprint costs, and time for the writer to accomplish much of this study.

And finally, I am most grateful to Drs. Richard Reyment, Donald F. Reaser, and Ernest L. Lundelius for their suggestions and careful reading of the manuscript.

STRATIGRAPHY OF THE BUDA LIMESTONE

Shattuck (1903) lamented that he knew nothing of the stratigraphy of the Buda Limestone, and that he had to condense his statements concerning that stratigraphy from Hill (1901). Martin (1961; 1967) gave brief accounts of the historical concepts of the Buda Limestone, and Lozo (1951) and Adkins and Lozo (1951) also considered a few statements regarding earlier concepts of the stratigraphy of the Buda Limestone. Hazzard (1959) also discussed some of the problems of the stratigraphy of the Buda Limestone.

Understanding of the regional stratigraphic relations within the Buda and Del Rio-Grayson Formations has progressed little since Hill (1901) insofar as published information is concerned. Other known data might be important to anyone studying the Buda Limestone, but their exact interpretation is, as yet, incomplete. The distribution of middle Cretaceous rocks in northern Mexico and Texas is depicted on figure 2, and some remarks concerning the stratigraphy of the Buda Limestone include:

1. In the Grayson County area (fig. 1) the middle limy member (Modlin Limestone member of some authors) of the Grayson Formation contains *Budaiceras* and *Faraudiella roemeri* (Lasswitz), fossils restricted to the Buda Limestone in other areas. *Budaiceras* also occurs in the Grayson Formation above the Modlin Limestone member in Grayson County, Texas, and near the top of the Grayson Formation on Denton Creek, east of Roanoke, Denton County (Stephenson, 1944). These occurrences support Taff's contention (Taff and Leverett, 1893; Hill, 1901) that at least the upper part of the Grayson Formation is equivalent to the Buda Limestone (figs. 3, 4).

2. Lozo (1951) pointed to the absence of disconformity between the Grayson and Woodbine Formations in the Grayson County area, a condition that Clark (1965) apparently overlooked.

3. The bored boulder horizon of limestone boulders of the Buda Limestone at the boundary of the Grayson and Woodbine Formations (Winton and Scott, 1922) and other evidence (Adkins and Lozo, 1951) indicates submarine erosion in the McLennan-Johnson-Hill-Bell counties area between the Del Rio (or Buda, if present) and the Woodbine Formations, although Kummel collected a single specimen of *Budaiceras* from high in the Grayson Formation of central Hill County.

4. The Buda Limestone in central Texas, near Austin, is divided into lower and upper members, the boundary between the two members being reported as disconformable by Whitney (in Adkins, 1933). Martin (1967) interprets this mid-Buda disconformity as increasing in magnitude in time to the north, but since it is within the *Budaiceras hyatti* zone, no great amount of time can be involved.

5. The Belton high (Murray, 1961; Tucker, 1962) seems to have been an effective posiment during most of Cretaceous deposition and provides a plausible explanation for items 3 and 4 above, since the Denton and Grayson counties area was in the East Texas Embayment to the north (figs. 5–7).

6. From San Marcos into the Rio Grande Embayment there is no disconformity within the Buda Limestone.

7. In the Rio Grande Embayment the Buda Limestone is divisible into three members (Hazzard, 1959), the middle member being softer and more nodular than the other two; the upper member is a sponge-bearing *(Verticellites)* porcellanite.

8. The relationships of two members in central Texas to three members in the Maverick Basin (fig. 5) are unknown. Nevertheless, fossils generally restricted to both members in Hays, Travis, and Williamson counties

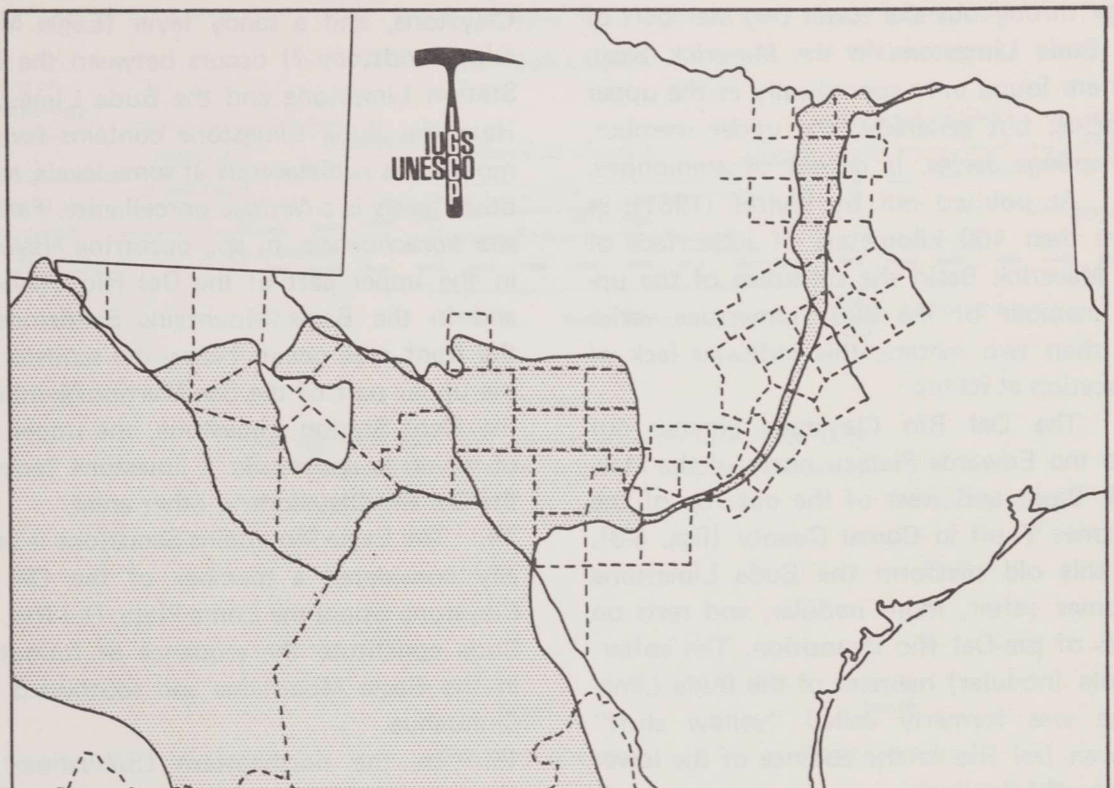

FIGURE 2

Areas of Texas and Mexico in which outcrops of middle Cretaceous (Upper Albian-Turonian) outcrops may be found. Scale of the map is too small to delineate the individual outcrops, or even the individual mountain ranges. Index to counties of Texas and states of Mexico is with figure 1.

range throughout the lower two members of the Buda Limestone in the Maverick Basin and are found only sporadically in the upper member; but generally, the upper member, the sponge facies, is devoid of ammonites.

9. As pointed out by Winter (1961), in more than 160 kilometers of subsurface of the Maverick Basin the thickness of the upper member of the Buda Limestone varies less than two meters; this indicates lack of truncation at its top.

10. The Del Rio Claystone pinches out onto the Edwards Plateau north of the Maverick Basin and west of the outcrop of the Balcones Fault in Comal County (figs. 6-8). On this old platform the Buda Limestone becomes softer, more nodular, and rests on rocks of pre-Del Rio deposition. The softer, middle (nodular) member of the Buda Limestone was formerly called "yellow stuff" or even Del Rio in the absence of the lower member of the Buda.

11. Onto the Devils River trend, north of the Del Rio pinchout, the lower member of the Buda Limestone also pinches out. This leaves the middle member of the Buda Limestone resting unconformably on limestone (Salmon Peak Formation or its Devils River limestone equivalent) carrying an undescribed species of *Mortoniceras* with large umbilical tubercules, which species is restricted to the *Drakeoceras lasswitzi* zone (fig. 8). This is the widespread mid-Washita unconformity of Rose (1972).

12. The Del Rio Claystone not only pinches out onto the Devils River Trend to the north, but also pinches out onto the Terrell Arch to the west of the Rio Grande Embayment; this pinchout is usually interpreted as non-depositional. In addition, in the area around Comstock, Terrell County, large boulders of Buda Limestone can be observed where they were reworked into the base of the overlying Boquillas Formation.

13. In the Kent area, San Martine Quadrangle, Trans-Pecos Texas, there is no Del Rio Claystone, and a sandy layer (Eagle Mountains Sandstone ?) occurs between the Kent Station Limestone and the Buda Limestone. Here the Buda Limestone contains few ammonites, is rudistaceous at some levels, and at other levels is a *Nerinea* porcellanite. *Faraudiella borachoensis,* n. sp., occurring elsewhere in the upper part of the Del Rio Claystone and in the Eagle Mountains Sandstone, in the Kent area occurs below the sandstone in the upper part of the San Martine Member of the Kent Station Limestone, the upper part of which is apparently a limestone facies of the Del Rio Claystone in other areas.

14. The Eagle Mountains Sandstone is generally considered a member of the Del Rio Claystone where the Loma Plata, Del Rio, and Buda constitute the sequence of formations in the Eagle Mountains and southward into Chihuahua.

15. In the northeastern Chihuahua area (Powell, 1963) the zone overlying the Buda Limestone is the zone of *Forbesiceras brundrettei* (Young) and though not carrying the index species, contains *Ostlingoceras brandi* Young, *Pseudouhligella elgini* Young, and *Euhystrichoceras adkinsi* Powell, fossils usually considered to represent the top of the Lower Cenomanian. The same fauna, which I still consider to be derived because the fossils bear chatter marks (Young, 1958b), is represented in the base of the Boquillas Formation on the northeast side of the Davis Mountains (Young, 1958b). Here this fauna probably represents eroded pebbles on a disconformable surface. Overlying it are species of the Zone of *Metoicoceras geslinianum* (d'Orbigny) [e.g., *Metoicoceras* sp. Young (1958b) = *Meticoceras boesei* Jones (1938) = *M. whitei* Hyatt (1903)]. *Forbesiceras brundrettei* and associated fossils lie between the faunas of the Buda Limestone and the overlying faunas of the Boquillas and Woodbine-Eagle Ford formations.

16. To the south, in southwestern Coahuila, on the west flank of the Coahuila Pe-

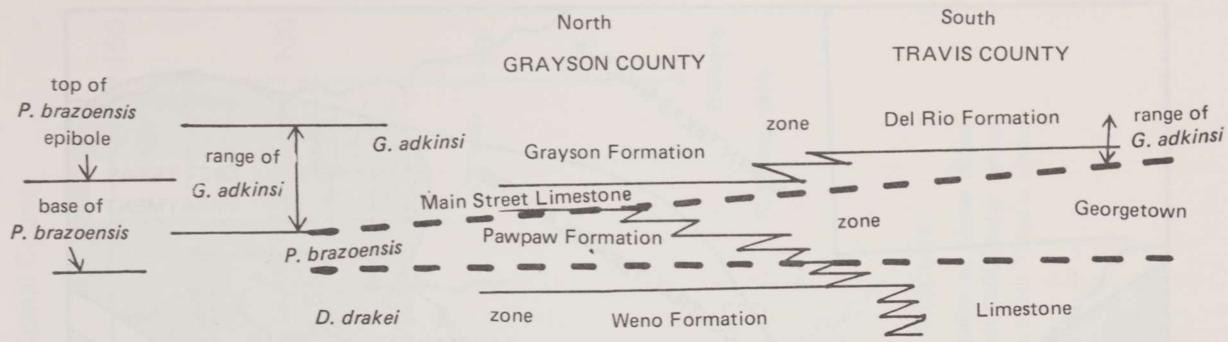

FIGURE 3

Biostratigraphic and lithic relations using the base of the range zone of *Graysonites adkinsi* as the base of the *Graysonites adkinsi* zone (not to scale).

K. Young, 1976

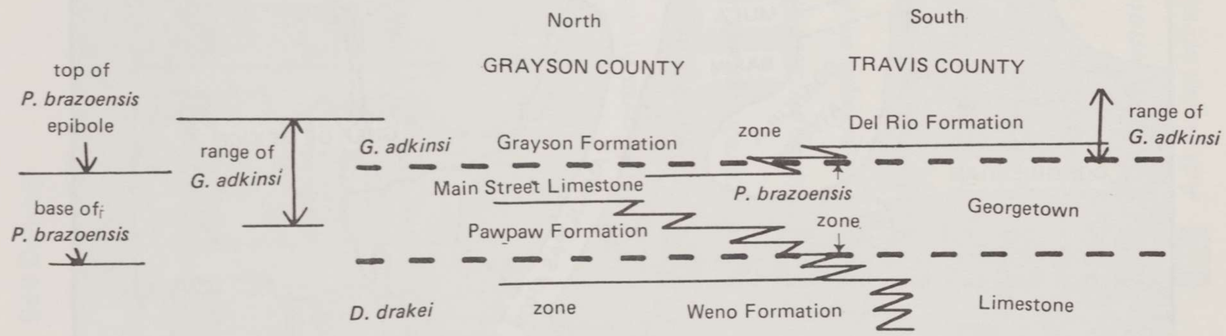

FIGURE 4

Biostratigraphic and lithic relations using the top of abundant *Plesioturrilites brazoensis* as the base of the *Graysonites adkinsi* zone (not to scale).

K. Young, 1976

ninsula, the equivalents of the Buda Limestone, Del Rio Claystone, and even the upper part of the Georgetown Limestone, are in the lower member of the Indidura Formation (Kellum and Mintz, 1962).

17. On the other hand, along the southern edge of the Coahuila Peninsula there seems to be considerable hiatus, typical Del Rio Claystone *(Graysonites* fossils) resting with sharp discontinuity below beds containing *Kanabiceras,* which in turn are overlain by beds containing *Romaniceras* and *Spathites* (Jones, 1938). W. J. Kennedy first called to my attention the mididentification by Jones of a *Kanabiceras* fragment as *Turrilites.* This means that the upper part of the Lower Cenomanian and most of the Upper Cenomanian are missing, as pointed out by R. T. Hazzard in unpublished notes in the W. S. Adkins papers. It is possible that a low sill, connecting the Coahuila Peninsula with the Miquihuana Platform, separated the Mesozoic Gulf of Mexico from the Cordilleran geosyncline during a part of the middle Cretaceous.

18. To the east of the Coahuila Peninsula the entire section gradually changes from the

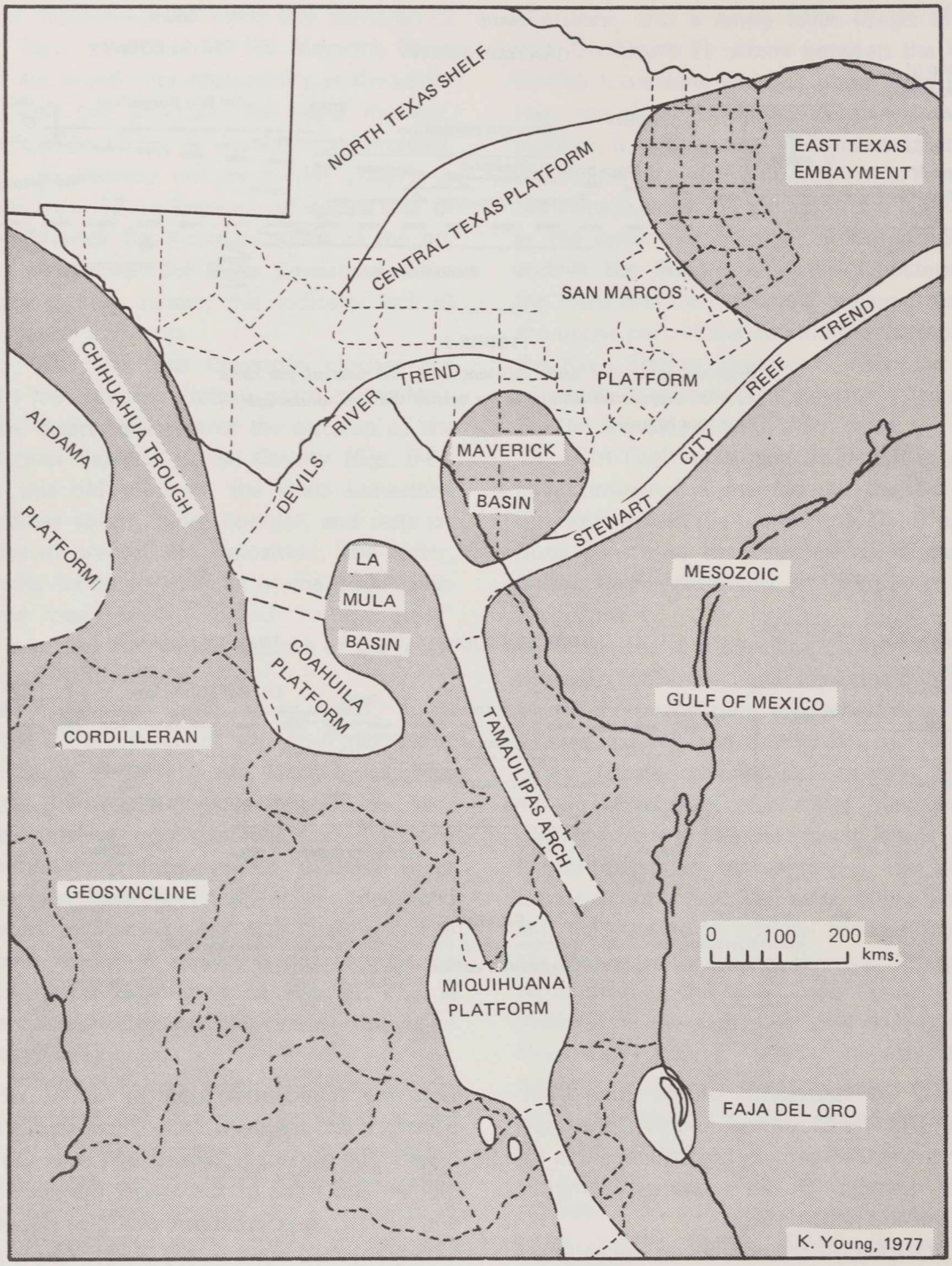

FIGURE 5

Paleogeography of northern Mexico and Texas during the Middle Cretaceous

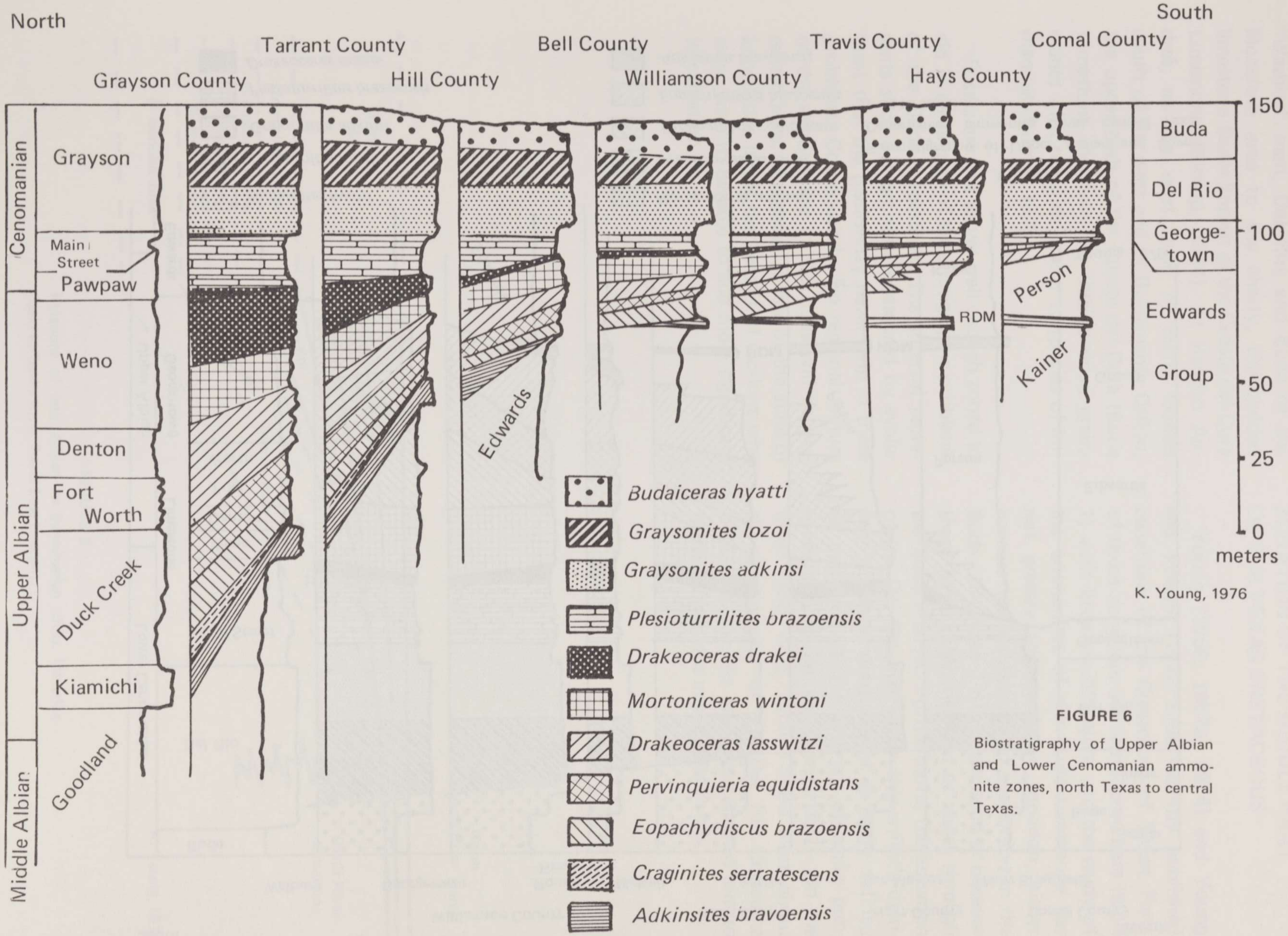

FIGURE 6

Biostratigraphy of Upper Albian and Lower Cenomanian ammonite zones, north Texas to central Texas.

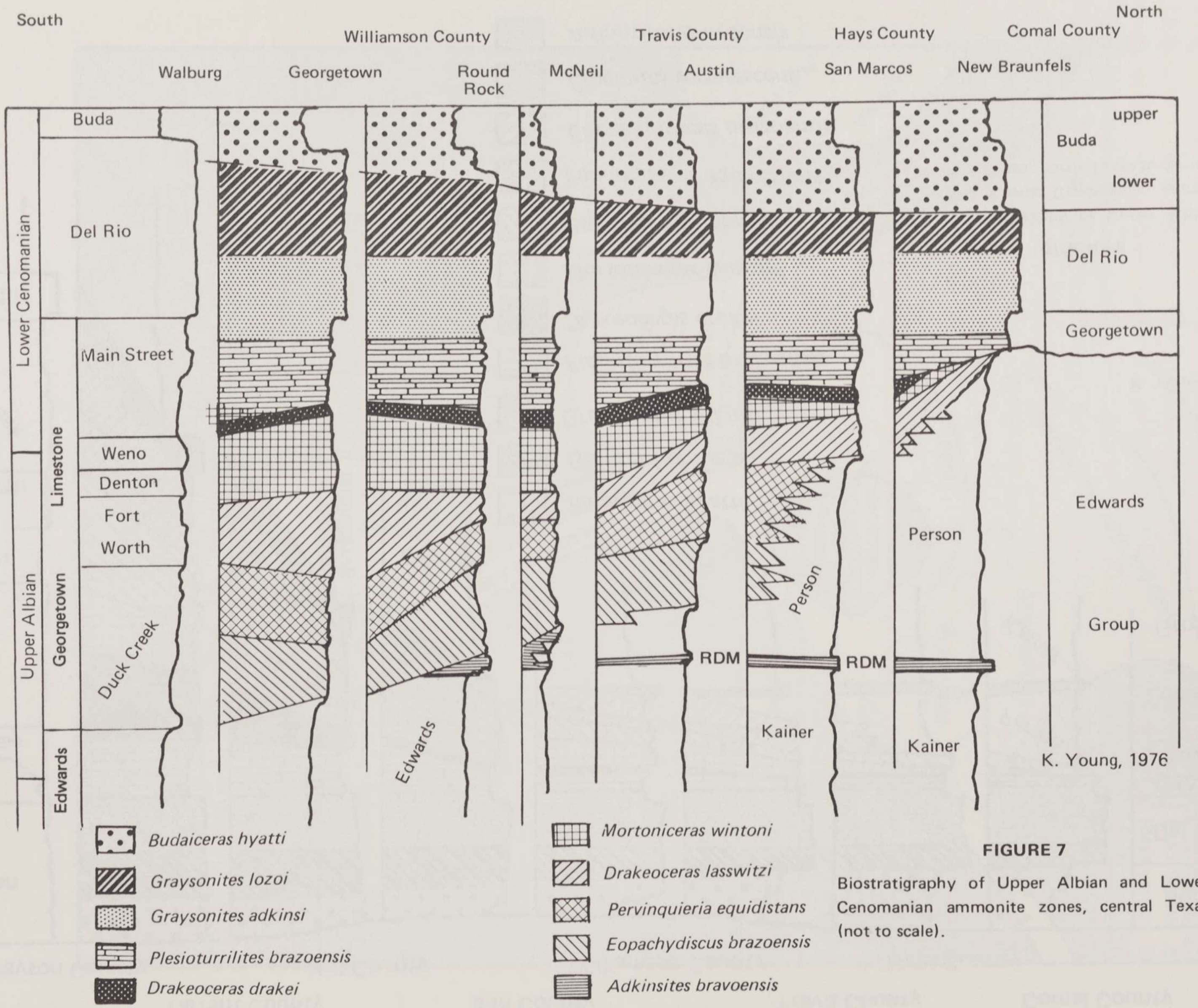

FIGURE 7

Biostratigraphy of Upper Albian and Lower Cenomanian ammonite zones, central Texas (not to scale).

"Washita" marl, Del Rio, and Buda of the Monclova area to the cherty, thin-bedded limestone facies known as the Cuesta del Cura Limestone (Bishop, 1964). At Rancho Andrés, on the west flank of Sierra Gomas south of the west end of Bustamante Cañon, the upper beds of the Cuesta del Cura (Buda Limestone member) are thick-bedded grainstones with rudistids similar to species of *Immanitas* (Palmer, 1928).

Fossils are not as yet well enough zoned to aid in solving all of the stratigraphic problems of the Buda Limestone. The interval represents such a short time (measured by evolution) that the fossils may never help in these problems. Consequently, no regional picture of the stratigraphy of the Buda will be presented here. The above review of the state of knowledge is for the benefit of workers who may, with it, be able to add more significant information.

ZONATION OF THE MIDDLE PART OF THE TEXAS CRETACEOUS

Young (1966, 1967b, 1974) and Young and Powell (1978) have recently published zonations of the Cretaceous of Texas. Parts of those zonations are reproduced here (table 1) with little modification, and the study of the ammonites of the Buda Limestone has not greatly improved the zonation, either because the distribution of ammonites in the Buda Limestone is not understood or because there is no differentiation of zones through the Buda interval. Furthermore, the zonation of the Del Rio interval, in this writer's opinion, is not as detailed and as easily defined as indicated by the diagram of zones published by Adkins and Lozo (1951). On the other hand, W. S. Adkins knew more about the stratigraphy of the Del Rio Claystone than I, or else his prejudices enabled him to reach conclusions unavailable to me.

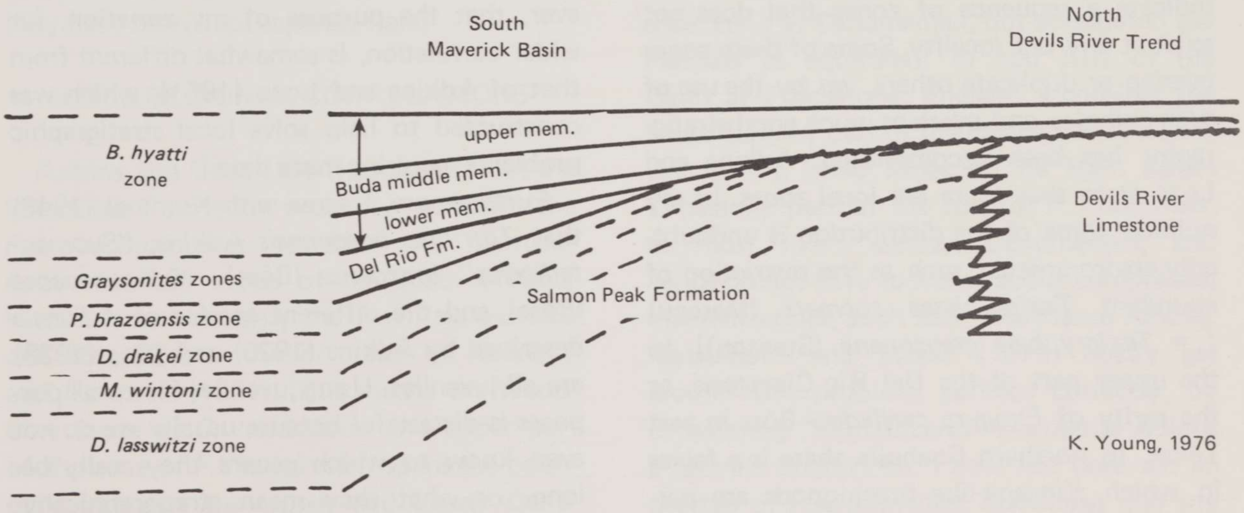

FIGURE 8

Relations of late Albian to Cenomanian rocks, Maverick Basin to Devils River Trend (not to scale).

The zonation given in table 1 has two questionable aspects. In Trans-Pecos Texas there is no doubt that the zone of *Forbesiceras brundrettei* overlies the zone of *Budaiceras hyatti.* On the other hand, there is some question of the relationship in the East Texas Embayment, where the Woodbine Formation overlies the Buda Limestone, the Grayson Marl, or in the subsurface, the Maness Shale. The middle ammonite zone of the Woodbine in Adkins and Lozo (1951, p. 155) is based on scarce data, but a fragment of an ammonite with schloenbachiine ribbing from this zone on Aquilla Creek, Hill County, is probably a *Forbesiceras brundrettei* (Young). It is not well preserved, but I can find no midventer keel as in *Schloenbachia.* Furthermore, *F.* sp. cf. *F. brundrettei* occurs in the Maness Shale, above the Buda Limestone, in the subsurface (pl. 1, figs. 74, 75). Above the *F. brundrettei* level the fossils of the east Texas zones are boreal, more closely related to North European forms, whereas the fossils of the Trans-Pecos zones are dominated by those more closely related to North African, Tethyan species.

Adkins and Lozo (1951) present what appears to be a detailed zonation of the Del Rio Claystone, but it is misleading, because they indicate a sequence of zones that does not exist at any one locality. Some of these zones overlap or duplicate others, yet by the use of such epiboles and overlaps much good stratigraphy has been accomplished. Adkins and Lozo state that these are local zones. In my opinion some of the distribution is undoubtedly environmental, such as the restriction of abundant *Texigryphaea roemeri* (Marcou) [= *Texigryphaia graysonana* (Stanton)] to the upper part of the Del Rio Claystone, or the rarity of *Exogyra cartledgei* Böse in east Texas. In northern Coahuila there is a facies in which *Kingena*-like brachiopods are particularly abundant in the Del Rio Formation. The restriction of many of the pyritized micromorphs (Adkins and Lozo, 1951) to the

TABLE 1

ZONATION OF THE LATEST ALBIAN AND LOWER CENOMANIAN OF NORTHERN MEXICO AND TEXAS BY AMMONITES

Stage	Substage	Zone
Cenomanian	Upper	*Conlinoceras tarrantense*
	Lower	*Forbesiceras brundrettei* *Budaiceras hyatti* *Graysonites lozoi* *Graysonites adkinsi* *Plesioturrilites brazoensis*
Albian	Upper	*Drakeoceras drakei* *Mortoniceras wintoni* *Drakeoceras lasswitzi*

synclinal areas likewise indicates environmental control, either depositionally or diagenetically. For these reasons I am not using the zonal systems of Adkins and Lozo (1951, pp. 153-156). Furthermore, for constructing a zonal sequence to compare with other such sequences from other areas, I prefer to restrict myself to ammonites rather than mixing ammonites, echinoids, and pelecypods, as is so frequently done for local stratigaaphy. It must be emphasized, however, that the purpose of my zonation, for wider correlation, is somewhat different from that of Adkins and Lozo (1951), which was constructed to help solve local stratigraphic problems requiring more detail.

Furthermore, I agree with Kummel (1948) that *Turrilites bosquensis* Adkins, *"Submantelliceras" brazoense* (Böse), *"S." wacoense* (Böse), and the different species of *Adkinsia* described by Adkins (1920) and Böse (1928) are all juveniles. Using juveniles for zonal purposes is distasteful because usually we do not even know to which genera they really belong, or what they mean stratigraphically, ecologically, diagenetically, or nomenclatorally.

Critics may take me to task, as Tatum

(1931) took Bõse and Cavins (1928) to task, for not tying the zones more thoroughly into the local rock units. Still, any chart that ties zones to local rock names is misleading, because it is good only for a specific section with a specific definition of zones. For example, the *Graysonites adkinsi* range zone, in my interpretation, ranges from the upper part of the Pawpaw Formation into the Grayson Formation in north Texas; in central Texas it ranges through the top three or four feet of the Georgetown Limestone into the Del Rio Claystone, and the *Plesioturrilites brazoensis* range zone overlaps more of the *Graysonites adkinsi* range zone in north Texas than in central Texas, but the *P. brazoensis* zone, in that interpretation (fig. 3) is that part of the *P. brazoensis* range zone that does not overlap the range zone of *G. adkinsi.* An alternative technique is to make the *G. adkinsi* zone equal to that part of its range zone that does not overlap the range zone of *P. brazoensis* (as in fig. 4). The apparent relationships of the Del Rio Claystone to underlying formations change with the technique of defining the zones. This is the reason that correlation charts involving the use of lithic units and biostratigraphic units concurrently are so often misleading, and is also the reason why they have been kept separate here.

INTERREGIONAL CORRELATIONS

Adkins and Lozo (1951) suggested that the Woodbine Formation probably represents the *Pseudacompsoceras vectense* and *Mantelliceras costatum* zones of the Spath (1926a) system, approximately the *Turrilites costatus* and *Mantelliceras dixoni* zones of Kennedy and Hancock (1971). This means the Woodbine (zone of *C. tarrantense* and upper part of the zone of *F. brundrettei)* spans the boundary between the Upper and Lower Cenomanian. I agree with Adkins and Lozo and correlate my zonal system as shown in table 2, including the admonition of Kennedy and Hancock (1971) that the *C. tarrantense* zone may be slightly younger than the *costatus* fauna. Of course, one must realize that the zonation of table 2 suffers, from among many defects, whatever inaccuracies are introduced by the vagaries of animal migrations and the inaccuracies of local stratigraphy. I have purposely made most of the boundaries disagree because the probability that they would agree is much too preposterous.

From 1919 to 1925, in their correspondence, Adkins and Bõse argued about the correlation of the Washita Division with the European system. At first Bõse wanted to include everything, including the *inflata* zone, in the *Vraconian,* down to and including his Duck Creek. Of these two it was Adkins who first felt that the Vraconian should be correlated higher, and after Bõse began to study Adkins's Pawpaw fauna (1920), the Washita faunas (Adkins and Winton, 1920), and the Del Rio fauna (Bõse, 1928) he raised the base of the Cenomanian to the base of the *Plesioturrilites brazoensis* zone and, following Spath (1926a), no longer worried much about the Vraconian. Scott (1926) had included the Grayson Formation in the Vraconian. Bõse (1928) considered the *Plesioturrilites brazoensis* zone as Cenomanian, but considered the Pawpaw as equivalent to bed XIII of the Gault at Folkestone, England. I consider the larger (upper) part of the Pawpaw Formation, which is a lithic facies of the Main Street Limestone part of the zone of *P. brazoensis,* as most likely earliest Cenomanian, and hence do not have to worry about compressed mantellicerines, such as *M. worthense* Adkins. Matsumoto and Inoma (1975) neatly get around this problem, perhaps correctly, by considering *"Mantelliceras" worthense* Adkins a juvenile *Stoliczkaia.* I have not observed an overlap of *Plesioturrilites brazoensis* and any of the mortonicerines, but this is most certain to occur at some locality, and the description of the Pawpaw fauna (Adkins, 1920) indicates

TABLE 2

LOWER CENOMANIAN CORRELATIONS BY AMMONITES—
TEXAS, AFRICA, ENGLAND, AND SOUTHERN FRANCE

Substage	England*	South France**	Africa***	Texas
Upper Cenomanian	*T. costatus*	*A. rhotomagensis*	Zone III	*C. tarrantense*
	M. dixoni	*M. mantelli*	Zone II	*F. brundrettei*
	M. saxbii	*M. martimpreyi*		*B. hyatti*
Lower Cenomanian	*H. carcitanensis*			
			schneegansi C	*G. lozoi*
	?	?	*schneegansi* B	*G. adkinsi*
			schneegansi A	*P. brazoensis*
Upper Albian	*S. dispar*		*S. dispar*	*D. drakei*

*Kennedy and Hancock, 1971
**Porthault, Thomel, and Villoutreys, 1967
***Dubourdieu, 1956

—K. Young, 1976

in this formation an overlap of normally Cenomanian species with normally Albian species. The best compromise is to draw the Cenomanian-Albian boundary between the highest mortonicerines and the lowest mantellicerines, and in the Pawpaw, in which they may overlap, take a choice. Most of the Pawpaw mortonicerines are unusual forms, such as *Spathiceras wenoense* (Adkins) and *Neokentroceras worthense* (Adkins), which are difficult to compare and correlate with other species. Consequently, I prefer to use the base of the mantellicerines, that is, the base of *"Submantelliceras" worthense* (Adkins), which is the oldest mantellicerine in Texas, as the base of the Cenomanian. If Matsumoto and Inoma (1975) are correct, and *"Mantelliceras" worthense* Adkins is really a juvenile *Stoliczkaia,* then one need not be concerned over mantellicerines and mortonicerines occurring together in Texas. Since *Graysonites adkinsi* Young is not a common fossil, and since *Plesioturrilites brazoensis* (Römer) and *Turrilites bosquensis* Adkins are extremely abundant, the base of a zone carrying *Plesioturrilites* becomes the best base for the Cenomanian. This is true especially since the rarer compressed mantellicerines appear within the upper part of the range of *P. brazoensis.*

Thus, if we exclude the questionable juvenile *"Submantelliceras" worthense* (Adkins), most of the zone of *Plesioturrilites brazoensis* is below the compressed mantellicerines, but also above the mortonicerines. I correlate it with Dubourdieu's (1956) horizon A of his *Hypoturrilites schneegansi* zone, which is also without mantellicerines, but above the *Stoliczkaia dispar* zone which correlates with the *Drakeoceras drakei* zone of Texas.

Mantelliceras saxbii (Sharpe) [= *Acanthoceras hoplitoides* Lasswitz] occurs in the Buda Limestone along with *M. cantianum* Spath [= *M. budaensis* Adkins = *M. charlestoni* Kellum and Mintz]. Between the *Budaiceras hyatti* zone (with *M. saxbii* and *M. cantianum)* and the *P. brazoensis* zone are the zones of *Graysonites adkinsi* and *Graysonites lozoi;* these two species have compressed mantellicerines as juveniles.

According to Kennedy and Hancock (1971) *M. martimpreyi* is a synonym of *M. saxbii.* On the other hand, it seems doubtful to the writer that all of the compressed mantellicerines that have been referred to *M. martimpreyi* in the African literature are actually synonymous with *M. saxbii.* In other words, the compressed mantellicerines of Dubourdieu's (1956) horizons B and C of his *H. schneegansi* zone are probably older than *M. saxbii* and correlate with the two zones of *Graysonites* in Texas and northern Mexico.

The faunas of the Del Rio and Buda formations of Texas and northern Mexico are closely related to North African faunas, with *Mantelliceras martimpreyi* (Pervinquière, 1907, pl. 16, figs. 18ab only, *non* Coquand) and compressed mantellicerines in common, in addition to similar species of *Euhystrichoceras, Sharpeiceras, Sciponoceras, Scaphites, Otoscaphites, Flickia, Ficheuria,* and so forth. The same statement can be made for faunal relations between Texas and Madagascar. A more detailed zonation of the Indian rocks is needed before a close correlation can be made to that area.

Matsumoto (1959b) points to the absence of mantellicerines in Japan, but his undescribed *Graysonites* fauna may represent the Del Rio equivalents. California, likewise, has Del Rio equivalents in the beds containing *Graysonites wooldridgei* Young (Matsumoto, 1959b) and perhaps Buda equivalents in Baja California, in the beds represented by undescribed *Sharpeiceras ?* (Matsumoto, 1959b).

Undoubted Lower Cenomanian ammonites have yet to be described from South America. The *Schloenbachia* illustrated by Bürgl (1957) is more closely related to species assigned by Powell (1963) to his genus *Quitmaniceras* from the *Kanabiceras septemseriatum* zone in northeastern Chihuahua. Similar species occur in Venezuela, Estado Ejido, with a lower Turonian species of *Lewisiceras.*

PALEONTOLOGY

Although the fauna of the Del Rio Claystone is not unusual, comparing well with faunas of the Lower Cenomanian of North Africa and Madagascar, with its Flickiidae and compressed mantellicerines, such as *Graysonites,* the lyellicerid genera, *Faraudiella* and *Stoliczkaia,* begin to develop in numbers unknown in the Lower Cenomanian of other parts of the world. The fauna of the Buda Limestone is quite unique and probably indigenous to Texas and northern Mexico (Young, 1972). It consists of a great relict flowering of the lyellicerine genera *Stoliczkaia,* and especially *Faraudiella* and *Budaiceras.* More than 95 percent of the ammonites from the Buda Limestone belong to the genera *Faraudiella* and *Budaiceras.* The genus *Budaiceras* has been reported outside Texas and northern Mexico only by Besairie (1936), but his species have since been correctly assigned to *Neophlycticeras* by Collignon (1964). They lack the smooth areas between the ventral ends of the ribs and the row of peripheral tubercles, and have only one peripheral tubercle per rib. They also appear to be Albian rather than late Early Cenomanian.

Along with this late Early Cenomanian adaptive radiation of the lyellicerine genus *Budaiceras,* there was a similar holdover of other lyellicerine genera such as *Stoliczkaia* and *Faraudiella,* not unknown in the Early Cenomanian of other parts of the world, but certainly not dominating the ammonite fauna as does *Faraudiella* in Texas and northern Mexico, just as though these lyellicerines were isolated and undergoing a final developmental burst. I have suggested elsewhere (1972) that this last, geographically restricted adaptive radiation was on the broad Comanche Shelf (Rose, 1972) behind the protection of the Stuart City Barrier Reef. The rarity of lytocerine species in the Buda, such as species of *Ostlingoceras, Plesioturrilites,* and *Hypoturrilites,* along with a scarcity of phyllocerines, pachydiscines, puzosiines, and mantellicerines, seems to indicate that these forms were not entirely adapted to the environment represented by the Buda Limestone, behind the Stuart City barrier reef;

barely enough of these generally cosmopolitan forms occur in the Buda Limestone to provide a few specimens for a sound correlation. Likewise, nautiloids, though present, are not at all abundant in the Buda Limestone.

The fauna of the Buda Limestone contains two species of nautiloids, *Paracymatoceras hilli* (Shattuck) and *Cymatoceras loeblichi* Miller and Harris. From the Buda Limestone there is one species of *Hypophylloceras,* one species of *Ostlingoceras,* one species of *Plesioturrilites,* and two species of *Hypoturrilites.* There is a single species of *Euhystrichoceras.* Among the pachydiscines and puzosiines there is one species of *Lewiceras* and a species of *Puzosia* related to *P. crebrisulcata* Kossmat. The single desmocerine is an indeterminant species of *Pseudouhligella.*

Adkinsia knikerae, n. sp., of the Flickiidae, is apparently such a rare form, if indeed it is not a juvenile of some early species of *Lewesiceras,* because it is so small that its rarity results from being overlooked on the outcrop by collectors. Among the lyellicerines there are five species of *Faraudiella,* three species of *Budaiceras,* and two species of *Stoliczkaia.* There are two species of *Mantilliceras,* three species of *Sharpeiceras,* and one species of *Paracalycoceras,* representing the acanthocerines.

Many of the Del Rio species have been sufficiently described until more is known of their occurrence and distribution. Two species of *Stoliczkaia* from pre-Grayson beds are described.

In all, 27 species of ammonites are known from the Buda Limestone and 27 species from the Del Rio and Grayson Formations.

Measurements and terminology used herein are generally standard, except some measurements, where noted, are given in millimeters rather than percent of D, because D could not be measured. D is the diameter at which a measurement is taken. U, H, and W are the width of the umbilicus, the height of the whorl, and the width of the whorl, respectively, at that diameter. H/W is the ratio. I must agree with Schöbel (1975) that the usual measurements taken on ammonites are rather useless, but editors usually insist that they be included. For the rib counts T, P, S, and B refer respectively to total, primary, secondary, and bifurcating pairs. A number of common statistical treatments were used where the samples were large enough, culminating in a comparison of the means of different samples. Generally, such treatments, when tested, were insignificant and not included in the discussions. This insignificance points up either (1) the unsuitability of standard ammonite mensuration, or (2) that in chalks, marls, and soft limestones measurements are too inaccurate because of sedimentary and diagenetic distortion. Where significant results were obtained, such are tabulated.

FAUNAL LISTS

Known Early Cenomanian faunas of northern Mexico and Texas include the following species of ammonites:

Pawpaw Formation (usually listed as Albian, but the upper part of the formation is probably a facies of the Main Street Limestone and therefore Lower Cenomanian; the fossils have not been collected in sufficient detail to determine exact levels.

Hypoturrilites primitivus Clark, 1965
Scaphites hilli Adkins and Winton, 1920
Worthoceras worthense (Adkins and Winton, 1920)
Stoliczkaia adkinsi Böse, 1928
Graysonites (?) or *Stoliczkaia (?) worthensis* (Adkins, 1920)

Main Street Limestone and Main Street equivalents in the Georgetown Limestone (Zone of *Plesioturrilites brazoensis* and lower part of zone of *Graysonites adkinsi)*
Ostlingoceras conlini Clark, 1965

Plesioturrilites brazoensis (Römer, 1852)
P. rhacioformis Clark, 1965
Graysonites adkinsi Young, 1958
G. wooldridgei Young, 1958
Stoliczkaia crotaloides (Stoliczka, 1864)
[= *Stoliczkaia texana* (Cragin, 1893)]
[= *Stoliczkaia uddeni* Böse, 1928]

Del Rio and Grayson Formations (upper part of the zone of *Graysonites adkinsi* and the zones of *G. lozoi* and *Budaiceras hyatti.)*

Sciponoceras sp. cf. *S. baculoides* (Mantell, 1822)
Plesioturrilites brazoensis (Römer, 1852)
P. pecosensis Clark, 1965
P. rhacioformis Clark, 1965
Turrilites bosquensis Adkins, 1920
Turrilites multipunctatus Böse, 1923
Wintonia graysonensis (Adkins, 1920)
Tetragonites brazoensis Böse, 1928
Eoscaphites sp. aff. *E. tenuicostatus* (Pervinquière, 1907)
Scaphites bosquensis Adkins, 1920
Otoscaphites subevolutus (Böse, 1928)
Scaphites sp. cf. *S. hugardianus* d'Orbigny
Ficheuria sp. aff. *F. pernoni,* Dubourdieu, 1953
Stoliczkaia crotaloides (Stoliczka, 1864)
[= *S. texana* (Cragin, 1893)]
[= *S. uddeni* Böse, 1928]
S. scotti Breistroffer, 1936
Faraudiella borachoensis, n. sp.
Faraudiella roemeri (Lasswitz, 1904) (Modlin Limestone member of the Grayson Formation)
Budaiceras hyatti (Shattuck, 1903) (from the Grayson only in north Texas, and questionably from the Del Rio in Chihuahua
[= *Schloenbachia roemeri* var. *harpax* Lasswitz, 1904]
[= *Budaiceras mexicanum* Böse, 1928, all except pl. 23, fig. 2]
Prionocycloides sp. cf. *P. proratum* (Coquand, 1880)
Adkinsia bosquensis (Adkins, 1920)
[= *A. adkinsi* Böse, 1928]
[= *A. semiplicata* Böse, 1928]
[= *A. sparsicosta* Böse, 1928]
[= *A. tuberculata* Böse, 1928]
Engonoceras bravoense Böse, 1928
E. retardum Hyatt, 1903
E. uddeni (Cragin, 1893)
Graysonites wooldridgei Young, 1958
G. adkinsi Young, 1958
[= *G. reynoldsi* Kellum and Mintz, 1962]
G. fountaini Young, 1958
G. lozoi Young, 1958
G. (?) Wacoensis (Böse, 1928) [juveniles]
G. (?) brazoensis (Böse, 1928) [juveniles]

Buda Limestone (zone of *Budaiceras hyatti)*

Hypoturrilites tuberculatus (Bosc, 1801)
H. roemeri (Whitney, 1911)
Ostlingoceras sp.
(?) Plesioturrilites brazoensis (Römer, 1852)
Mariella wysogorskii (Lasswitz, 1904)
Hypophylloceras sp. cf. *H. tanit* (Pervinquière, 1907)
Puzosia sp. cf. *P. crebrisulcata* Kossmat, 1898
Pseudouhligella sp.
Lewesiceras sp.
Euhystrichoceras remolinense Böse, 1928
Adkinsia knikerae, n. sp.
Stoliczkaia crotaloides (Stoliczka, 1894)
[= *S. texana* (Cragin, 1893)]
[= *S. uddeni* Böse, 1928]
S. scotti Breistroffer, 1936
Faraudiella texana (Shattuck, 1903)
[= *Scholenbachia frechi* Lasswitz, 1904]
[= *Schloenbachia curvata* Lasswitz, 1904]
[= *Schloenbachia haberfellneri* Lasswitz, 1904, *non* von Hauer]
Faraudiella roemeri (Lasswitz, 1904)
F. archerae, n. sp.
F. franciscoensis (Kellum and Mintz, 1962)
Budaiceras hyatti (Shattuck, 1903)
[= *Schloenbachia roemeri* var. *harpax* Lasswitz, 1904]
[= *Budaiceras mexicanum* Böse, 1928, all except pl. 23, fig. 2]

Budaiceras elegantior (Lasswitz, 1904)
[= *Schloenbachia roemeri* var. *elegantior* Lasswitz, 1904]
[= *Schloenbachia evae* Lasswitz, 1904]
[= *Budaiceras mexicanum (pro parte)* Böse, 1928, pl. 23, fig. 2 only]
[= *Budaiceras evae* Adkins, 1928, pl. 23, fig. 2, *non* Lasswitz]
Budaiceras alticarinatum, n. sp.
Sharpeiceras tlahualiloense (Kellum and Mintz, 1962)
[= *Tlahualiloceras tlahualiloense* Kellum and Mintz, 1962]
Sharpeiceras florencae Spath, 1926
S. mexicanum Böse, 1928
Mantelliceras cantianum Spath, 1926
[= *M. budaense* Adkins, 1931]
[= *M. charlestoni* Kellum and Mintz, 1962]
Mantelliceras saxbii (Sharpe, 1857)
[= *Acanthoceras hoplitoides* Lasswitz, 1904]
Mantelliceras sp.
[= *Acanthoceras martimpreyi* Pervinquière, 1907, pl. 16, figs. 18ab, only, *non* Coquand]
Paracalycoceras sp.

Ammonite lists by zones follow; the fauna of the Pawpaw has been omitted. Based on physical stratigraphy, the Pawpaw Formation is largely equivalent to the Main Street Limestone to the south. This could make it Cenomanian, but it has usually been included in the latest Albian because it contains *Mortoniceras* and *Spathiceras.* The presence of mantellicerines, however, give it a Cenomanian cast. The early collecting of pyritic micromorphs was not in sufficient detail to determine if the mortonicerines and mantellicerines actually occur in the same beds.

Zone of *Plesioturrilites brazoensis*

Ostlingoceras conlini Clark, 1965
Turrilites bosquensis Adkins, 1920
Plesioturrilites brazoensis (Römer, 1852)
P. rhacioformis Clark, 1965
Scaphites hilli Adkins, 1920
Graysonites adkinsi Young, 1958
G. wooldridgei Young, 1958

Zone of *Graysonites adkinsi*

Sciponoceras sp. cf. *S. baculoides* (Mantell, 1822)
Turrilites bosquensis Adkins, 1920
Turrilites multipunctatus Böse, 1923
Plesioturrilites brazoensis (Römer, 1852)
P. rhacioformis Clark, 1965
P. pecosensis Clark, 1965
Wintonia graysonensis (Adkins, 1920)
Otoscaphites subevolutus (Böse, 1928)
Eoscaphites sp. aff. *E. tenuicostatus* (Pervinquière, 1907)
Scaphites bosquensis Böse, 1928
Engonoceras bravoense Böse, 1928
Ficheuria sp. aff. *F. pernoni* Dubourdieu, 1953
Adkinsia bosquensis (Adkins, 1920)
[= *A. tuberculata* Böse, 1928]
[= *A. adkinsi* Böse, 1928]
[= *A. sparsicostata* Böse, 1928]
[= *A. semiplicata* Böse, 1928]
Prionocycloides sp. cf. *P. proratum* (Coquand)
Stoliczkaia crotaloides (Stoliczka, 1864)
[= *S. texana* (Cragin, 1893)]
[= *S. uddeni* Böse, 1928]
Graysonites adkinsi Young, 1958
G. fountaini Young, 1958
G. wooldridgei Young, 1958
G. (?) wacoensis (Böse, 1928)
[= *Mantelliceras wacoense* Böse, 1928]
[= *Mantelliceras brazoense* Böse, 1928]

Zone of *Graysonites lozoi*

Tetragonites brazoensis Böse, 1928
Sciponoceras sp. cf. *S. baculoides* (Mantell, 1822)
Turrilites bosquensis Adkins, 1920
Wintonia graysonensis (Adkins, 1920)

Otoscaphites subevolutus (Böse, 1928)
Scaphites bosquensis Böse, 1928
Engonoceras bravoense Böse, 1928
E. retardum Hyatt, 1903
E. uddeni (Cragin, 1893)
Faraudiella borachoensis, n. sp.
Adkinsia bosquensis (Adkins, 1920)
[= *A. adkinsi* Böse, 1928]
[= *A semiplicata* Böse, 1928]
[= *A. sparsicostata* Böse, 1928]
[= *A. tuberculata* Böse, 1928]
Stoliczkaia scotti Breistroffer, 1936b
[= *S. dispar* Scott, 1926, pl. 3, figs. 3, 4, *non* d'Orbigny]
[= *Stoliczkaia* n. sp., Adkins 1928, p. 236]
[= *S. scotti* Stoyanow, 1949]
[= *S. patagonica* Stoyanow, 1949]
[= *S. excentrumbilicata* Stoyanow, 1949]
S. crotaloides (Stoliczka, 1864)
[= *S. texana* (Cragin, 1893)]
[= *S. uddeni* Böse, 1928]
Graysonites lozoi Young, 1958
G. (?) wacoensis (Böse, 1928)
[= *Mantelliceras wacoense* Böse, 1928]
[= *Mantelliceras brazoense* Böse, 1928]

Zone of *Budaiceras hyatti*

Hypophylloceras sp. cf. *H. tanit* (Pervinquière, 1907)
Ostlingoceras spp.
(?) Plesioturrilites brazoensis (Römer, 1852)
Mariella wysogorskii (Lasswitz, 1904)
Hypoturrilites roemeri (Whitney, 1911)
H. sp. cf. *H. tuberculatus* (Bosc, 1801)
Puzosia sp. cf. *P. crebrisulcata* Kossmat, 1898
Pseudouhligella sp.
Faraudiella texana (Shattuck, 1903)
[= *Barrosiceras texanum* Shattuck, 1903]
[= *Schloenbachia frechi* Lasswitz, 1904]
[= *Schloenbachia frechi* var. *curvata* Lasswitz, 1904]
[= *Schloenbachia haberfellneri* Lasswitz, 1904, *non* von Hauer]
Faraudiella roemeri (Lasswitz, 1904)
[= *Schloenbachia roemeri* Lasswitz, 1904]
F. archerae, n. sp.
Budaiceras elegantior (Lasswitz, 1904)
[= *Schloenbachia roemeri* var. *elegantior* Lasswitz, 1904]
[= *Schloenbachia evae* Lasswitz, 1904]
[= *Budaiceras mexicanum (pro parte)* Böse, 1928, pl. 23, fig. 2 only]
[= *Budaiceras evae* Adkins, 1928, pl. 23, fig. 2]
[= *Budaiceras* sp. Adkins, 1928, p. 237; Böse, 1928, pl. 18, fig. 7]
Budaiceras hyatti (Shattuck, 1903)
[= *Barroisiceras hyatti* Shattuck, 1903]
[= *Schloenbachia roemeri* var. *harpax* Lasswitz, 1904]
[= *Budaiceras mexicanum* Böse, 1928, all except pl. 23, fig. 2]
Budaiceras alticarinatum, n. sp.
Mantelliceras cantianum spath, 1926
[= *M. budaensis* Adkins, 1931]
[= *M. charlestoni* Kellum and Mintz, 1962]
Mantelliceras sp.
[= *Acanthoceras martimpreyi* Pervinquière, 1907, pl. 15, figs. 18ab, only, *non* Coquand]
Mantelliceras saxbii (Sharpe, 1857)
[= *Acanthoceras hoplitoides* Lasswitz, 1904]
Sharpeiceras florencae Spath, 1925
S. mexicanum Böse, 1928
S. tlahualiloense (Kellum and Mintz, 1962)
[= *Tlahualiloceras tlahualiloense* Kellum and Mintz, 1962]
Paracalycoceras sp.

PALEOECOLOGY

As usual, with extinct animals, the paleontologist has to stretch his imagination to even use the word ecology with a prefix, but in this section some distribution phenomena that do not seem to fit any other place will be discussed. Martin (1961, 1967) has discussed the corrosion zones within the Buda Limestone and the apparent thin depositional rhythms represented by its different beds. He has further pointed out that in the base of some beds specimens of *Budaiceras* are collected keel down, as though buried in and held up by soft mud, but that above the few basal centimeters of such a bed all ammonites are found lying on their sides. This phenomenon is correlated with a dominant micrite at the base becoming more sparry toward the top of the thin sedimentary cycle. Reyment (1970) has discussed this problem. The ammonites of the Buda Limestone are highly compressed and would need support to stay upright.

Nearly all of the fossils of the Buda Limestone are steinkerns, but the species of *Budaiceras* appear to be thin-shelled in those rare specimens that possess a little replacement spar where the shell should be. This may account for their extreme rarity in the upper part of the Buda Limestone of Travis and Williamson counties, Texas, which was deposited in an environment of higher energy than the lower member of the Buda Limestone (Martin, 1967).

Budaiceras hyatti (Shattuck) seems to be generally widespread throughout the area of Buda deposition, except in the rudistid and *Nerinea* facies of the Kent area, Culberson County, Texas, and adjacent counties, and in the facies with sponges on either side of the Rio Bravo, Texas and Chihuahua. Ammonites are also rare in the upper porcellaneous facies of the Rio Grande Embayment. On the other hand, *B. elegantior* (Lasswitz) is generally more restricted to the Edwards Plateau and the East Texas Embayment. *Faraudiella roemeri* (Lasswitz) is widespread, but not abundant, and is only rarely found on the Edwards Plateau in Edwards, Sutton, and Kinney counties. In contrast to this, *Faraudiella texana* (Shattuck) completely dominates the fauna of the Buda Limestone in the Eagle and Quitman mountains, Hudspeth County. It is interesting that in the early Upper Albian *Adkinsites imlayi* Young dominates the faunas from this same area in the zone of *A. bravoensis* (Böse) (Young, 1966). Other species of *Budaiceras* and *Faraudiella* are not represented by enough specimens to draw conclusions concerning distribution. The latter statement is also true of other ammonites from the Buda Limestone; most of them are from the central Texas area because Professor Whitney collected that area so thoroughly. *Sharpeiceras florencae* Spath is widespread, but not common, except in the middle (nodular) member of the Buda Limestone along the western margin of the Maverick Basin.

Sharpeiceras tlahualiloense (Kellum and Mintz, 1962) may or may not deserve separate specific designation; it appears intermediate between *S. florencae* Spath and *S. laticlavium* (Sharpe).

Among the Del Rio ammonites species of *Graysonites* are distributed widely, but are rare. This statement is also true of *Stoliczkaia crotaloides* (Stoliczka) and *Faraudiella borachoensis,* n. sp. The micromorph faunas are fairly abundant at some localities and horizons, particularly in the synclinal areas (Adkins and Lozo, 1951), but this is probably related to environments resulting in the right geochemical conditions for producing pyrite micromorphs of the juvenile whorls or the small specimens, or siliceous micromorphs as in northeastern and eastern Zacatecas, Mexico (Böse, 1923).

SYSTEMATIC PALEONTOLOGY

Order AMMONOIDEA
Suborder PHYLLOCERINA Arkell, 1950
Superfamily PHYLLOCERACEA Zittel, 1884
Family PHYLLOCERIDAE Zittel, 1884
Subfamily PHYLLOCERINAE Zittel, 1884
Genus *HYPOPHYLLOCERAS* Salfeld, 1924

Type species: *Hypophylloceras onoense* (Stanton, 1895) by original designation of Salfeld (1924).

Neophylloceras Shimizu, 1934; *Paraphylloceras* Shimizu, 1935 *(nom. nud.) (non* Salfeld, 1919), *Hyporbulites* Breistroffer, 1947; *Goretophylloceras* Collignon, 1949; *Aphroditiceras* Mahmoud in Breistroffer, 1951 *(nom. nud.); Euphylloceras* Drushchish, 1953; *Ephphylloceras* Collignon, 1956.

HYPOPHYLLOCERAS sp. cf. *H. TANIT*
(Pervinquière, 1907)
pl. 2, figs. 1-3; text fig. 9h
cf. *Phylloceras tanit* Pervinquière, 1907, pp. 53-54, fig. 5, pl. 3, figs. 3-9 *[= Phylloceras seresitense* Spath, 1923, *non* Pervinquière, 1907]
cf. *Hypophylloceras seresitense tanit* (Pervinquière) Wiedmann, 1962, p. 143
Hypophylloceras sp. cf. *H. tanit* (Pervinquière) Young and Powell, in press

Remarks.—The specimens of *Hypophylloceras* from the Buda Limestone are lirate as in *H. seresitense* (Pervinquière), and if one interprets *H. seresitense* as consisting of the subspecies of *H. seresitense seresitense* and *H. seresitense tanit* (Pervinquière) as does Wiedmann (1962a), then the Buda Limestone specimens compare most favorably with *H. seresitense tanit.* The second specimen, even more poorly preserved, is also from the Buda Limestone. Nothing new can be added to the description of the species from these specimens, and the Texas forms are higher and narrower in whorl section than those specimens normally assigned to *H. seresitense seresitense.*

Measurements of UT-17375:

D	U	H	W	H/W
65.0	8.5	58.5	35.5	1.69
38.0	7.1	64.5	37.0	1.75
29.0	---	58.0	36.0	1.62

Horizon and localities.-- Of the three specimens of *Hypophylloceras* sp. cf. *tanit* (Pervinquière), UT-17375 is from the Buda Limestone at Shoal Creek and 29th Street, Austin, F. L. Whitney Collection. Ken J. Martin collected another specimen from Bear Creek, and Whitney collected a third specimen from Manchaca Road and Williamson Creek. All specimens are from the lower member of the Buda Limestone, Travis County, Texas.

Suborder LYTOCERATINA Hyatt, 1900
Superfamily TURRILITACEAE Meek, 1876
Family BACULITIDAE Meek, 1876
Genus *SCIPONOCERAS* Hyatt, 1884

Type species: *Hamites baculoides* Mantell, 1822
Cyrtochilus Meek, 1876 *(non* Jakowlew, 1875) = *Cyrtochilella* Strand, 1929

SCIPONOCERAS sp. cf. *S. BACULOIDES*
(Mantell, 1822)
pl. 1, figs. 41-45; text fig. 9j
Baculites sp. cf. *baculoides* Mantell in Böse, 1928, pp. 210-211, pl. 3, figs. 11-14; pl. 4, figs. 3-11
Sciponoceras baculoides (Mantell) in Young and Powell, in press [1978]

Remarks.—These specimens are from the Del Rio Claystone, and like Böse (1928) I cannot tell them from Mantell's species. However, all specimens are more or less slightly distorted and incomplete, and it seems best just to compare them to Mantell's species.

Horizon and localities.—There are a number of specimens from the Grayson Formation, 3.8 kms. west of Aquilla, Hill County, Texas, and several more from the Del Rio Formation,


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east of the Santa Fe railroad tracks, 7.2 kms. south of McGregor, McLennan County, Texas. Eight specimens are from the Del Rio Formation, Rancho la Bamba, west side of the Sierra Lágrima, northeastern Chihuahua, Mexico.

Family TURRILITIDAE Meek, 1876
Genus *MARIELLA* Nowak, 1916

Type species: *Turrilites bergeri* Brongniart, 1822

MARIELLA WYSOGORSKII (Lasswitz, 1904)
pl. 1, fig. 60

Synonymy: as given by Clark (1965, p. 42)
Mariella wysogorskii (Lasswitz) Young and Powell, in press

Remarks.—The specimen illustrated herein is the same specimen, UT-30537, that Clark illustrated (1965, pl. 11, fig. 2). It is from the Buda Limestone, west of Diezyocho (Van Horn) Creek, Jeff Davis County [not Presidio

PLATE 1

1-4—Turrilites bosquensis Adkins; *1,* basal, *2, 4,* lateral, and *3,* apical views of UT-6973, from the Del Rio Formation, Rancho la Bamba, Chihuahua, Mexico; collected by W. T. Haenggi; *1, 4,* X 2; *2, 3,* X 1.

5-8—Turrilites multipunctatus (Böse); *5, 7,* lateral and *6, 8,* apical, views of UT-6982, from the Del Rio Formation, Rancho la Bamba, Chihuahua, Mexico, collected by W. T. Haenggi; *5, 8* X 2; *6, 7,* X 1.

9-16—Eoscaphites sp. cf. *E. tenuicostatus* (Pervinquière); *9, 15,* apertural, *13, 16,* ventral, and *10-12, 14,* lateral views of UT-6987, from the Del Rio Formation, Rancho la Bamba, Chihuahua, Mexico, collected by W. T. Haenggi; *9, 10, 13, 14,* X 1; *11, 12, 15, 16,* X 2.

17-35—Otoscaphites subevolutus (Böse); *17,* lateral view of BEG-18621-Z *(see also* text fig. 9d); *18, 21,* lateral, *19,* sectional, and 20, 22, ventral views of BEG-18621-W *(see also* text fig. 9b); *23-25,* lateral, ventral, and dorsal views of UT-7302-A *(see also* text fig. 9g); *26,* a composite of three specimens; *27, 28,* ventral views of body chamber of UT-8648; *29, 33, 34,* lateral and *32, 35,* ventral views of UT-8640; *31,* lateral view of body chamber of UT-8647; *17-22,* from the Grayson Formation, 2.4 kms. west of Aquilla, Hill County, Texas, collected by Bernhard Kummel; *23-35,* from the Del Rio Formation, Rancho la Bamba, Chihuahua, Mexico, collected by W. T. Haenggi; *17-20, 23-25, 27, 29-33,* X 2; *21, 22, 26, 28, 34, 35,* X 1.

36-40—Scaphites sp. cf. *S. hugardianus* d'Orbigny; *36, 38,* lateral, and *39,* ventral views of UT-8651; *37, 40,* lateral views of UT-8650 *(see also* text figs. 9pr); *both* from the Del Rio Formation, Rancho la Bamba, Chihuahua, Mexico, collected by W. T. Haenggi; *36, 37,* X 1; *38-40,* X 2.

41-45—Sciponoceras sp. cf. *S. baculoides* (Mantell); *41, 42, 44,* BEG-18621-V, from the Grayson Formation, 2.4 kms. west of Aquilla, Hill County, Texas, collected by Bernhard Kummel; *43, 45,* BEG-18750-A *(see also* text fig. 9j) from the Del Rio Formation east of the Santa Fe railroad track, 7.2 kms. south of McGregor, McLennan County, Texas, collected by W. S. Adkins; *41, 44, 45,* X 2; *42, 43,* X 1.

46-55, 61-66—Adkinsia bosquensis (Adkins). *46, 49,* lateral, *47, 50,* ventral, and *48,* sectional views of a tuberculate specimen, BEG-18621-A *(see also* text figs. 10cf); *51, 54,* ventral, and *52, 53, 55,* lateral views of BEG-18621-T *(see also* text fig. 10b), a less tuberculate specimen; *58, 59, 61,* lateral, *60, 63,* ventral, and *62,* apertural, views of BEG-18621-V, a variant with reduced tuberculation; *all* from the Grayson Formation, 2.4 kms. west of Aquilla, Hill County, Texas, collected by Bernhard Kummel; 46, *47, 51-53, 63, 64,* X 1; *48-50, 54, 55, 61, 62, 65, 66* X 2.

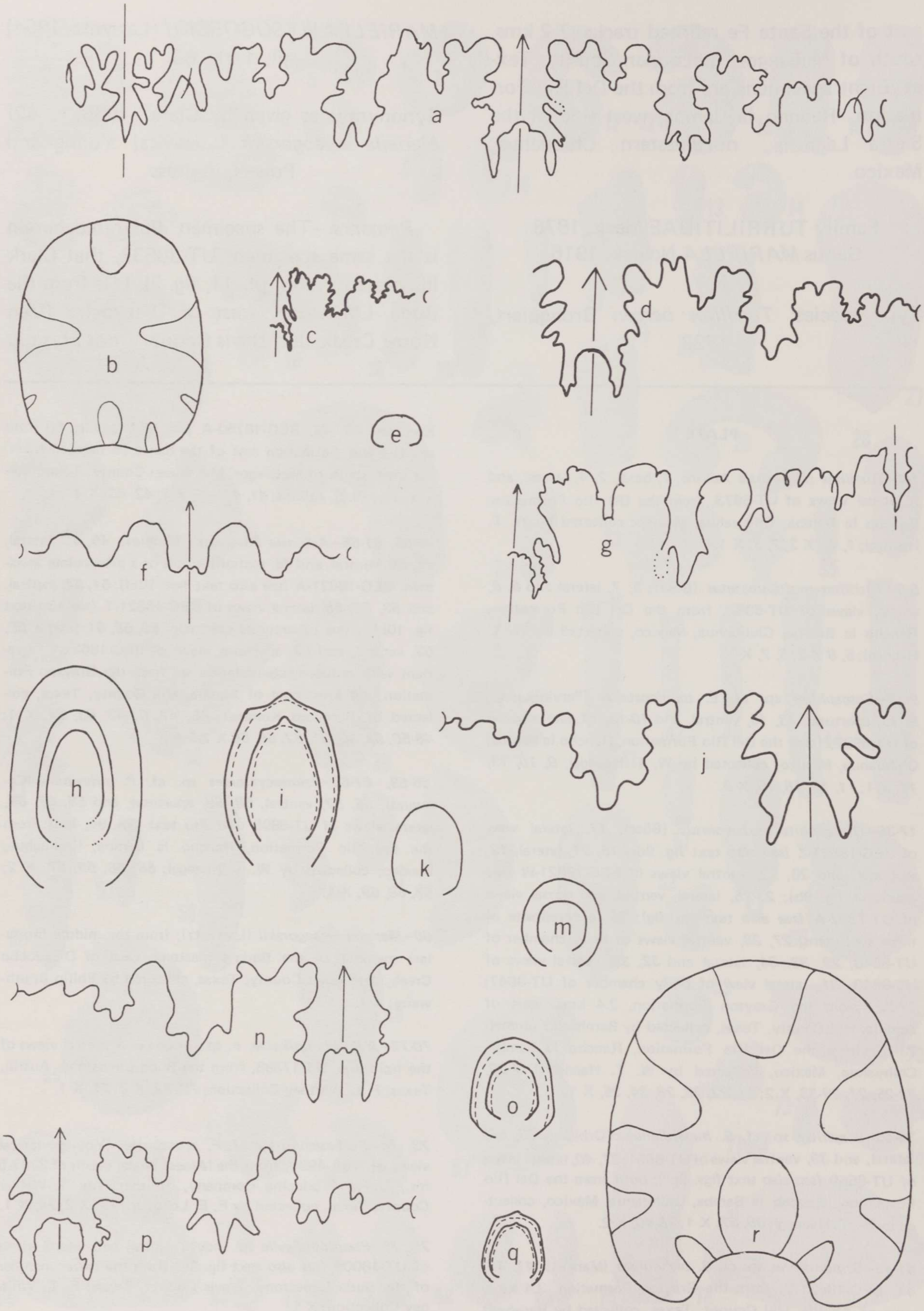
56-59, 67-69—Prionocycloides sp. cf. *P. proratum* (Coquand); *56, 57,* ventral, *58, 69,* apertural, and *59, 67, 68,* lateral views of UT-6895 *(see also* text figs. 9c, 10a), from the Del Rio Formation, Rancho la Bamba, Chihuahua, Mexico, collected by W. T. Haenggi; *56, 58, 59, 67,* X 2; *57, 68, 69,* X 1.

60—Mariella wysogorskii (Lasswitz); from the middle (nodular) member of the Buda Limestone, west of Diezyocho Creek, Jeff Davis County, Texas, collected by Philip Braithwaite; X 1.

70-72—Adkinsia knikerae, n. sp.; lateral and ventral views of the holotype, UT-17388, from the Buda Limestone, Austin, Texas; F. L. Whitney Collection; *70, 72,* X 2; *71,* X 1.

73, 74—Forbesiceras sp. cf. *F. brundrettei* (Young); lateral views of WSA-4980, from the Maness Shale, depth of 3747.5 ms., Union Producing Company, Smithers no. 1, Walker County, Texas, collected by F. E. Lozo, Jr.; *73,* X 2; *74,* X 1.

75, 76—Pseudouhligella sp. indet.; ventral and lateral views of UT-18005 *(see also* text fig. 9k) from the lower member of the Buda Limestone, Travis County, Texas; F. L. Whitney Collection; X 1.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County as stated by Clark (1965)], Texas. Without further information and specimens there is no need for further discussion.

Genus *TURRILITES* Lamarck, 1801

Type species: *Turrilites costatus* Lamarck, 1801

TURRILITES BOSQUENSIS Adkins, 1920
pl. 1, figs. 1-4

Synonymy: See Clark (1965, p. 47) for synonymy.

Plesioturrilites sp. aff. *P. oehlerti* (Pervinquière, 1907) in Young and Powell (in press).

Remarks.—This species has been described by Adkins (1920), Böse (1928), and Clark (1965). Clark's interpretation is somewhat broader than those of Adkins and Böse, and if correct, *Turrilites bosquensis* might well become a synonym of *Turrilites aumalensis* Coquand (1880); some of Clark's specimens (1965, pl. 17, figs. 9, 13, 15, 16) even show the clavate tubercles that Breistroffer (1953) attempts to use to define his subgenus *Mesoturrilites.* The marked plesioturrilitid groove does not show well in the pyritic micromorphs, and if *T. bosquensis* is to be assigned to *Plesioturrilites,* it must be done by accepting the assignment of the large specimen illustrated by Clark (1965, pl. 15, fig. 1) to this species, a hazardous assignment at best

I had compared the specimen illustrated on plate 1, figs. 1-4, to *Turrilites oehlerti* (Pervinquière, 1907) (Young and Powell, in press), but would now consider Bose's (1923b, pl. X, figs. 25-31) *Turrilites carrancoi* as probably synonymous with *T. oehlerti* Pervinquiere, because of the more delicate ribbing in the earlier whorls.

FIGURE 9

a, b, d, g, n—Otoscaphites subevolutus (Böse); *a,* suture of UT-8642; *b,* section of BEG-18621-W *(see also* plate 1, figs. 18-22); *d,* suture of BEG-18621-Z *(see also* plate 1, fig. 17); *g,* suture of UT-7302-A *(see also* plate 1, figs. 23-25); *n,* suture of UT-8643 at a diameter of 6 mm.; *a, g, n,* from Rancho la Bamba, Chihuahua, Mexico, collected by W. T. Haenggi; *b, d,* from the Grayson Formation, 2.4 kms. west of Aquilla, Hill County, Texas, collected by Bernhard Kummel; *all* X 17.

c—Prionocycloides sp. cf. *P. proratum* (Coquand); suture of UT-6895 *(see also* plate 1, figs. 56-59, 67-69, and text fig. 10-a), from the Del Rio Formation, Rancho la Bamba, Chihuahua, Mexico, collected by W. T. Haenggi; X 7.

e, f—Ficheuria sp. aff. *F. pernoni* Dubourdieu; section and suture of UT-7291 *(see also* plate 2, figs. 6-11), from the Del Rio Formation, Rancho la Bamba, Chihuahua, Mexico, collected by W. T. Haenggi; *e,* X 1; *f,* X 17.

h—Hypophylloceras sp. cf. *H. tanit* (Pervinquière); sections of UT-17375 *(see also* plate 2, figs. 1-3), at diameters of 29, 38, and 65 mm., from the Buda Limestone, Shoal Creek, Austin, Texas, F. L. Whitney collections; X 1.

i—Faraudiella sp. cf. *F. rhamnonota* (Seeley); sections of WSA-1962 *(see also* plate 3, figs. 3, 12), from the Denton Formation near Belton, Bell County, Texas, collected by W. S. Adkins; X 1.

j—Sciponoceras sp. cf. *S. baculoides* (Mantell); suture of BEG-18750-A *(see also* plate 1, figs. 43, 45), from the Del Rio Formation, east of the Santa Fe Railroad track, 7.2 kms. south of McGregor, McLennan County, Texas; X 17.

k—Pseudouhligella sp. indet.; section of UT-18005 *(see also* plate 1, figs. 75, 76), from the lower member of the Buda Limestone, Travis County, Texas, F. L. Whitney collection; X 1.

m—Puzosia sp. cf. *P. crebrisulcata* Kossmat; sections of UT-18025 *(see also* plate 2, figs. 12-14) at diameters of 20 and 38.5 mm., from the lower member of the Buda Limestone at Austin, Travis County, Texas; F. L. Whitney collection; X 1.

o, q—Stoliczkaia adkinsi Böse; *o,* sections of UT-14466 *(see also* plate 3, figs. 8, 9), from 4.5 ms below the top of the Georgetown Limestone, Shoal Creek, Pease Park, Austin, Travis County, Texas, collected by K. Young; *q,* sections of the holotype *(see also* pl. 2, figs. 15, 19-21), the specimen illustrated by Böse (1928, plate 18, figs. 9-13), from the Pawpaw Formation, Glen Garden Country Club, Fort Worth, Tarrant County, Texas, collected by W. S. Adkins; *both* X 1.

p, r—Scaphites sp. cf. *S. hugardianus* d'Orbigny; *p,* suture, and *r,* section of UT-8650 *(see also* plate 1, figs. 37, 40), from the Del Rio Formation, Rancho la Bamba, Chihuahua Mexico, collected by W. T. Haenggi; *both* X 17.


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Horizon and localities.—*Turrilites bosquensis* Adkins is common at many localities in the Del Rio Formation of Texas and northern Mexico. The specimen illustrated on plate 1, figs. 1-4, plus 11 other specimens, is from the Del Rio Formation, Rancho La Bamba, west flank of the Sierra Lágrima, northeastern Chihuahua, Mexico, where it occurs with *Ficheuria, Graysonites (?)* sp. juv., *Prionocycloides, Otoscaphites subevolutus* (Böse), *Adkinsia,* and species of *Scaphites.*

TURRILITES MULTIPUNCTATUS Böse, 1923
pl. 1, figs. 5-8

Turrilites multipunctatus Böse, 1923, pp. 154-155, plate X, figs. 48-58

? *Paraturrilites kerkourensis* Dubourdieu, 1953, pp. 48-50, plate 4, figs. 4-10

Remarks.—In the number of tubercles per volution and the four rows of tubercles, this species was compared to *Turrilites bergeri* Brongniart by Böse (1923b, p. 155), but unlike *Turrilites bergeri, T. multipunctatus* shows tubercles elongate parallel to the axis of coiling. There are four rows of tubercles, three seen from the side and one from the base only. The tubercles are separated by weaker areas of ribbing, that Böse actually called "smooth areas," between the first and second and second and third rows, designating the rows from apicad. Böse points out that the number of rows of tubercles per volution ranges from 24 to 32, and he attributes the specimen with 24 to an undescribed variety. My specimen has closer to 34 rows of tubercles per whorl. The range of variation of the apical angle is excessive in pyrite micromorphs, and therefore not worth measuring; part of that range seems to be the result of uneven expansion during pyritization. Böse's specimens were silicified.

Horizon and localities.—In addition to the Böse locality between Camacho and the Trinidad Mine, Zacatecas, Mexico, 12 specimens, including the one illustrated on plate 1, figs. 5-8, have been identified from the Del Rio Formation, Rancho la Bamba, west flank of the Siera Lágrima, northeastern Chihuahua, Mexico.

PLATE 2

1-3—***Hypophylloceras*** sp. cf. *H. tanit* (Pervinquière); lateral and ventral views of UT-17375 *(see also* text fig. 9h), from the Buda Limestone, Shoal Creek, Austin, Texas; F. L. Whitney Collection; X 1.

4, 5—***Euhystrichoceras remolinense*** Böse; lateral and ventral views of a cast of the holotype, BEG-35236 (= UC-35764) *(see also* text fig. 11d), from the Buda Limestone near El Remolino, Coahuila, Mexico; collected by Emil Böse; X 1.

6-11—***Ficheuria*** sp. aff. *F. pernoni* Dubourdieu; *6, 10, 11,* lateral, *7, 8,* ventral, and *9,* apertural views of UT-7291 *(see also* text figs. 9de), from the Del Rio Formation, Rancho la Bamba, Chihuahua, Mexico, collected by W. T. Haenggi; *6, 8, 9, 11,* X 2; *7, 10,* X 1.

12-14—***Puzosia*** sp. cf. *P. crebrisulcata* Kossmat; ventral and lateral views of UT-18025 *(see also* text fig. 9m), from the lower member of the Buda Limestone at Austin, Travis County, Texas; F. L. Whitney Collection; X 1.

15-25—***Stoliczkaia adkinsi*** Böse; *15, 21,* lateral, and *16, 20,* ventral views of the holotype *(see also* text fig. 9q), illustrated by Böse (1928, pl. 18, figs. 9-13), from the Pawpaw Formation, Glen Garden Country Club, Fort Worth, Tarrant County, Texas, collected by W. S. Adkins; *17, 19, 22,* lateral, and *18, 25,* ventral views of the paratype illustrated by Böse (1928, pl. 18, figs. 15, 17c) from the Pawpaw Formation on Sycamore Creek, southeast of Fort Worth, Tarrant County, Texas, collected by W. S. Adkins; *23,* lateral, and *24,* ventral views of UT-273 *(see also* text fig. 11b), from 4.5 ms. below the top of the Georgetown Limestone, Pease Park, Shoal Creek, Austin, Texas, collected by K. Young; *15-17, 22-25,* X 1; *18-21,* X 2.

26, 27—***Lewesiceras*** n. sp.; ventral and lateral views of UT-30495 *(see also* text fig. 11kk), from the Buda Limestone, Rubbrecher Ranch, Comal County, Texas, collected by Victor King; X 1.

Superfamily SCAPHITACEAE Meek, 1876
Family SCAPHITIDAE Meek, 1876
Subfamily SCAPHITINAE Meek, 1876
Genus *OTOSCAPHITES* Wright, 1953

Type species: *Ammonites (?) bladensis* Schlüter, 1872

OTOSCAPHITES SUBEVOLUTUS (Böse, 1928)
pl. 1, figs. 17-35; text figs. 9abdgn

Synonymy given by Clark (1965, p. 59)
Eoscaphites subevolutus (Böse) Young and Powell, in press, pl. 8, figs. 1, 7

Description.—Conch is discoidal, evolute, and 30 ± mm. in greatest dimension, the coiled part about 10 mm. of this and the hook almost another 10 mm., leaving the shaft to take up the remainder.

The shaft opens sharply from the coil with slightly prosiradiate ribs, flexed at midflank and bifurcating or intercalating just ventrad of midflank. Ribs on the shaft become more prosiradiate toward the hook.

The coiled part of the conch contains from 15 to 20 primary ribs at a diameter of 10 mm., with secondary ribs appearing between diameters of 5 and 6 mm. Secondary ribs intercalate or bifurcate at the outer one-third of the flank to outer one-fourth of the flank and are largely restricted to the venter. Juvenile whorls prior to a diameter of 8 mm. are extremely variable in shape and density of ornamentation, and the smallest whorls are smooth although the designation by Böse (1928, p. 226) of the three smallest whorls as smooth is inaccurate, since the length of the smooth part varies from individual to individual. The umbilicus is usually imperforate, but perforate specimens are known [pl. 1, fig. 30, herein and Böse (1928) pl. 7, figs. 10 and 17, at least]. The coiled part of the conch may have as many as 3½ or 4 whorls, and prior to a diameter of from 5 to 7 mm. the whorl width is greater than the whorl height. Overlap of the flank by any succeeding whorl may vary from an overlap of one-half the flank to almost no overlap, as pointed out by Böse (1928, p. 226).

The hook is nearly symmetrical, almost a half circle, and has rather strong bullae extending from just laterad of the impressed zone to the outer one-third of the flank, where they usually bifurcate to three ribs on the venter. Other ribs may intercalate at the outer one-third of the flank and also extend over the venter.

There is a well developed impressed zone on the shaft that continues throughout the length of the hook. Of the 20 or so hooks examined most are distorted by pyritization, and apertural edges do not seem to be preserved; the question as to the presence or absence of lappets in this species is still unresolved.

The E, L, and I elements of the suture are well developed at all stages ascertainable, and P_1 is also easily seen. The U element is somewhat obscure on sutures from the coiled part (text figs. 9gn), which appear to be scaphitine, whereas the U element is well developed on sutures from the shaft, and these sutures are more like those of other species of *Otoscaphites.*

Measurements of coiled parts from two specimens (UT-6981):

D	U	H	W	H/W
8.6	34.0	44.0	38.5	1.14
4.4	36.5	34.0	48.0	0.71
9.1	36.0	42.0	36.5	1.15
3.8	47.5	39.5	53.0	0.75

Measurements from Böse (1928, p. 227), six specimens:

14.4	32.0	42.0	44.0	0.95
11.1	42.0	41.0	33.0	1.24
9.3	41.0	38.0	32.0	1.19
8.8	38.0	41.0	38.0	1.08
7.6	37.0	37.0	36.0	1.03
5.0	50.0	32.0	40.0	0.80

Remarks.—*Otoscaphites subevolutus* (Böse) is most often compared with *Scaphites evolutus* Pervinquière (1910), from which it differs in having a higher whorl section beyond the diameters of 5 to 7 mm., less dense ribbing in the juveniles, and a larger number of whorls in the coiled part of the conch.

The ornamentation is generally stronger than that on most species of *Otoscaphites,* but the ornamentation on the shaft is very close to that on the shaft of the specimen figured as *Otoscaphites awanuiensis* by Wright (1957, pl. 54, fig. 6), except that ornamentation on the New Zealand specimen is weaker. The ornamentation is not quite the same on Wright's other specimen (1957, pl. 54, figs. 7ab). Most species of *Otoscaphites* are younger than *O. subevolutus,* and their ornamentation is also more reduced (e.g., Wiedmann, 1965, pl. 58, figs. 2-4, 6 and pl. 59, figs. 1-2), but the ornamentation of *O. subevolutus,* especially plate 1, figures 17, 29, 33, 34, could be the precursor to the ornamentation of *O. bladensis* (Schlüter, 1872) as illustrated by Wiedmann (1965, pl. 58, especially figs. 2a-c, 3, and 4). Wiedmann's figures 3 and 4 also apparently show the variation of evoluteness so emphasized by Böse (1928, p. 226).

The U element of the suture is less well developed in *Otoscaphites subevolutus* than in other species of the genus, except for sutures on the shaft (text figs. 9a, g). Perhaps the lack of the development of the U element in the coiled part of the conch is because of the early stage of this species in the otoscaphitine lineage, providing the generic designation is correct. The L and P_1 elements are much narrowed on the shaft, compared to the coil. Wiedmann's (1965) and Wright's (1953) suggestions that *Scaphites evolutus* (Pervinquière, 1910) be assigned to *Otoscaphites* may well be correct, but in *O. subevolutus* (Böse) the type of suture typical of *Otoscaphites* is almost restricted to the shaft. Because of the lack of preservation of mouth edges, I do not yet believe the generic designation is completely satisfactory, but feel, because of the open hook and the great extension of the shaft and the ornamentation, that *Otoscaphites* is the best assignment until someone demonstrates otherwise.

Clark (1965) points to the absence of shafts and hooks in the Bureau of Economic Geology collections (collections now deposited with the Texas Memorial Museum, The University of Texas at Austin). He is partly correct; specimens on plate 1, figures 17 and 18 are from these collections, and they show parts of the shaft. I do not understand why there should be no hooks unless earlier collectors failed to pick them up because they did not recognize them for what they were. In a clay sediment as fine as the Del Rio Claystone there should be no sorting. In the Rancho la Bamba section, northeast Chihuahua, Mexico, there are many shafts and hooks, but the hooks are more often distorted by pyritization than the shafts or coiled parts. All of the hooks, and some 20 have been examined, are broken from the shafts at the last suture. The shaft is usually separated from the coil at the first suture with a free impressed zone. Again the clay sediment is remarkably fine at Rancho la Bamba, where different parts are dissociated but in the same deposit, and one would suspect scavengers or bioturbation to be responsible for the dissociation of shafts, hooks, and coils, since the dissociation does not seem to be restricted to the weathering profile.

Horizon and localities.—*Otoscaphites subevolutus* (Böse) is Lower Cenomanian, occurring in both the zones of *Graysonites adkinsi* and *G. lozoi.* It occurs in the Del Rio and Grayson Formations throughout Texas and northern Mexico, except on those platform areas where the formations are thin and more nearly the composition of limestone. Distribution, locally, is restricted stratigraphically to distinct, thin levels that have not been correlated with each other and probably cannot be correlated with each other. Specimens illustrated on plate 1 are from the Grayson Formation, 2.4 kms. west of Aquilla, Hill County, Texas, and from the Del Rio Formation, Rancho la Bamba, west flank of the Sierra Lágrima, northeastern Chihuahua, Mexico.

Genus *EOSCAPHITES* Breistroffer, 1947
Type species: *Ammonites (?) circularis* J. de C. Sowerby, 1836

EOSCAPHITES (?) sp. cf. *E. TENUICO- COSTATUS* (Pervinquière, 1910)
pl. 1, figs. 9-16

cf. *Scaphites tenuicostatus* Pervinquière, 1910, p. 28, text fig. 12, pl. 2, figs. 17-19; Reeside, 1927, p. 34.
cf. *Eoscaphites tenuicostatus* (Pervinquière) Wiedmann, 1962b, p. 212; Wiedmann, 1965, pp. 410-411, pl. 53, figs. 7abc.
Eoscaphites tenuicostatus Young and Powell, in press, pl. 6, figs. 13, 14.

Remarks.—I am not likely to add much to the knowledge of this species or its generic assignment with the single example illustrated on plate 1, figs. 9-16. Even the generic assignment is still as questionable as it was when Wiedmann (1965) questionably assigned this species of Pervinquière (1910) to *Eoscaphites* Breistroffer. The Mexican specimen seems to be intermediate between *Eoscaphites tenuicostatus* (Pervinquière) and *Scaphites simplex* Jukes-Brown (1975). The Mexican specimen is more strongly ribbed than Pervinquière's, but less strongly ribbed than *S. simplex.* The specimen from Mexico is also just beginning to show the lateral bulges or thickenings of the shaft that is so well developed in *S. simplex.*

Horizon and locality.—The single specimen illustrated on plate 1 was recovered from the Del Rio Formation, Rancho la Bamba, west flank of the Sierra Lágrima, northeastern Chihuahua, Mexico, and it occurs with *Otoscaphites subevolutus* (Böse). *Scaphites* sp. cf. *S. hugardianus* d'Orbigny, *Turrilites bosquensis* Adkins, *Ficheuria* sp., *Prionocycloides* sp. cf. *P. proratum* (Pervinquiére), and juvenile specimens of *Graysonites.*

Genus *SCAPHITES* Parkinson, 1811
Type species: *Scaphites aequalis* Sowerby, 1813, designated by Meek, 1876

SCAHPITES sp. cf. *S. HUGARDIANUS* d'Orbigny, 1841
pl. 1, figs. 36-40; text figs. 9p,r

Remarks. -A few specimens of *Scaphites* from Mexico, much less tumid than *S. bosquensis* Böse, *S. simplex* Jukes-Brown, or *S. aumalensis* Coquand, seem to conform to the earlier whorls of *S. hugardianus* d'Orbigny in involution, bifurcation of ribs just ventrad of midflank, and whorl height-width ratios. The absence of shafts and hooks prevents the accurate identification, because the tubercles on the flanks of the shafts and hooks, so typical of the *meriani* group, have not yet developed.

Horizon and locality.—Several specimens are from the Del Rio Formation at Rancho la Bamba, west flank of the Sierra Lágrima, northeastern Chihuahua, Mexico. They are associated with the same species that are associated with *Eoscaphites (?) tenuicostatus* (Pervinquière), above.

Suborder AMMONITINA Hyatt, 1889
Superfamily DESMOCERACEAE Zittel, 1895
Family DESMOCERIDAE Zittel, 1895
Subfamily PUZOSIINAE Spath, 1922
Genus PUZOSIA Bayle, 1878
Pleuropachydiscus Hyatt, 1900; *Pseudosilesitoides* Breistroffer, 1952 (nom. nud.)
Type species: *Ammonites subplanulatus* Schlüter, 1871 (= *P. planulata* Bayle, 1878, *non* J. de C. Sowerby, 1827)

PUZOSIA sp. cf. *P. CREBRISULCATA* Kossmat, 1898
pl. 2, figs. 12-14; text fig. 9m

Remarks.—UT-18025 is a small specimen (D=38.5), probably of a small species, almost as evolute as the much older species, *P. sharpei* Spath and *P. communis* Spath from the Greensand.

The Buda Limestone specimen is more evolute than *P. mayoriana* (d'Orbigny) and more evolute than the species Pervinquiére (1907) identified as *P. paronae* Kilian. The latter species should be about the same age as the Buda Limestone. The Buda specimen is very similar to *P. crebrisulcata* Kossmat (1898), with the same bi-concave constrictions projected sharply forward at midventer. *P. crebrisulcata* occurs with fossils that indicate an age comparable to that of the Buda Limestone.

Measurements from the one individual, UT-18025, are.

D	U	H	W	H/W
35.5	35.0	39.0	36.5	1.07
30.0	35.0	38.5	38.5	1.00
25.0	34.0	40.0	38.0	1.05
20.0	32.5	47.5	42.5	1.12

Horizon and locality.—*Puzosia* sp. cf. *P. crebrisulcata* Kossmat is from the lower member of the Buda Limestone at Austin, Travis County, Texas; F. L. Whitney Collection.

Subfamily DESMOCERINAE Zittel, 1895
Genus *DESMOCERAS* Zittel, 1884
Latidorsella Jacob, 1908; *Phyllodesmoceras* Spath, 1925
Subgenus *PSEUDOUHLIGELLA* Matsumoto, 1942
Pseudouhligella Matsumoto, 1938, *nom. nud.*
Type species: Desmoceras whiteavesi var. *japonica* Yabe, 1902

DEMOCERAS (PSEUDOUHLIGELLA) sp.
pl. 1, figs. 75, 76, text fig. 9k

Remarks.—A small fragment, UT-18005, seems to belong to the subgenus *Pseudouhligella* Matsumoto. This fragment has constrictions and ribs at about the same frequency as does *Pseudouhligella vetus* Murphy and Rodda (1959). However, the species described by Murphy and Rodda is somewhat older, and somewhat higher whorled. *Pseudouhligella* sp. from the Buda has more frequent and less biconcave constrictions than does *P. ezoanum* Matsumoto, and has more frequent and not so strongly biconcave constrictions as *P. whiteavesi* (Yabe) or *P. japonica* (Yabe). The constrictions of the specimen from the Buda Limestone are not as strongly biconcave as on most species of the subgenus, and since this is one of the diagnostic features of the genus, the assignment of this form to *Pseudouhligella* may be questionable.

Horizon and locality.—*Pseudouhligella* sp. is from the top of the lower member of the Buda Limestone at Manchaca, Travis County, Texas, and was collected by F. L. Whitney.

Family PACHYDISCIDAE Spath, 1922
Genus *LEWESICERAS* Spath, 1922
Type species: *Ammonites peramplus* Mantell, 1822

LEWESICERAS sp.
pl. 2, figs. 26, 27; text fig. 11mm

Remarks.—Conch with few regularly expanding whorls, with walls sloping into a moderately narrow umbilicus, and with rounded venter. The larger whorl section is suboval, slightly depressed, being more oval than the juvenile whorl section. H/W ranges from 1.08 at the 50 mm. diameter to between 0.9 and 0.95 at greater diameters. The greatest intercostal width is just ventrad of the position of the umbilical bulla, and the greatest costal width is at the umbilical bulla. Ribbing is raised and nearly rectiradiate across the flank, projected forward on the venter. In the last volution there are 13 primary ribs, which extend to the umbilicus and end in umbilical nodes or bullae. Intercalated be-

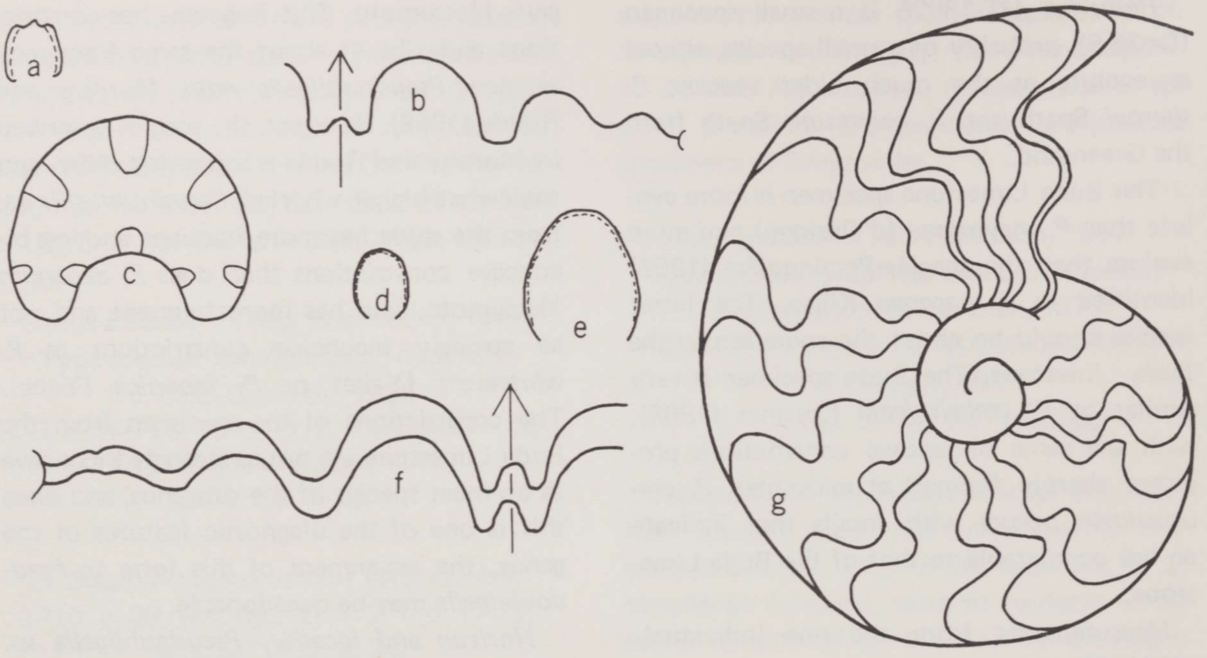

FIGURE 10

a—Prionocycloides sp. cf. *P. proratum* (Coquand); section of UT-6985 *(see also* pl. 1, figs. 56-59, 67-69, and text fig. 9c), from the Del Rio Formation, Rancho la Bamba, Chihuahua, Mexico, collected by W. T. Haenggi; X 1.

b, c, f, g—Adkinsia bosquensis (Adkins); *b,* suture of UT-18621-T *(see also* pl. 1, figs. 51-55); *c, f,* section and sutures of BEG-18621-A *(see also* pl. 1, figs. 46-50); *g,* sutures of BEG-18621-E; these sutures are very unevenly spaced, and some of the later sutures are closer together; *all* from the Grayson Formation, 2.4 kms west of Aquilla, Hill County, Texas, collected by Bernhard Kummel; *all,* X 17.

d, e—Stoliczkaia scotti Breistroffer; *d,* section of UT-47893, from the Del Rio Formation, west side of the Sierra del Carmen, northern Coahuila, Mexico, collected by C. L. Baker; *e,* section of WSA-6032 *(see also* pl. 7, fig. 11, pl. 8, fig. 11), from the upper 8.2 ms of the Grayson Formation, Grayson Point, northeast of Roanoke, Denton County, Texas; collected by Roy T. Hazzard; *both,* X 1.

tween the primary ribs at one or more positions on the flanks are approximately 30 secondary ribs. From a diameter of 60 mm or more the intercostae are wider than the costae; prior to the 60 mm diameter the costae and intercostae are approximately the same width. The only specimen is entirely septate, and there is no information on the body chamber or the aperture.

Measurements of UT-30495 are:

D	U	H	W	H/W	P	S	B	T
100.0	24.5	------	------	------	13	30	----	43
75.00	26.0	45.5	48.0	0.95				
60.0	26.5	46.5	51.0	0.91				
50.0	22.0	39.0	36.0	1.08				

Lewesceras sp. from the Buda Limestone is one of the earlier members of the genus. It is more densicostate than is the type species of the genus, *L. peramplus* (Mantell), and the ornamentation is not as robust. There are also more umbilical bullae per whorl on the Buda

Limestone species than on *L. peramplus.* The Turonian and Coniacian forms described by Collignon (1955) are all more coarsely and more robustly costate than this species from the Buda Limestone, and most of them have a more depressed whorl section.

Horizon and locality.—UT-30495 is from the outlier of Buda Limestone, one-third km. west of the Rubbrecher. ranch house, Comal County, Texas; it was collected by Victor King.

Superfamily HOPLITACEAE H. Douvillé, 1890

Family SCHLOENBACHIIDAE Parona and Bonarelli, 1897

Genus *EUHYSTRICHOCERAS* Spath, 1923

Type species: *Ammonites nicaisei* Coquand, 1862

EUHYSTRICHOCERAS REMOLINENSE Böse, 1928

pl. 2, figs. 4, 5; text fig. 11d

Holotype.—The holotype, and only known specimen of the species, is from the Buda Limestone near El Remolino, District of Jiménez, Coahuila, Mexico, described by Böse (1928, pp. 247-250, pl. 9, figs. 13-15).

This specimen is at the University of California, Berkeley, and a cast, BEG-35236, from which the photographs on plate 2, figs. 4, 5, were taken, is at the Texas Memorial Museum, University of Texas at Austin.

Remarks.—No other specimens of the genus *Euhystrichoceras* Spath have been recovered from the Buda Limestone since Böse described *E. remolinense* in 1928.

The only species of *Euhystrichoceras* from America, besides *E. remolinense* Böse, is *E. adkinsi,* described by Powell (1963) from the basal Ojinaga Formation of northeastern Chihuahua, Mexico.

Euhystrichoceras remolinense Böse is most like the form described by Pervinquière (1907, pl. 11, figs. 15a-c) as *Mortoniceras nicaisei* (Coquand), the thick variety. Pervinquière's (1907, pl. 11, figs. 13a-c and 14a-c) other specimens are much less thick whorled, being more like the specimen figured by Collignon (1928, pl. 16, figs. 16, 16a), but perhaps a little more compressed. Powell's species, *E. adkinsi,* is narrower and thinner, as in Pervinquière's plate 11, figs. 13a-c and 14a-c, but is much more densely costate in the adult, more like *"Prohysteroceras" (?) tunisiense* Spath (1926), which looks more like a *Euhystrichoceras* than a *Prohysteroceras.* Böse's species then, is more like the thick variety illustrated by Pervinquière, with the same general shape and configuration, but less densely costate. There are about 10 primary ribs per volution on each specimen, Böse's and Pervinquière's, but there are two intercalated ribs between each pair of primary ribs on Pervinquière's specimen and only one intercalated rib between each pair of primary ribs on Böse's specimen.

The specimens of *E. nicaisei* (Coquand), particularly figure 16 of plate 3, described by Collignon (1931) are more coarsely costate, as in the Böse species. Collignon's (1931) specimen illustrated on figure 17 of plate 3 has the more closely spaced sigmoid ribbing on what appears to be the body chamber, and is more densely costate than Böse's species.

Measurements of the holotype are:

D	U	H	W	H/W	P	S	B	T
35.0	31.5	35.5	37.0	0.96	3	8	16	27
30.0	31.5	33.5	35.0	0.95				
25.0	32.0	36.0	40.0	0.90				
20.0	30.0	40.0	42.5	0.94				

The Buda Limestone is such difficult collecting that the rarer species are represented usually by only one or two specimens, and the degree of variation cannot be ascertained.

Horizon and locality.—Same as for the holotype, upper part of the Lower Cenomanian.

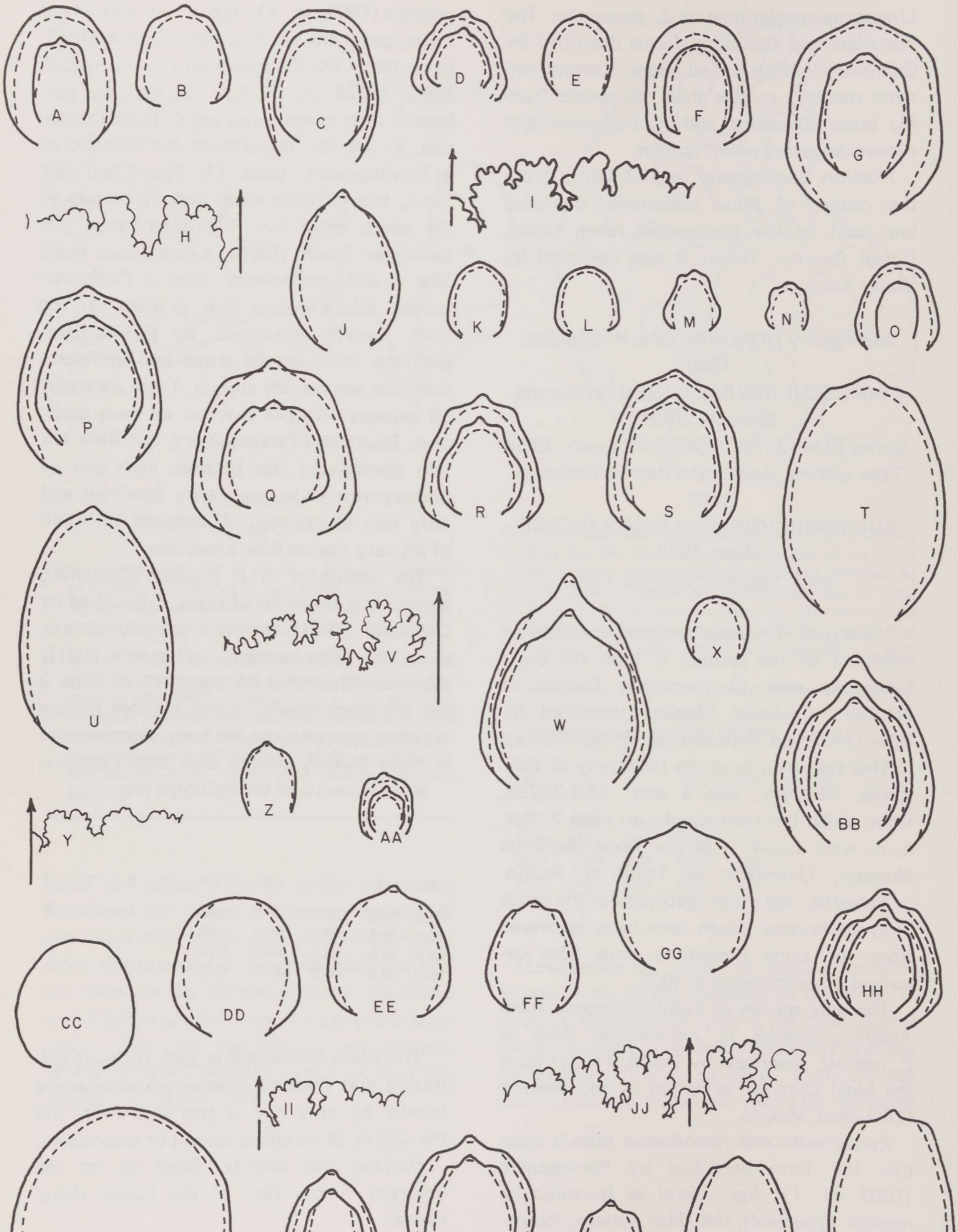
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FIGURE 11

a—Faraudiella sp. cfr. *F. rhamnonota* (Seeley); sections of UT-1350 *(see also* pl. 3, fig. 10 and pl. 5, figs. 13, 15), from about 5 ms below the top of the Georgetown Limestone, Barrow Branch, Austin, Travis County, Texas, collected by S. E. Clabaugh, X 1.

b—Stoliczkaia adkinsi Böse; section of UT-273 *(see also* pl. 2, figs. 23, 24) from 4.5 ms below the top of the Georgetown Limestone, Pease Park, Shoal Creek, Austin, Travis County, Texas, collected by K. Young, X 1.

c, e, f—Stoliczkaia crotaloides (Stoliczka); sections of *c,* UT-1433 *(see also* pl. 3, figs. 4, 5), from the Del Rio Formation; *e,* UT-41152, a cast of the specimen illustrated by Böse (1928, pl. 4, figs. 12, 13) as *Stoliczkaia uddeni,* from the Del Rio Formation, McLennan County, Texas, at a diameter of 20 mm., collected by W. S. Adkins; and *f,* of a cast ot the specimen illustrated by Böse (1928, pl. 4, figs. 14, 15) as *Stoliczkaia uddeni,* from the Del Rio Formation, McLennan County, Texas, at diameters of 30 and 45 mm., collected by W. S. Adkins; *all,* X 1.

d—Euhystrichoceras remolinense Böse; section of a plaster cast of the specimen illustrated by Böse (1928, pl. 9, figs. 13-15) *(see also* pl. 2, figs. 4, 5) from the Buda Limestone, El Remolino, district of Jìménez, Coahuila, Mexico, collected by Emil Böse, X 1

g—Faraudiella borachoensis, n. sp.; sections of UT-14515, the holotype *(see also* pl. 4, figs. 1-4), from the top of the Kent Station Limestone, San Martine Quadrangle, Reeves County, Texas, collected by Grant Moyer, X 1.

h, j, dd-jj,—Budaiceras hyatti (Shattuck). *h, hh,* suture and section of UT-18029 *(see also* pl. 8, figs. 16, 17) from the lower member of the Buda Limestone, Shoal Creek, Austin, Travis County, Texas, F. L. Whitney Collection; *j,* section of higher whorled variant, WSA-2345 *(see also* pl. 7, fig. 5), from the lower part of the Buda Limestone, Gray Hill, Agua Fria Quadrangle, Brewster County, Texas, collected by C. Gardley Moon; dd-gg, sections at diameters of 69, 60, 50, and 40 mm., and *jj,* suture of UT-18036 *(see also* pl. 7, figs. 7, 9, 11, and pl. 8, fig. 18), from the Buda Limestone, Austin, Travis County, Texas, F. L. Whitney Collection; *ii,* sections of UT-16743 *(see also* pl. 7, figs. 2-4, and pl. 8, fig. 15) at diameters of 50, 60, and 75 mm., from the lower member of the Buda Limestone, Shoal Creek, Austin, Travis County, Texas, F. L. Whitney Collection; *all* X 1.

i, w, z, mm, nn-rr—Budaiceras elegantior (Lasswitz); *i, pp suture and section of UT-1*8002 *(see also* pl. 9, figs. 5, 11, 12) from the lower member of the Buda Limestone, Manchaca, Travis County, Texas, F. L. Whitney Collection; *w, rr,* suture and section of UT-17836 *(see also* pl. 8, fig. 11), a high whorled variant from the Buda Limestone, Manchaca, Travis County, Texas, F. L. Whitney Collection; *z,* suture of UT-16755 *(see also* pl. 8, figs. 10, 12), from the Buda Limestone, Shoal Creek, Austin, Travis County, Texas; F. L. Whitney Collection; *mm,* suture of UT-957 *(see also* pl. 9, figs. 9, 10) from the Buda Limestone, Blanco River, Hays County, Texas; F. L. Whitney Collection; *nn,* sections of UT-14132-B *(see also* pl. 8, figs. 4-6) from the Buda Limestone, Shoal Creek, Austin, Travis County, Texas, F. L. Whitney Collection; *oo,* sections of UT-14132-A *(see also* pl. 8, fig. 9) from the Buda Limestone, Shoal Creek, Austin, Travis County, Texas, F. L. Whitney Collection; *qq,* section of UT-19829 *(see also* pl. 8, figs. 7, 8) at a diameter of 44 mm., from the nodular (middle) member of the Buda Limestone, 1.6 km. east of the junction of highways 41 and 377, Edwards County, Texas, collected by Roy T. Hazzard; *i,* X 2; *w, z, mm-rr* X 1.

k-o—Faraudiella archerae, n. sp.; sections of UT-16746, the holotype *(see also* pl. 6, figs. 3-9) at diameters of 29, 25, 20, and 15 mm., from 0.6 m. below the top of the lower member of the Buda Limestone, Round Rock, Williamson County, Texas, F. L. Whitney Collection, X 1.

p, y—juveniles of mantellicerids and/or lyellicerids; *p,* sections of UT-18007-B *(see also* pl. 6, fig. 11) at diameters of 10 and 15 mm., from the lower member of the Buda Limestone, Bear Creek, Travis County, Texas, F. L. Whitney Collection; *y,* section of UT-17374 *(see also* pl. 6, fig. 10) from the lower member of the Buda Limestone, Bear Creek, Travis County, Texas, F. L. Whitney Collection; *p,* X 2; *y,* X 1.

q-s, bb—Faraudiella roemeri (Lasswitz); *q,* sections of WSA-3478, a plaster cast of the holotype *(see also* pl. 6, figs. 27-30), at diameters of 40 and 67 mm., from the Buda Limestone, Shoal Creek, Austin, Travis County, Texas, specimen illustrated by Lasswitz (1904, pl. 6, fig. 3); *r,* sections of WSA-6088 *(see also* pl. 5, figs. 12, 16), from the nodular (middle) member of the Buda Limestone near Rock Springs, Edwards County, Texas, collected by Roy T. Hazzard, at diameters of 35 and 60 mm.; *s,* sections of UT-16760 *(see also* pl. 5, fig. 2, and pl. 6, figs. 1, 2) from 0.6 m. below the top of the lower member of the Buda Limestone, Round Rock, Williamson County, Texas, F. L. Whitney Collection; *bb,* sections of UT-18017-C *(see also* pl. 5, figs. 1, 6, 11) a juvenile specimen from the Buda Limestone, Shoal Creek, Austin, Travis County, Texas, F. L. Whitney Collection, at diameters of 14.5 and 21 mm.; *all* X 1.

t-v—Faraudiella texana (Shattuck); *t,* sections of UT-32977 *(see also* pl. 4, fig. 14), from the nodular (middle) member of the Buda Limestone, southern Van Horn Mountains, Jeff Davis County, Texas, collected by Page C. Twiss; *u,* section of UT-6115 *(see also* pl. 4, fig. 4 and pl. 5, fig. 10), from the nodular (middle) member of the Buda Limestone near Rock Springs, Edwards County, Texas, collected by Roy T. Hazzard; *v,* section of UT-18082 *(see also* pl. 5, fig. 8), from the lower member of the Buda Limestone, Blanco River, Hays County, Texas, F. L. Whitney Collection; *all* X 1.

x, cc—Budaiceras alticarinatum, n. sp.; *x,* sections of UT-18018 *(see also* pl. 9, figs. 1, 13, 17) at diameters of 65 and 72.5 mm., from the Buda Limestone, Central Texas, F. L. Whitney Collection; *cc,* sections of UT-19695, the holotype *(see also* pl. 9, figs. 2, 16), at diameters of 50, 60, and 75 mm., from the Buda Limestone on Sink Creek, Hays County, collected by Kenneth J. DeCook; *all,* X 1.

aa—Budaiceras sp. juv.; sections of WSA-6200 *(see also* pl. 9, figs. 6-8), from the nodular (middle) member of the Buda Limestone, at the intersection of highway 41 and the road to the Devils Sink Hole, Edwards County, Texas, collected by Roy T. Hazzard; X 2.

kk— Lewesiceras, n. sp.; section of UT-30495 *(see also* pl. 2, figs. 26, 27), from the Buda Limestone, Rubbrecher Ranch, Comal County, Texas, collected by Victor King, X 1.

Genus *PRIONOCYCLOIDES* Spath, 1925
Type species: *Ammonites proratus* Coquand, 1880

PRIONOCYCLOIDES sp. cf. *P. PRORATUM* (Coquand, 1880)
pl. 1, figs. 56-59, 67-69; text figs. 9c, 10a

cf. *Ammonites proratus* Coquand, 1880, p. 32
cf. *Mortoniceras proratum* Pervinquière, 1907 p. 237, pl. 11, figs. 5-12
cf. *Mortoniceras (?) proratum* Pervinquière, 1910, p. 66, pl. 6, figs. 20-28
cf. *Prionocycloides proratum* (Coquand) in Spath, 1925, p. 182; Wright, in Arkell, Kummel and Wright, 1957, p. L400, fig. 519-5;
Collignon, 1964, pp. 22, 24, pl. 322 figs. 1422, 1423
Prionocycloides sp. aff. *P. proratum* (Coquand) in Young and Powell, 1978 (in press) pl. 6, figs. 2-4
non Mortoniceras proratum (Coquand) in Scott, 1926, p. 212, plate 1, figs. 6′, 6″

Remarks.—The single specimen compared to *Prionocycloides* sp. cf. *P. proratum* (Coquand) from Rancho la Bamba is probably distorted. It has the median keel so typical of Coquand's species (Pervinquière, 1907, pl. 11, figs. 5-12; 1910, pl. 6, figs. 20-28). Spath (1925) cites Coquand (1854) as the correct reference, as does Wright (Arkell, Kummel and Wright, 1957). But the species is not mentioned in Coquand (1854). Pervinquière (1907, 1910) correctly cites Coquand (1880) as the first description of the species.

The specimen from Rancho la Bamba is flattened, and the keel has been extruded ventrad. In this respect one might suspect the specimen to be a juvenile specimen of *Graysonites* that has expanded under sedimentary load during pyritization, as explained by Kennedy and Hancock (1971). But none of the identifiable specimens of *Graysonites* from the same locality have suffered this phenomenon. The specimen is more coarsely ribbed, as in plate 11, figs. 10ab of Pervinquière (1907), but with the long, low, weak umbilical bullae of his plate 11, figs. 9ab. Collignon's (1964, pl. 322, figs. 1422, 1423) specimens do not seem to be crushed, and the whorl sections seem to be more normal than either mine or most of Pervinquière's. His *P. besairiei* (pl. 322, fig. 1324) has a stronger keel, stronger ribbing, and is less compressed.

The suture is like that published by Pervinquière (1907, p. 238, fig. 97), except that the E-element is much deeper, which might also indicate that the specimen is a distorted or aberrant juvenile of the genus *Graysonites.*

Horizon and locality.—Del Rio Formation, Rancho la Bamba, west flank of the Sierra Lágrima, northeastern Chihuahua, Mexico; lower part of the Lower Cenomanian.

Family FORBESICERIDAE Wright, 1952
Genus *FORBESICERAS* Kossmat, 1898
Discoceras Kossmat, 1895, *non* Barrande, 1867; *Cenomanites* Haug. 1898
Type species: *Ammonites largilliertianus* d'Orbigny, 1842

FORBESICERAS sp. cf. *F. BRUNDRETTEI* (Young, 1958)
pl. 1, figs. 73, 74

cf. *Neopulchellia brundrettei* Young, 1958, pp. 289-291, pl. 39, figs. 1-3, 26-28, 33, 35-38; pl. 40, figs. 6, 9, 11; text figs. 1fikm; Young, 1959b, p. 79, p. 81, figs. 4, 7, 8, p. 83, fig. 4; Young, 1960, p. 44, figs. 4, 7, 8, p. 46, fig. 4
cf. *Forbesiceras brundrettei* (Young) in Young and Powell, 1978 (in press), pl. 3, figs. 1, 2, 5

Remarks. –*Forbesicers brundrettei* (Young) is remarkably like the specimens of *F. obtectum* (Sharpe, 1853) illustrated by Pervinquiére (1907, pl. 5, figs. 7-10), except that the ribbing is more uneven, more falciform, and lacks the mid lateral tubercle so characteristic of *F. obtectum.* Furthermore, with

F. brundrettei there is less ontogenetic change in the ribbing, the tabulate venter being maintained into the adult, and the ribbing maintaining its form onto the adult, at which stage the whorl becomes a little wider compared to its height. The specimen illustrated on plate 1, figs. 73, 74, is somewhat flattened and was taken from a core. The strength of the ribbing may also have been reduced by the same sedimentary load that flattened the internal mold. There is no indication of a mid-flank tubercle, and for this reason the specimen is compared to *F. brundrettei* (Young).

Horizon and localities.—The specimen illustrated on plate 1, figs. 73 and 74 is from the Maness Formation, Smithers No. 1, Union Producing Co., Walker County, Texas, depth of 3747.5 meters; there are other specimens of similar preservation from the same horizon in the core. Still another specimen similar to *F. brundrettei* (Young) is from a sandstone in the Woodbine Formation, about 23 ms. above the top of the Del Rio Formation on Alligator Creek, 8.0 kms. westnorthwest of West, Hill County, Texas [Stop 10. East Texas Geol. Soc. field trip for 1951 (Adkins and Lozo, 1951, p. 147, fig. 21)].

Superfamily ACANTHOCERACEAE Hyatt, 1900

Family FLICKIIDAE Adkins, 1928

Genus *FICHEURIA* Pervinquière, 1910

FICHEURIA sp. aff. *F. PERNONI* Dubourdieu, 1953

pl. 2, figs. 6-11; text figs. 8ef

aff.: *Ficheuria pernoni* Dubourdieu, 1953, pp. 35-36, fig. 11, pl. 3, figs. 51-54; Wright, in Arkell, Kummel and Wright, 1957, p. L409 and fig. 527-2

Ficheuria sp. aff. *F. pernoni* Dubourdieu in Young and Powell (1978, in press) pl. 7, figs. 7-9, 11

Remarks.—*Ficheuria pernoni* Dubourdieu is much more globose than *F. kiliani* Pervinquière (1907); also the sutural elements are narrower. In these respects the two specimens from the Del Rio Formation resemble Dubourdieu's species more than Pervinquière's. The Mexican specimens differ from *F. pernoni* in the possession of a steeper umbilical wall and in the absence of the large undulations along the umbilical rim. The sutural elements of the Mexican form (text figs. 9ef) are almost identical with those of *F. pernoni* (Dubourdieu, 1953, p. 35, fig. 11).

Horizon and locality.—Two specimens of *Ficheuria* sp. aff *F. pernoni* Dubourdieu are from the Del Rio Formation, Rancho la Bamba, northeastern Chihuahua, Mexico.

Genus *ADKINSIA* Böse, 1928

Type species: *Adkinsia bosquensis* (Adkins, 1920

ADKINSIA BOSQUENSIS (Adkins, 1920)

pl. 1, figs. 46-55, 61-66; text figs. 10bcfg

Flickia (?) bosquensis Adkins, 1920, pp. 87-89, fig. 10, pl. 1, fig. 4, pl. 4, fig. 11

Adkinsia bosquensis (Adkins) in Böse, 1928, pp. 238, 240, 242-247, pl. 9, figs. 1-6.

Adkinsia adkinsi Böse, 1928, pp. 237-238, 240, 247, pl. 8, figs. 9-14

Adkinsia sparsicosta Böse, 1928, pp. 238-240, pl. 8, figs. 15-20

Adkinsia tuberculata Böse, 1928, pp. 240-242, 245, pl. 8, figs. 21-26;

Adkinsia semiplicata Böse, 1928, pp. 246-247, pl. 9, figs. 7-12

Remarks.--Originally tentatively assigned to the genus *Flickia* by Adkins (1920), Böse erected the genus *Adkinsia* for this group of fossils in 1928. Böse assigned five species, four of them new, to the genus *Adkinsia;* they were *Adkinsia bosquensis* (Adkins), *A. adkinsi* Böse, *A. sparsicosta* Böse, *A. tu-*

berculata Böse, and *A. semiplicata* Böse. Since all of these species occur together in some combination at one locality or another, and since there seem to be all gradations between them, I interpret them in totality as representing one extremely variable species, which may even be the naepionic stage of some unknown adult. All specimens are septate throughout and mouth edges and body chambers are unknow. *A. bosquensis* (Adkins) is more robust and has more tubercles thatn *A. knikerae,* n. sp.

Horizon and localities.–Adkinsia bosquensis (Adkins) occurs at many localities and several levels in the Del Rio Formation of Texas and northern Mexico, and the Grayson Formation of northern Texas. The specimens illustrated in pl. 1, figs. 46-55, 61-66, are from the Grayson Formation, 2.4 kms. west of Aquilla, Hill County, Texas.

ADKINSIA KNIKERAE, n. sp.
pl. 1, figs. 70-72

Holotype. UT-17388, from the Buda Limestone at 29th and Shoal Creek, Austin, Travis County, Texas, collected by F. L. Whitney.

Specific characters.-Conch with few whorls, regularly expanding; with umbilical walls sloping steeply into a narrow umbilicus; and with venter rounded. The whorl section is higher than wide, H/W ranging around 1.1. U ranges around 21.0. The greatest intertuberculate width is just ventrad of the umbilicus, and the greatest width is at the umbilical tubercle. Ornamentation consists of about six sharp tubercles that are large in relation to the size of the shell. Between the tubercles there are faint constrictions which cross the flanks, but play out before the venter. The holotype and only specimen is entirely septate, and the suture is simple, with siphonal and two lateral lobes and three lateral saddles. The second lateral lobe occurs barely dorsad of the umbilical tubercle; the third saddle is largely on the umbilical wall. The sutures are entirely simple with no frills on either saddles or lobes.

The aperture is unknown, and overlap is greater than 50 percent of the flank. The only specimen is entirely septate and there is no body chamber.

Measurements of the holotype are:

D	U	H	W	H/W
4.2	21.5	45.0	40.5	1.12
3.3	21.0	51.5	-----	------

Remarks.—In setting up the genus *Adkinsia* in 1928 Böse had five species, all of which I have included in *A. bosquensis* (Adkins, 1920). *Adkinsia knikerae,* n. sp., differs from Böse's original species far more than they differed from each other. Although *A. bosquensis* contains forms that range from smooth to tuberculate at the umbilicus, when tubercles are present there are around nine, either nodate or bullate. *A. knikerae* has six nodate umbilical tubercles that are larger in relation to the size of the shell than are those of *A. bosquensis.* The constrictions on the flanks of *A. knikerae* do not cross the venter, whereas the constrictions of *A. bosquensis,* although fainter, do cross the venter. *A. knikerae* is more discoid than *A. bosquensis.*

Horizon and locality.—The horizon and locality are the same as for the holotype.

Family LYELLICERIDAE Spath, 1921
Genus *STOLICZKAIA* Neumayr, 1875*

Type species: *Ammonites dispar* d'Orbigny, 1841, designated by Diener (1925)

Generic characters.—Conch with few whorls and umbilicus increasing in diameter with age; with umbilical walls sloping moderately steeply into a moderately narrow umbilicus.

*This paper was set before I received the May, 1978 issue of Palaeontology containing the paper on *Stoliczkaia* by C. W. Wright and W. J. Kennedy.

The umbilicus on the whorl containing the body chamber is even wider, the body chamber having a tendency to loosen (become subscaphitoid). The ribs are strong or weak, dense or sparse; peripheral tubercles appear on the midline in the juvenile and in the subgenus *Faraudiella* extend into the adult stage and onto the body chamber. The suture is acanthocerid with reduced elements.

Remarks. Breistroffer (1947) has separated from *Stoliczkaia* Neumayr, s. s., those species that have peripheral tubercles extending into the adult stage and onto the body chamber, and has applied to these species the generic name *Faraudiella,* here considered a subgenus of *Stoliczkaia.* The genus is listed as Upper Albian by Wright (Arkell, Kummel, and Wright, 1957, p. L410). Although this grouping provides an easy morphological classification for two subgenera of *Stoliczkaia, Stoliczkaia,* s. s., and *Faraudiella,* I am not convinced that all of the forms which I here assign to *Faraudiella* because of the morphological definition actually comprise a single lineage, or even a single phyletic tree within the genus. Thus the genus as I consider it may be polyphyletic, but this cannot be determined for certain as yet. Such a species as *S. (F.) archerae,* n. sp., may not belong to the same lineage as *S. (F.) blancheti* (Pictet and Campiche), the type species of *Faraudiella.*

The assumption in the present taxonomy is that the development of a greater number of peripheral tubercles than ribs, as in *Budaiceras,* and the disappearance of the ribs across the venter, involved more basic organic changes than did any increase or decrease in strength of costation or increase in size of umbilical or other tubercles.

In other words, in differentiating *Stoliczkaia* Neumayr, s. s., from *Faraudiella* Breistroffer only two characters are used: (1) the persistence of peripheral tubercles to a later growth stage, and (2) the persistence of an acute venter onto the whorl containing the body chamber. Even the second of these characters does not always hold for *Faraudiella roemeri* (Lasswitz), but most species of *Faraudiella* have peripheral tubercles and an acute venter persisting onto the whorl containing the body chamber. *Budaiceras* Böse is differentiated from both *Stoliczkaia* and *Faraudiella* by more basic and primary characters, namely *Budaiceras* does not have ribs across the venter, and it has developed a greater number of peripheral tubercles than ribs. However, the juveniles of some species of *Budaiceras* show the one-to-one ratio of peripheral clavi to ribs and only achieve the greater number of peripheral clavi beyond the juvenile whorls. The specimens Besairie (1936) assigned to *Budaiceras* have since been placed in *Neophlycticeras* as *N. madagascariense* (Besairie) and *N. spathi* (Besairie) (Collignon, 1963), the genus from which the *Budaiceras-Stoliczkaia* complex appears to have been derived.

Subgenus *STOLICZKAIA* Neymayr, 1875

Type species: Same as for the genus

Subgeneric characters.—This subgenus contains those species of *Stoliczkaia,* s. l., in which the peripheral tubercle or clavus is restricted to the juvenile whorls and does not extend onto the adult whorls, and in which the venter is more rounded and not acute.

STOLICZKAIA (STOLICZKAIA) CROTALOIDES (Stoliczka, 1864)
pl. 3, figs. 1, 2, 4-6, 8, 12, 14, 16, 17;
text figs. 11cef

Ammonites crotaloides Stoliczka, 1864, pp. 88-89, pl. 46, figs. 3, 3abc
Ammonites dispar d'Orbigny in Lasswitz, 1904, pl. 4, fig. 1 only
Hoplites texanus Cragin, 1893, pp. 235-236, pl. 4, figs. 1, 2
Stoliczkaia uddeni Böse, 1928, pp. 211-212, pl. 4, figs. 12-15; Adkins, 1928, p. 236
Stoliczkaia aff. *dispar* (d'Orbigny) in Böse, 1928, pp. 212-214, pl. 5, figs. I-5 (only)
Stoliczkaia texana (Cragin) in Adkins, 1928, p. 236; Young, 1959, p. 83, figs. 5-7; Young, 1960, p. 46, figs. 5-7; Young and Powell, in press, pl. 6, figs. 1, 16
(?) Stoliczkaia dispar (d'Orbigny) in Collignon, 1933, p. 60, pl. 6, fig. 1

Holotype.—By monotypy, the specimen illustrated by Stoliczka, 1864, pl. 46, figs. 3, 3abc.

Specific characters.—Conch with few whorls and with umbilicus increasing in size with increased diameter. The umbilicus is moderately narrow in the younger whorls, widening in later whorls, U ranging from 16 to 28 prior to a diameter of 60 mm. and from 23 to 38 at larger diameters. The umbilical wall is steep, meeting the previous flank at right angles. Whorl height is greater than whorl width, H/W probably ranging from around 1.05 to 1.3; however, the upper limits are difficult to judge, because different specimens show a wide range of compaction; height-width ratios exceeding 1.3 probably represent crushed specimens. The intercostal section is suboval at earlier diameters, becoming slightly subquadrate at greater diameters; in slightly crushed specimens this subquadrate shape, of the body chamber in particular, may be exaggerated. Beyond a diameter of 30 mm. the costal whorl section is nearly always subquadrate because of a heightening, and less often thickening, of the ribs ventrolaterally. This ventrolateral development of the ribs varies from specimen to specimen, being greater in the specimen illustrated on plate 3, figures 1 and 2 and on the individual figured by Stoliczka (1864, pl. 46, figs. 3, 3abc) and not so great on the specimen figured on plate 3, figures 13, 15.

Costation is coarse and strong, and on the earlier whorls there is usually one primary rib alternating with one secondary rib, which is intercalated. Near to and on the body chamber all ribs, or nearly all ribs, become primary and the ribs become even stronger. The number of ribs per volution ranges from around 18 to about 30. One specimen has 38, but it is an extreme example. Bifurcations at the umbilicus are rare, and the number of primary ribs exceeds the number of secondary ribs. Ribs cross the venter prominently, and extend over the umbilical shoulder and down the umbilical wall to the umbilical seam. On the outer whorls and on the body chamber the intercostae are one and one-half to two times the width of the costae. On earlier whorls costae and intercostae are about equal in width.

No juveniles are small enough to reveal the peripheral tubercles presumed to be present, and the marly matrix of the Del Rio Formation does not allow the excavation of earlier whorls. On no specimens are the body chambers complete, and there is no record of mouth edges except on Stoliczka's holotype, where a mouth edge appears to be preserved. Also, because of the marly softness of the Del Rio Formation, the sutures cannot be recovered. It is assumed from experience in this group of ammonites that the heavier, sparser costation on the adult whorls is either near or on the body chamber.

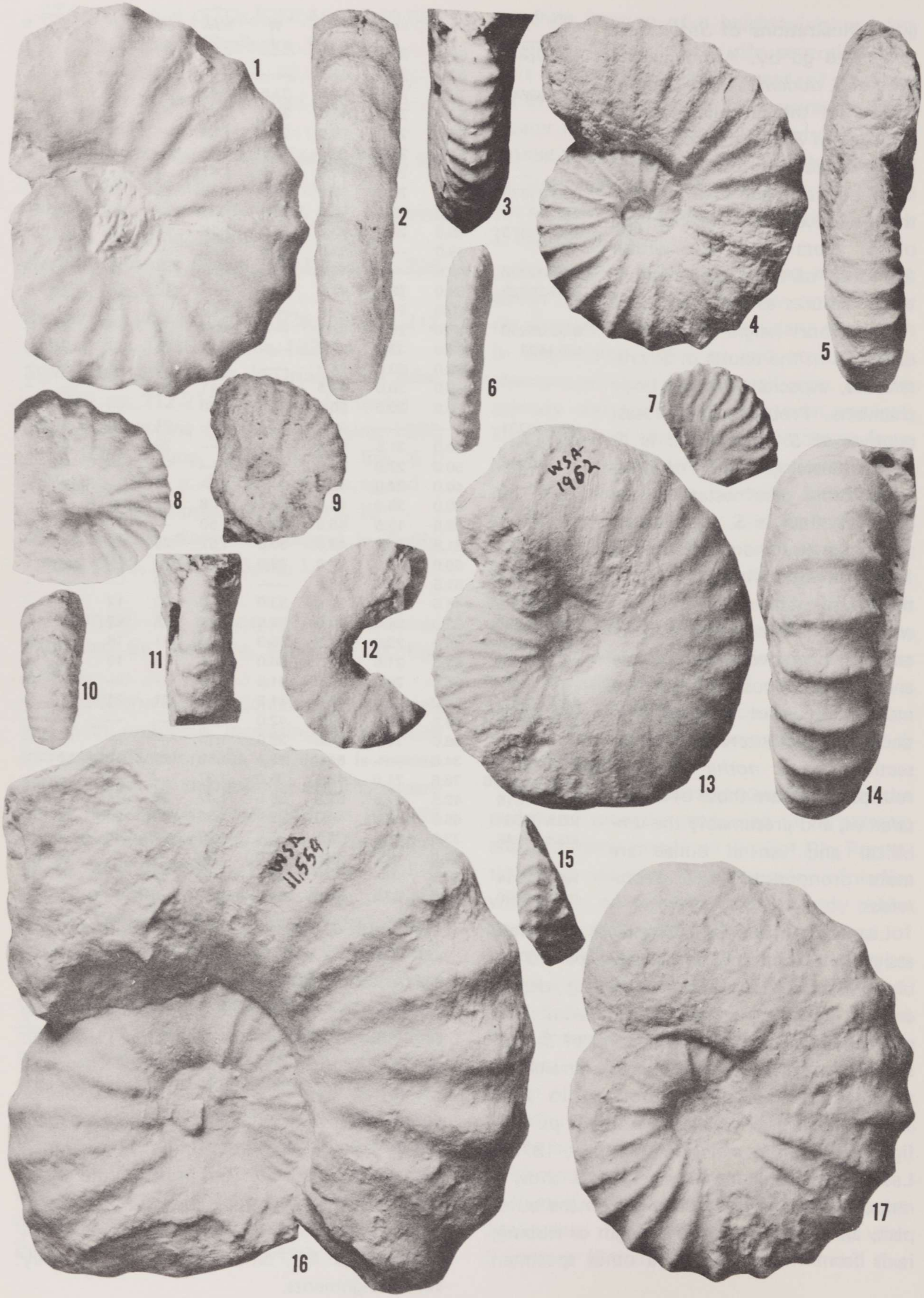
Measurements are shown on page 43.

Remarks.—Breistroffer (1947, p. 88) places *Stoliczkaia uddeni* Böse in synonymy with *S. texana* (Cragin), even though he had few good illustrations of *Stoliczkaia texana* to go by. Although the type of *S. uddeni* is more densely costate in the juveniles than is the type of *S. texana,* specimens in the collection show a complete range between, and even beyond, these two extremes, and the type of *S. crotaloides* falls within the range of these specimens in these features as well as others.

The whorl height-width ratio decreases in the adults of *S. crotaloides,* especially on the body chambers. Probably the closest relative of *S. crotaloides* is *S. notha* (Seeley), but *S. notha* is much more densicostate in the juveniles than is *S. crotaloides,* and has many more intercalated and bifurcated ribs per whorl in the juvenile stages. On the adult whorls *S. notha,* like *S. crotaloides,* becomes more strongly and sparsely costate. Furthermore, the whorl sections, particularly the intercostal whorl sections, of *S. notha* are more rounded than are those of *S. crotaloides,* and presumably the umbilical and ventral bullae are more pronounced in *S. crotaloides.*

	D	U	H	W	H/W	T	P	S	B
Holotype	60.0	30.0	36.5	------	------	23	20	1	1
	50.0	28.0	40.0	------	------	23	?	?	?
WSA-9864	70.0	28.5	44.5	31.5	1.41	24	20	4	--
	57.0	23.0	47.5	37.0	1.29	----	----	----	--
	38.0	21.0	50.0	37.0	1.36	----	----	----	--
UT-30644	57.0	23.0	44.0	35.0	1.26	----	----	----	--
	40.0	21.5	51.5	35.0	1.47	----	----	----	--
BEG-21579	45.0	26.5	43.5	33.5	1.30	22	13	5	2
	30.0	23.5	45.0	33.5	1.35	----	----	----	--
BEG-21573	30.0	20.0	43.5	37.0	1.18	28±	14	14	--
	19.0	------	58.0	45.0	1.30	----	----	----	--
WSA-12478	45.5	------	43.0	28.5	1.50	----	----	----	--
BEG-35225	69.0	29.0	41.5	------	------	18	17	1	--
	60.0	21.5	------	------	------	----	----	----	--
BEG 35210	38.0	26.5	39.5	------	------	21	16	5	--
UT-1433	65.0	37.5	37.0	------	------	25	16	9	--
	50.0	23.0	44.0	------	------	25	14	11	--
	40.0	20.0	47.5	33.5	1.41	----	----	----	--
	30.0	20.0	50.0	33.5	1.50	----	----	----	--
BEG-19731	------	------	------	------	------	21	16	5	--
UT-17377	60.0	31.5	41.5	------	------	20	12	8	--
	50.0	27.0	40.0	------	------	----	----	----	--
	40.0	24.0	40.0	------	------	----	----	----	--
WSA-1961	60.0	35.0	41.5	32.5	1.28	22	19	3	--
	48.5	19.5	46.5	31.0	1.50	----	----	----	--
UT-30642	61.5	22.0	49.0	30.0	1.62	26	22	4	--
UT-41281	66.0	32.0	37.0	28.0	1.32	22	11	----	--
UT-44581	51.5	18.5	43.0	------	------	22	----	----	--
UT-41272	48.5	29.0	39.0	33.0	1.19	20	12	8	--
UT-30643	62.0	24.0	40.5	27.5	1.47	28	22	6	--
WSA-13214-B	46.0	23.0	44.5	25.0	1.78	21	18	2	1
WSA-13146	51.5	21.5	46.5	36.0	1.28	28	19	1	4
	34.0	20.5	53.0	41.5	1.29	----	----	----	--
WSA-9799	54.0	28.0	43.5	31.5	1.38	21	21	----	--
WSA-13214-A	52.5	20.0	47.5	42.0	1.14	----	----	----	--
	36.0	16.5	44.5	39.0	1.14	----	----	----	--
WSA-13145	34.0	------	51.5	32.5	1.59	28	16	12	--
WSA-13142-B	76.5	21.0	48.5	35.0	1.37	----	----	----	--
WSA-12516	42.5	17.5	52.0	35.5	1.42	38	14	24	--
WSA-6036	68.5	22.0	44.0	32.0	1.36	31	19	12	--
WSA-11048	73.0	25.5	38.5	35.5	1.07	21	18	3	--
	56.0	17.0	48.5	40.0	1.20	----	----	----	--
WSA-12514	54.5	------	------	39.5	------	30	20	10	--
WSA-12496	65.6	23.0	46.5	36.5	1.27	----	----	----	--

Lasswitz's (1904, pl. 4, figs. 2ab) specimen, assigned by him to *Stoliczkaia dispar* (d'Orbigny), has the change in ribbing (e.g., denser on the juveniles, coarser on the adults) so characteristic of many specimens of *S. crotaloides,* but the ribs are much straighter, as in the form assigned by Stoliczka to *"Ammonites" dispar* (Stoliczka, 1864, pl. 45, figs. 1, 1a [= *S. clavigera* Neumayr, 1875]. Lasswitz's specimen, however, does show a reduction of the body chamber on the outer part, also with decreased strength of ribbing; it is from India. Lasswitz's other specimen (1904, pl. 4, fig. 1) belongs to *S. crotaloides,* but Lasswitz's illustrations are not always to be trusted. A specimen which may be closely related to *Stoliczkaia crotaloides* is the specimen illustrated by Collignon (1933, pl. 6, fig. 1) as *Stoliczkaia dispar.* Kossmat's (1898, pl. 24, fig. 2) illustration of *S. dispar* agrees very well with that of Lasswitz mentioned above, also from India, but is much less coarsely costate. Of most of the specimens outside of Europe assigned to *Stoliczkaia dispar,* Kossmat's and Stoliczka's (1964 pl. 46, figs. 1-2, only) seem to be the only valid assignments.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WSA 1962

Over 30 specimens of *S. crotaloides* (Stoliczka) from the Del Rio, Grayson, and Buda formations are known to the writer.

Horizons and localities.—One specimen of *S. crotaloides* (Stoliczka) is known from the top of Main Street Limestone in Bell County, basal Cenomanian. Other specimens are from the Del Rio, Grayson, and Buda formations, ranging from the Red River on the north of Texas south to Monclova, Coahuila, Mexico, and all along the central Texas outcrop of these formations. Interestingly enough, no specimens of this species have been recovered from west Texas, Trans-Pecos Texas, or adjacent Chihuahua. *S. crotaloides* ranges through the entire Lower Cenomanian, zones of *Graysonites adkinsi, G. lozoi,* and *Budaiceras hyatti.*

STOLICZKAIA (STOLICZKAIA) ADKINSI Böse, 1928

pl. 2, figs. 15-25; pl. 3, figs. 9, 10;
text figs. 9o, q, 11b

Stoliczkaia adkinsi Böse, 1928, pp. 193-198, pl. 18, figs. 9-17; Adkins, 1928, p. 236, pl. 20, fig. 15, pl. 21, fig. 4

Holotype.—The holotype is the specimen illustrated by Böse (1928, pl. 18, figs. 9-13). It is from the Pawpaw Formation in Tarrant County, Texas, and was collected by W. S. Adkins; it is reillustrated in this paper on plate 2, figures 15, 16, 20, 21, and text fig. 9q. It is deposited with the Texas Memorial Museum, The University of Texas at Austin.

Specific description.—Conch is with few whorls, umbilicus opening rapidly, with umbilical walls sloping into an umbilicus of moderate width. U ranges from around 11 to about 20 at diameters of less than 30 mm, and from 21 to 30 at greater diameters. The ratio of whorl height to width at diameters of less than 30 mm ranges from about 1.25 to about 1.35, but at greater diameters the whorl height is 1-2/3 to 1-3/4 that of its width, H/W ranging from 1.6 to 1.85. The whorl section is higher than wide, consequently, and narrows ventrad; the greatest width both costally and intercostally is just ventrad of the umbilicus. The number of ribs per volution ranges from 26 to 34, and the ribs are slightly flexed and faintly projected.

PLATE 3

Figs. 1, 2, 4-6, 8, 12, 14, 16, 17—*Stoliczkaia crotaloides* (Stoliczka); *1, 2,* ventral and lateral views of BEG-36225, a cast of the specimen illustrated by Böse (1928, pl. 5, figs. 1-3) as *Stoliczkaia* aff. *dispar* d'Orbigny, collected by Emil Böse. The specimen has been crushed by sedimentary load and is from the Del Rio Formation at El Oregano, on the road to San Carlos, District of Jiménez, Coahuila, Mexico; *4, 5,* lateral and ventral views of UT-1433 *(see also* text fig. 11c), from the Del Rio Formation, slightly flattened by sedimentary load; F. L. Whitney Collection; *6, 12,* ventral and lateral views of BEG-35210, a cast of the specimen figured by Böse (1928, pl. 5, figs. 4, 5) as *Stoliczkaia* sp. aff. *S. dispar* (D'Orbigny) from near El Orégano, region of Jiménez, Coahuila, Mexico, collected by Emil Böse; specimen is crushed by sedimentary load; *8,* lateral view of UT-41152, a cast of the specimen illustrated by Bose (1928, pl. 4, figs. 12, 13) as *Stoliczkaia uddeni (see also* text fig. 11e), from the Del Rio Formation, McLennon County, Texas, collected by W. S. Adkins; *14, 17,* ventral and lateral views of WSA-9846, an uncrushed specimen from the Grayson Formation, near Hemming, Cooke County, Texas; *16,* lateral view of a large specimen, WSA-11559, from the Grayson Formation, Little Mineral Creek, Grayson County, Texas, collected by W. S. Adkins. *All* X 1.

3, 11, 13—*Faraudiella* sp. cf. *F. rhamnonota* (Seeley); *3, 13,* ventral views of WSA-1962 *(see also* text fig. 9i) from the Denton Formation, near Belton, Bell County, Texas, collected by W. S. Adkins; *11,* ventral view of UT-1350 *(see also* pl. 5, figs. 13, 15, & text fig. 11a), from about 5 ms below the top of the Georgetown Limestone, Barrow Branch, Austin, Tx., collected by S. E. Clabaugh; *all,* X 1.

9, 10—*Stoliczkaia adkinsi* Bose; lateral and ventral views of UT-14466 *(see also* text fig. 9p), from 4.5 ms below the top of the Georgetown Limestone, Pease Park, Shoal Creek, Austin, Texas; collected by K. Young, X 1.

7, 15—*Faraudiella franciscoensis* (Kellum and Mintz); lateral and ventral views of WSA-6202, from the nodular (middle) member of the Buda Limestone, at intersection of highway 41 and the road to the Devil's Sink Hole, Edwards County, Texas, collected by Roy T. Hazzard; X1.

At diameters preceding 20 mm. the ribs are rounded, but may become sharper by the 30 mm. diameter, with the orad flanks steeper than the aborad flanks. No umbilical tubercles can be defined, but there are ventrolateral tubercles and median tubercles, which are faint on these juveniles, and the larger specimens, such as UT-273 (pl. 2, figs. 23, 24) illustrate the disappearance of the median and ventrolateral tubercles prior to any non-septate stages. The tubercles are distinct, but very small. Since the known specimens of this species are entirely septate, nothing can be said concerning the aperture, and a decent suture has yet to be reproduced, although Böse tried to paint the sutures in on his specimens (1928, pl. 9, figs. 9-17); Böse's specimen shows a narrow ventral lobe, a wide first lobe, and rather reduced elements on the suspensive lobe.

Measurements are:

	D	U	H	W	H/W	T	P	S	B
Bose, pl.	28.0	19.5	45.5	35.5	1.25	---	---	---	---
8, figs.	19.0	18.5	50.0	37.0	1.36	---	---	---	---
9, 13	13.5	18.5	48.0	37.0	1.36	---	---	---	---
UT-	30.0	26.5	51.5	40.0	1.29	---	---	---	---
14466	25.0	11.0	50.0	38.0	1.32	29	13	16	---
UT-17	54.5	21.0	52.5	28.5	1.83	32	15	17	---
UT-273	29.5	17.0	45.5	39.0	1.17	26	14	12	---

Remarks.—Böse (1928) has discussed in detail the relationship of the juveniles of *Stoliczkaia adkinsi* to other species known to him. As pointed out above, there is nothing that can be called a true umbilical tubercle; however, Böse put it nicely in saying the primary ribs have a slight radial swelling on the umbilical border. Böse described the intercalation of the ribs in much more detail than can be useful at the specific level. He also described the intercostae as being much wider than the costae, but this appears to depend on how you look at them, and on how the light was reflected from his particular specimens; in the notations I use the costae and intercostae appear to be about the same width. Böse points out that all of the specimens illustrated by Pictet and Campiche (1859) are much more densicostate than *S. adkinsi,* but that otherwise the smaller whorl of figure 3 of Pictet and Campiche is very similar to his specimen. The Pictet and Campiche illustrations do not show the faint swellings at the ventrolateral position that is so typical of *S. adkinsi.* Böse also suggested that his specimen is close to the original one from India, but that the Indian species is also more densicostate. Presumably Kossmat's (1898, pl. 24, fig. 2) is the Indian example of *Stoliczkaia dispar* d'Orbigny to which Böse referred. It is more densicostate than *S. adkinsi,* and at least in the visible whorls, the ribs are completely rectiradiate and not projected. *Stoliczkaia argonautiformis* (Stoliczka, 1864) is also much more densicostate than either *S. dispar* or *S. adkinsi. Ammonites dispar* as illustrated in Stoliczka (1894, pl. 45, figs. 1, 1a [= *Stoliczkaia clavigera* Newmayr, 1875] could be somewhat closer to *S. adkinsi,* but there is no sign of the median tubercle at the smallest diameter illustrated by Stoliczka, and the ribbing does not seem quite so flexed. *Stoliczkaia dispar,* as illustrated by Scott (1926) [= *S. scotti* Breistroffer, 1936b], is likewise much more densicostate and also comes from a younger level.

Horizon and localities.—Böse was killed in an automobile accident before his paper on the Cretaceous ammonites (1928) was in proof. In his description of *Stoliczkaia adkinsi* he states that he had one specimen from the Glen Garden Country Club at Fort Worth, Texas; he further said that it was from the Pawpaw clay, and represents the highest Albian. However, Böse was in Nuevo Laredo when he wrote the manuscript and apparently he did not have all of the specimens. Adkins prepared plate 18 of the University of Texas Bulletin 2748, and Adkins had other specimens of *S. adkinsi,* which he included on the plate without Böse's knowledge. Although the rapport between Adkins and Böse was good, Böse died without the opportunity of proofreading either text or plates. Nevertheless, adherence to the written word, insofar as possible, is necessary. Thus, in addition to the Glen Garden Country Club, two other specimens are also illustrated in Böse's paper, both from south of Fort Worth, Tarrant County, Texas, on Sycamore Creek. A further specimen, UT-14466, is from the *Drakeoceras drakei* zone on Shoal Creek at Pease Park, Austin, Travis County, Texas. This level is approximately five meters below the top of the Georgetown Limestone. A sewer line now passes through this small outcrop and the *Drakeoceras drakei* zone is no longer exposed at the Pease Park locality; according to Young (1959b) this locality correlates with some part of the lower part of the Pawpaw Formation of north Texas. The horizon should be the highest Albian, as indicated by Böse (1928), since it is about 0.3 m. below the base of the zone of *Plesioturrilites brazoensis* at Austin.

STOLICZKAIA (STOLICZKAIA) SCOTTI
Breistroffer, 1936
pl. 7, fig. 11; pl. 8, figs. 10, 11, 15, 17, 23; pl. 9, figs. 13, 14; text fig. 10de

Stoliczkaia dispar (d'Orbigny) in Scott, 1926, p. 141, pl. 3, figs. 3, 4 *non* d'Orbigny

Stoliczkaia aff. *dispar* (d'Orbigny) in Böse, 1928, pl. 5, figs. 6-8 only

Stoliczkaia sp., Adkins, 1928, p. 236

Stoliczkaia dispar (d'Orbigny) *scotti* Breistroffer, 1936b, p. 24

Stoliczkaia scotti Breistroffer, 1947, p. 88

Stoliczkaia scotti Stoyanow, 1949, p. 129, pl. 26, figs. 7, 8

Stoliczkaia patagonica Stoyanow, 1949, p. 128, 129, pl. 26, figs. 3, 4

Stoliczkaia excentrumbilicata Stoyanow, 1949, p. 128, pl. 26, figs. 5-6

Holotype. Breistroffer failed to designate a holotype, but otherwise gave distinguishing features and cited the proper references and figures. The larger of Scott's specimens (1926, pl. 3, fig. 3) is herein designated the lectotype of *S. scotti.* Stoyanow (1949) did not know of Breistroffer's name, and he accidentally applied the name *scotti,* also named for Gayle Scott, to the same species. Stoyanow did designate a holotype, but it is my understanding (Stoll, et al., 1961) that the lectotype must come from the original suite.

Remarks.--*Stoliczkaia scotti* is a densely costate species, retaining the costation to adult stages. The Texas specimens have all been flattened by sedimentary load, but the specimens illustrated by Stoyanow (1949) on plate 26, figures 3-8, seem to have retained an original shape. If this is correct, then U should be around 12 to 18 and the whorl height-width ratio should run from 1.05 to 1.30. Sutures cannot be recovered, and none of the specimens can be shown to have body chambers. The number of ribs per volution ranges from 36 to 56.

Measurement of several specimens are shown on page 48.

It is amazing that two authors should name, independently, the same species in honor of the same person, Gayle Scott. In fact, the resemblance of Scott's (1926, pl. 3, figs. 3, 4) to Stoyanow's specimens indicates that part of the Molly Gibson Formation is Lower Cenomanian. Although the ribbing, and particularly the long umbilical bullae, are reduced in the specimens from the Del Rio and Grayson Formations, it is normal for the ornamentation of fossils from marly formations to have the ornamentation depressed by sedimentation and compaction, whereas the ornamentation is not degraded in many limestones, particularly the sparites.

Horizon and localities.–Scott's specimens of *Stoliczkaia scotti* Breistroffer are from the Grayson Formation on Denton Creek, near Roanoke, Denton County, Texas. Böse's

(1928, pl. 5, figs. 6-8) specimens are from the Del Rio Formation, 4.9 km. from El Orégano, on the road to San Carlos, Coahuila, Mexico. Stoyanow's specimens are from the upper part of the Molly Gibson Formation, west of the Molly Gibson Mine, Patagonia Mountains, Arizona. Other specimens are from the uppermost Grayson Formation near Pilot Point and near Roanoke, Denton County, Texas; from the Del Rio Formation north of Round Rock, Williamson County, Texas; from the Buda Limestone (basal) on Onion Creek, Travis County, Texas; from the Buda Limestone at San Rafael, northern Coahuila, Mexico, and from the Del Rio Formation, Sierra del Carmen, northern Coahuila, Mexico.

Subgenus *FARAUDIELLA* Breistroffer, 1947

Type species: *Ammonites blancheti* Pictet and Campiche (1859), by original designation of Breistroffer (1947)

Remarks. The presumed relations of *Faraudiella* to other late lyellicerid genera is given in fig. 12. *Faraudiella* is distinguished from *Stoliczkaia,* s. s., by the retention of the peripheral tubercles to or onto the body chamber, and by usually possessing a more acute venter, at least prior to the body chamber, although this feature is lost in some of the late Early Cenomanian species. The presumed evolution of American species of *Faraudiella* is given in fig. 13.

F. blancheti (Pictet and Campiche) has reduced ribbing on the flanks, much as in *Stoliczkaia dispar,* but most species of the subgenus do not have weak or effaced ribbing on the flanks. The subgenus is usually taken as representing the latest Albian in the boreal province, but Breistroffer (1947, p. 89) records *F. blancheti* from his late Vraconian.

	D	U	H	W	H/W	T	P	S	B
UT-47893	21.0	16.5	38.0	21.5	1.78	44	--	--	–
WSA-6032	39.0	14.1	46.0	33.5	1.38	36	?	?	?
WSA-16205	31.5	------	------	28.5	------	42	?	?	?
UT-18133	32.5	------	------	26.0	------	42	?	?	?
UT-46879	23.5	12.8	49.0	------	------	38	?	?	?
UT-10536	25.5	17.7	47.0	------	------	40	?	?	?
UT-47892	25.5	21.5	47.0	23.5	2.00	40	?	?	?
UT-47890	21.5	23.0	49.0	------	------	42	?	?	?
	16.5	24.5	42.5	------	------	----	--	--	--
UT-47891	19.0	23.5	44.5	26	1.70	----	--	--	--
UT-47889	25.0	16.0	48.0	24.0	2.00	42	?	?	?
STOYANOW'S SPECIMENS									
PT-23	53.0	17.0	44.5	22.0	2.00	50	18	32	--
PT-32	66.0	------	47.0	27.5	1.72	----	----	----	--
PT-51	26.0	------	47.0	38.5	1.20	----	----	----	--
PT-01	24.0	18.0	58.4	46.0	1.27	44	12	32	--
PT-10	45.0	18.0	42.0	38.0	1.06	56	15	41	--

Certainly the subgenus is well represented in the Early Cenomanian of the Tethyan, especially in Texas, where *Stoliczkaia,* s. s., also extends into the later Early Cenomanian.

STOLICZKAIA (FARAUDIELLA)
sp. cf. *S. (F.) RHAMNONOTA* (Seeley, 1865)
pl. 3, figs. 3, 10, 13; pl. 5, figs. 13, 15
text figs. 9i, 11a

cf. *Ammonites rhamnonotus* Seeley, 1865, p. 233, pl. XI, fig. 7, and synonymy given by Spath, 1931, p. 333

Holotype.–The holotype of *Faraudiella rhamonota* (Seeley) is the specimen described by Seeley (1965) and figured by Spath (1931) as text figure 109c; it is from the Upper Albian, and questionably the *dispar* zone.

Remarks.–The specimens herein illustrated as *Faraudiella* sp. cf. *F. rhamnonota* (Seeley) could well belong to that species. The Texas specimens are not as densicostate as the specimens illustrated by Spath (1931, text fig. 9c, pl. 31, figs. 4, 7, 9, 12ab, and pl. 32, fig. 8); furthermore, the Texas specimens are generally less densicostate than *Faraudiella scotti* and are higher whorled than most Texas species of *Faraudiella,* except *F. texana* (Shattuck). *F. texana* has straighter ribs and the ribs are more accented on the venter, which is less rounded.

Measurements of three specimens are:

	D	U	H	W	H/W	T	P	S	B
WSA-12512	36.0	26.5	------	------	------	26	--	----	--
UT-1350	50.0	18.0	47.0	30.0	1.57	23	9	14	--
	40.0	------	51.0	------	------	----	--	----	--
	21.0	------	62.0	40.5	1.53	----	--	----	--
UT-1962	63.0	21.5	48.0	29.0	1.65	32	?	?	--
	38.0	12.0	50.0	30.0	1.66	----	--	----	--

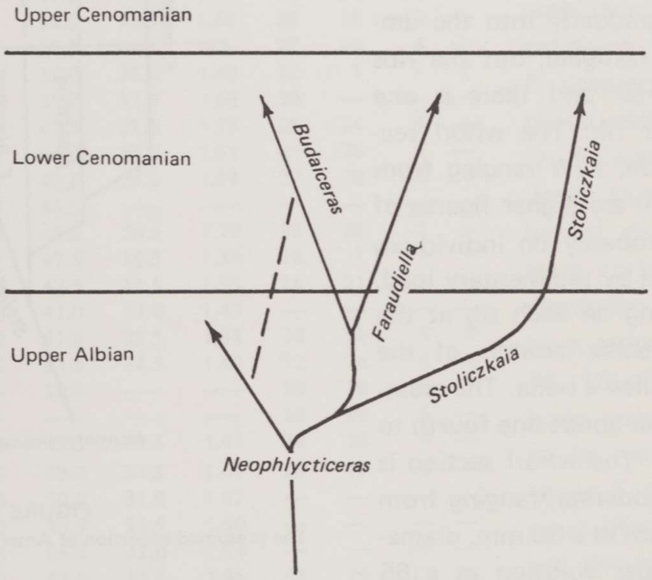

FIGURE 12

The presumed evolution of late Albian and Lower Cenomanian lyellicerid genera.

Horizons and localities.—UT-1350 is from the *Drakeoceras drakei* zone, from about 4.5 ms. below the top of the Georgetown Limestone on Barrow Branch, east side of Balcones Drive, about 200 ms. north of 35th Street, Austin, Travis County, Texas. WSA-12512 is from the Main Street Limestone, probably the *Drakeoceras drakei* zone at the Love Farm southwest of Salado, Bell County, Texas. WSA-1962 is from the Denton Formation, probably the zone of *Mortoniceras wintoni,* near Belton, Bell County, Texas.

STOLICZKAIA (FARAUDIELLA) TEXANA (Shattuck, 1903)

pl. 4, figs. 4-14; pl. 5, figs. 4, 5, 8-10
text figs. 11tuv

Barroisiceras texanum Shattuck, 1903, p. 35, 36, pl. 25, figs. 1, 2

Schloenbachia frechi Lasswitz, 1904, p. 9, 10, 28, pl. 6, figs. 6ab

Schloenbachia frechi var. *curvata* Lasswitz, 1904, pp. 9, 10, 28, pl. 6, fig. 7

Schloenbachia haberfellneri Lasswitz, 1904, pp. 9, 10, 28-29, pl. 8, fig. 3 *(non* von Hauer, 1866)

Budaiceras texanum (Shattuck); Adkins, 1928, p. 237; Wright, in Arkell, Kummel and Wright, 1957, p. L410 , figs. 530-5abc, 554-c

Budaiceras frechi (Lasswitz); Adkins, 1928, p. 237

Budaiceras frechi var. *curvata* (Lasswitz); Adkins, 1928, p. 237

Budaiceras sp. Adkins, 1928, p. 237

Holotype.—The holotype is the specimen illustrated by Shattuck (1903, pl. 25, figs. 1 and 2); it is in the United States National Museum, Washington, D. C.

Specific characters.-Conch with few whorls and moderately wide umbilicus in later whorls. The umbilicus is moderately narrow on specimens prior to the 20 mm. diameter. U ranges from 14.5 to 28. The umbilicus expands rapidly onto the body chamber and the umbilical wall slopes gradually into the umbilicus. The venter is fastigate, but the ribs extend across the venter and there is one peripheral tubercle per rib. The whorl section is higher than wide, H/W ranging from around 1.3 to 1.6; there are higher figures of H/W, but these are probably on individuals that have been flattened by sedimentary load. There is a slight swelling on each rib at the umbilicus, which by some stretch of the imagination might be called a bulla. The greatest intercostal width is at about one fourth to one third of the flank. The whorl section is suboval. Costation is moderate, ranging from 23 or so ribs per volution at a 30 mm. diameter to 40 ribs or so per volution at a 65 mm. diameter. However, the average at a 60 mm. diameter might more closely approach 28 to 30. On some specimens as many as half of the ribs are intercalated; on other specimens only a few ribs are intercalated. On a few specimens the ribs do not intercalate completely, but only appear across the venter; on such specimens there may even be a peripheral tubercle without a rib, and these specimens seem to lead to species of *Budaiceras,* but no real, complete transitions have ever been collected. Generally there is one ventral tubercle per rib and one ventrolateral tubercle per rib. On several small specimens, on which the juvenile could be observed, the ribs are absent on the first half of the flank prior to a 15 mm. diameter. Ventral tubercles first appear between diameters of 10 and 15 mm., but there are small projected shoulder tubercles at earlier diameters, much as in many species of *Mantelliceras* and *Stoliczkaia*. Tuberculation onto the adult then consists of slightly clavate ventral tubercles on the midline and ventrolateral tubercles at the shoulders. The aperture is unknown. The absence of ribs on the inner part of the flank prior to the 15 mm. diameter also shows up on the specimen illustrated by Lasswitz (1904, pl. 6, fig. 7).

There are about 100 specimens of *Faraudiella texana* (Shattuck) that have been examined in the collections at the University of Texas. Several are well preserved, but none possesses an aperture. Overlap is to dorsad of the first one-third of the flank.

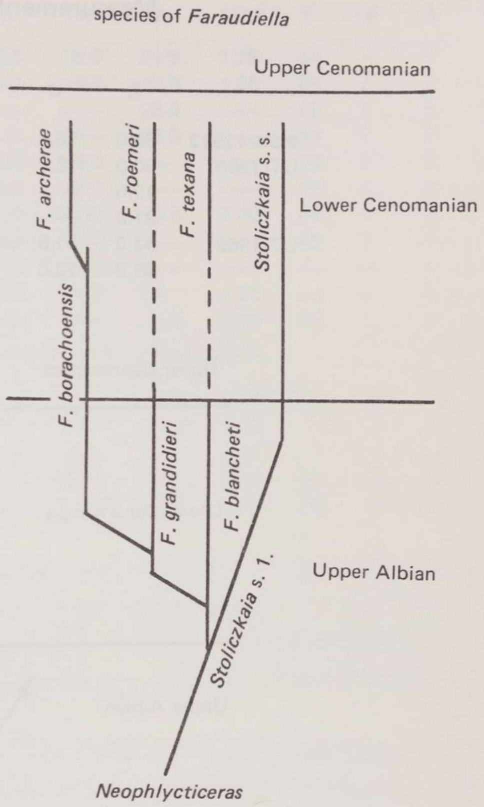

FIGURE 13
The presumed evolution of American species of *Faraudiella.*

Measurements are:

	D	U	H	W	H/W	T	P	S	B
UT-1535	123.0	24.5	38.5	20.3	1.90	---	---	---	---
	113.5	21.0	41.0	22.0	1.85	---	---	---	---
	72.0	24.5	57.0	-----	-----	---	---	---	---
UT-30542	86.0	21.5	49.0	28.5	1.72	32	25	7	---
UT-18082	80.0	15.0	49.5	28.0	1.75	29	23	6	---
UT-6264	101.5	21.5	48.0	-----	-----	30	26	4	---
WSA-6118	35.5	24.0	45.0	-----	-----	30	22	8	---
UT-8297	37.0	20.0	49.0	-----	-----	27	23		---
UT-10594	79.0	27.0	40.5	26.5	1.52	32	?	?	?
WSA-275-D	61.0	21.5	47.5	29.5	1.61	36	26	10	---
UT-47886	59.0	22.0	47.5	-----	-----	36	28	8	---
UT-18013	57.0	19.5	55.5	33.5	1.66	28	18	10	---
UT-43336	54.5	18.5	50.5	-----	-----	28	24	4	---
WSA-697-A	26.0	-----	52.0	36.5	1.42	32	?	?	?
WSA-10562	51.0	23.5	51.0	31.5	1.63	30	---	---	---
UT-45713	63.5	17.5	47.5	27.5	1.71	28	24	4	---
WSA-6111	67.0	27.5	44.0	29.0	1.51	27	20	7	---
UT-16753	42.0	19.0	45.5	28.5	1.58	27	20	5	1
UT-18064	66.0	21.5	48.5	-----	-----	---	---	---	---
WSA-4230	62.5	24.0	45.0	26.5	1.70	30	28	2	---
UT-18017-C	21.0	14.5	47.5	35.5	1.33	28	?	?	?
UT-17382-A	63.5	26.0	42.5	31.5	1.35	26	21	5	---
UT-9102	66.0	26.0	47.0	33.0	1.42	---	---	---	---
UT-43444	62.0	24.0	51.0	35.5	1.43	30	18	8	2
UT-8595	43.5	22.0	51.5	34.5	1.50	32	26	6	---
WSA-6114	44.0	20.5	50.0	-----	-----	30	18	12	---
UT-582	25.0	-----	-----	-----	-----	26	20	6	---
UT-18009-A	34.5	19.0	43.5	30.5	1.43	30	26	4	---
UT-47895	64.8	27.5	49.0	34.5	1.43	28	15	13	---
UT-566	50.0	16.0	50.0	31.0	1.62	---	---	---	---
	40.0	15.0	50.0	31.5	1.60	---	---	---	---
	23.0	17.5	56.5	37.0	1.53	---	---	---	---
WSA-2347	35.0	21.5	43.0	31.5	1.36	31	19	12	---
	25.0	-----	48.0	34.0	1.41	---	---	---	---
WSA-6115	100.0	23.0	43.0	26.5	1.62	34	34	---	---
	68.0	-----	50.5	-----	-----	---	---	---	---
	42.0	-----	47.5	-----	-----	---	---	---	---
UT-11262	75.0	25.5	44.5	36.5	1.22	---	---	---	---
	60.0	27.5	46.5	38.0	1.22	---	---	---	---
	50.0	-----	49.0	36.0	1.36	---	---	---	---
UT-16742-A	23.0	18.5	48.0	27.0	1.77	29	29	---	---
	20.0	20.0	50.0	27.0	1.85	---	---	---	---
	15.0	21.5	53.5	30.0	1.62	---	---	---	---
	10.5	11.5	57.5	32.0	1.70	---	---	---	---
UT-16742-B	24.0	18.5	41.5	29.0	1.47	25	25	---	---
	20.0	17.5	45.5	30.0	1.50	---	---	---	---
	15.0	10.0	50.0	32.5	1.50	---	---	---	---
UT-16748	30.0	20.0	48.5	35.0	1.38	23	12	11	---
	25.0	18.0	46.0	32.0	1.42	---	---	---	---
	20.0	20.0	45.0	32.5	1.38	---	---	---	---
UT-16749	38.0	17.1	46.0	30.0	1.52	26	14	12	---
	30.0	15.0	50.0	31.5	1.58	---	---	---	---
UT-16752	48.0	21.0	49.0	34.5	1.42	27	16	11	---
	30.0	18.5	55.0	33.5	1.65	---	---	---	---
UT-16759	33.0	-----	-----	-----	-----	27	14	13	---
	30.0	18.5	48.5	33.5	1.45	---	---	---	---
	25.0	16.0	48.0	32.0	1.50	---	---	---	---
	20.0	17.5	55.0	32.5	1.69	---	---	---	---
UT-16761	30.0	16.5	48.5	31.5	1.53	24	13	11	---
	25.0	16.0	44.0	34.0	1.30	---	---	---	---
	20.0	15.0	42.5	30.0	1.41	---	---	---	---

(Continued on page 52)

Remarks.—Faraudiella texana (Shattuck) has a more rounded venter than the type species of the subgenus, *F. rhamnonota* (Seeley), but has a less rounded venter than either *F. roemeri* (Lasswitz) or *F. grandidieri* (Boule, Lemoine, and Thevenin, 1907). *F. texana* is higher whorled than *F. roemeri,* and the umbilicus is slightly more closed, averaging about 21, whereas in *F. roemeri* the mean of the umbilical width is 22.56 (significantly different at the 0.95 confidence level). Although the number of ribs per whorl does not seem to be significant, still, the regression lines, when computed, have quite different slopes (figs. 14, 15). From the standpoint of body measurement there seems to be very little difference between *F. texana* and *F. franciscoensis* (Kellum and Mintz, 1962), yet the strongly falcoid ribbing of *F. franciscoensis,* with one to two intercalated ribs between each primary pair is quite different from *F. texana. F. archerae,* n. sp., is a much smaller species than *F. texana,* and does not retain the acute venter beyond these smaller diameters. Furthermore, the ribbing of *F. archerae* is relatively stronger, with more pronounced tubercles or bullae at the umbilicus.

*Horizon and localities.—*All specimens of *Faraudiella texana* from Central Texas are from the zone of *Budaiceras hyatti,* upper part of the Early Cenomanian. All but one of these specimens are from the lower member of the Buda Limestone, but the one is from the lower part of the upper member. This distribution may only be the result of far fewer ammonites having been collected from the upper member than from the lower member of the Buda Limestone. *Faraudiella texana* is also known from the Buda Limestone (and *Budaiceras hyatti* zone) of Brewster, Jeff Davis, Hudspeth, Upton (?), Kinney, Val Verde, Terrell, Culberson, Uvalde, and Edwards counties, Texas, and from the Sierra Pilares and El Banquete, just southwest of the Rio Bravo, northeastern Chihuahua, Mexico. Böse had collected the species in northern Coahuila. The species has not been recovered from the *Budaiceras hyatti* zone in the Grayson Formation of North Texas.

	D	U	H	W	H/W	T	P	S	B
UT-17384	35.0	24.0	45.0	31.0	1.45	----	----	----	----
	30.0	23.5	43.0	30.0	1.45	----	----	----	
	25.0	22.0	44.0	36.0	1.22	----	----	----	----
	20.0	17.5	50.0	37.5	1.34	---	----	----	----
UT-18003	25.0	18.0	52.0	36.0	1.44	----	----	----	----
UT-32977-A	96.0	25.0	46.5	29.0	1.59	29	16	13	---
	80.0	24.0	45.5	32.0	1.43	----	----	----	----
	70.0	21.5	48.0	32.0	1.49	----	----	----	---
	60.0	20.0	50.0	34.0	1.46	---	---	----	----
	50.0	19.0	52.0	35.0	1.46	----	---	----	---
UT-32977-C	79.0	24.5	38.0	26.5	1.43	21	18	3	---
	60.0	21.0	41.5	------	------	----	----	---	---
	41.5	24.0	48.0	35.0	1.42	---	----	----	----
UT-35445	63.5	15.8	49.0	34.5	1.41	40	20	20	----
	50.0	16.0	53.0	36.0	1.47	----	----	---	---
	35.0	14.5	54.0	34.5	1.58	---	----	----	----
UT-18007-A	23.0	21.5	46.0	30.5	1.50	24	24	----	----
	20.0	20.0	45.0	32.5	1.38	---	----	----	----
	15.0	16.5	53.5	33.5	1.60	---	---	----	----
UT-571	19.0	21.0	50.0	------	------	23	23	----	---
UT-18008	21.5	25.5	44.0	30.0	1.46	----	---	----	----
	16.5	21.0	48.5	33.0	1.46	----	---	----	----
	11.5	22.0	48.0	35.0	1.37	----	----	----	----
UT-18001	25.0	16.0	52.0	32.0	1.63	29	29	----	----
	20.0	17.5	52.5	30.0	1.67	----	----	----	---
	15.0	16.5	50.0	30.0	1.66	----	----	----	----
UT-17374	23.0	22.0	45.5	32.5	1.40	26	26	----	----

STOLICZKAIA (FARAUDIELLA) ROEMERI (Lasswitz, 1904)

pl. 5,, figs. 1-3, 6-7, 11, 12, 14, 16;
pl. 6, figs. 1, 2, 27-30; text figs. 11q-s, bb

Schloenbachia roemeri Lasswitz, 1904, p. 27, pl. 6, fig. 3.

Budaiceras roemeri (Lasswitz) in Böse, 1928, p. 258; in Adkins, 1928, p. 237 *(pro parte, non* pl. 23, fig. 4)

Holotype.—The holotype is the specimen illustrated by Lasswitz (1904) on plate 6, figure 3, as *Schloenbachia roemeri;* it is from the Buda Limestone at Austin, Texas, and was at the University of Breslau (now Wroclaw) when Adkins made the cast in the 1920s herein illustrated (WSA-3478, plate 6, figs. 27-30). The specimen seems since to have disappeared.

Specific description.—Conch with a few rapidly expanding whorls and umbilical walls sloping into a narrow umbilicus. U ranges from 17.5 to 35, the larger reading occurring on adult individuals on which overlap of the whorl over the preceding flank rapidly decreases. The venter is rounded, with peripheral tubercles on the ribs that cross the venter. The whorl section is higher than wide, H/W ranging from about 1.0 to 1.4. The greatest costal and intercostal widths are dorsad of the first one-third of the flank, except costally it is at the umbilical tubercle when that tubercle is present. The whorl section is suboval intercostally and subquadrate costally. Costation is moderate, the number of ribs per whorl ranging from a low of 22 to a high of 34, and there is no relation between size of shell and number of ribs (fig. 15). Costae are straight and rectiradiate and slightly wider than intercostae. Roughly one-third of the costae are intercalated, but this feature varies widely from no intercalations to almost two-thirds intercalations. Bifurcations are rare. There are less intercalated costae on the holotype than on most other Texas specimens.

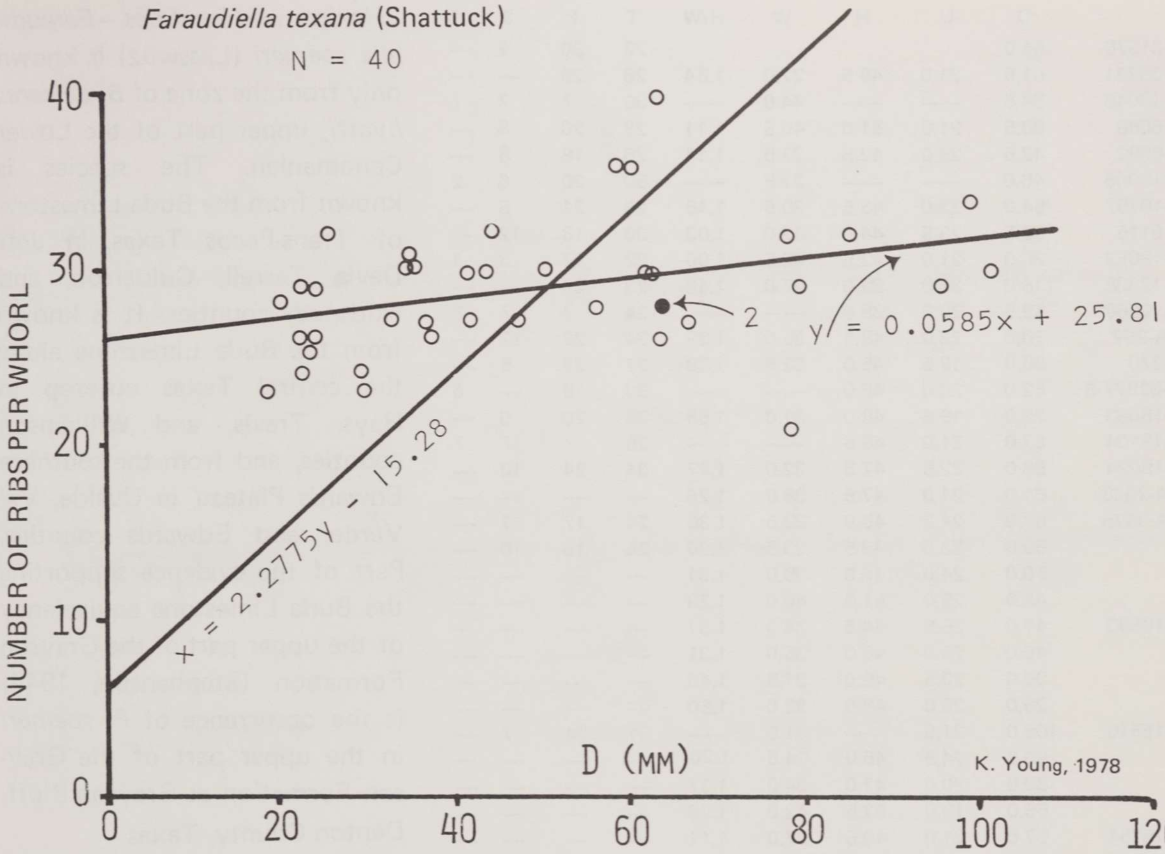

FIGURE 14

Regression of number of ribs per whorl on the diameter in *Faraudiella texana* (Shattuck).

There are three sets of nodes, the umbilical nodes low and strongly bullate, the ventrolateral just barely clavate, and the peripheral nodate to barely clavate. There is one peripheral node per rib, and the ribs cross the venter strongly. On some of the younger whorls intercalations are limited to the venter, and on such specimens there may be more peripheral nodes than lateral or flank ribs; however, there is a rib on the venter for each peripheral tubercle, and in this way *F. roemeri* differs from all species of *Budaiceras.*

The aperture is unknown, and no specimen contains a complete body chamber, however, the body chamber is as strongly ribbed as the rest of the conch on those specimens which contain a part of the body chamber. Overlap is between one-third and one-half of the flank. Good sutures have yet to be recovered from *F. roemeri* (Lasswitz).

Measurements are shown on page 54.

Remarks.—Faraudiella roemeri (Lasswitz) is one of the more robust species of *Faraudiella.* With ventral tubercles on ribs extending clear to the body chamber and even onto the body chamber, this species comes under the definition of *Faraudiella* as given by Breistroffer (1947). A comparison of *F. roemeri* to *F. texana* (Shattuck) is given under the discussion of *F. texana.* In overall conformation *F. roemeri* is much like *F. grandidieri* (Boule, Lemoine and Thevenin, 1907), but the latter may have up to twice as many ribs per whorl as *F. roemeri. F. archerae,* n. sp., is a much smaller species. *F. borachoensis,* n. sp., has peripheral nodes at all stages, and the ribs are

	D	U	H	W	H/W	T	P	S	B
UT-31578	84.0					22	20	2	---
UT-38271	61.5	21.0	49.5	27.0	1.84	26	26	---	---
UT-18046	54.5	------	------	44.0	------	30	?	?	?
UT-6088	60.5	21.5	51.0	46.5	1.11	28	20	8	---
UT-6592	42.5	26.0	43.5	37.5	1.14	26	18	8	---
UT-18006	46.0	------	------	32.5	------	30	20	6	2
UT-16757	54.0	23.0	45.5	30.5	1.45	26	21	5	---
UT-6115	38.5	23.5	44.0	43.0	1.03	30	18	12	---
UT-18052	26.0	21.0	42.5	42.5	1.00	22	17	3	1
UT-12338	118.0	35.0	39.0	27.0	1.43	23	23	---	---
UT-10560	52.5	20.0	38.0	------	------	24	?	?	?
WSA-252	70.0	23.0	48.5	35.0	1.39	34	22	12	---
UT-270	80.0	18.5	45.0	32.5	1.38	27	22	5	---
UY-32977-B	52.0	20.0	46.0	------	------	30	18	---	6
UT-18093	76.0	19.5	48.0	31.0	1.55	26	20	6	---
UT-18104	67.0	21.0	45.5	------	------	25	?	?	?
UT-18024	56.0	22.5	47.5	32.0	1.47	34	24	10	---
WSA-2338	61.0	24.0	47.5	38.0	1.26	---	---	---	---
WSA-3478	67.0	24.5	45.0	32.5	1.35	24	17	7	---
	60.0	23.5	43.5	33.5	1.30	26	16	10	---
	50.0	24.0	46.0	35.0	1.31	---	---	---	---
	40.0	25.0	51.0	40.0	1.28	---	---	---	---
UT-10593	47.0	26.5	44.5	34.0	1.31	---	---	---	---
	40.0	25.0	46.0	35.0	1.31	---	---	---	---
	30.0	23.5	45.0	31.5	1.43	---	---	---	---
	25.0	20.0	48.0	32.0	1.50	---	---	---	---
UT-15510	108.0	31.5	------	31.5	------	31	24	7	---
	90.0	24.5	45.0	34.5	1.30	---	---	---	---
	80.0	20.0	47.0	34.0	1.37	---	---	---	---
	55.0	19.0	52.5	42.0	1.26	---	---	---	---
UT-16754	57.0	21.0	40.5	37.0	1.11	---	---	---	---
UT-16760	50.0	24.0	46.0	37.0	1.24	---	---	---	---
	40.0	17.5	47.5	40.0	1.19	---	---	---	---
	30.0	18.5	51.5	40.0	1.29	---	---	---	---
UT-18000-L	45.0	24.5	44.5	34.5	1.29	25	11	10	2
	40.0	21.0	42.5	35.0	1.21	---	---	---	---
	30.0	18.5	48.5	36.5	1.32	---	---	---	---
UT-19721	110.0	------	46.5	------	------	32	14	10	4
	75.0	22.5	46.0	------	------	---	---	---	---
	60.0	21.5	49.0	------	------	---	---	---	---
	50.0	21.0	46.0	------	------	---	---	---	---
UT-19723	125.0	29.0	44.0	------	------	22	14	8	---
	115.0	27.0	44.0	------	------	---	---	---	---
	100.0	27.0	41.5	30.0	1.28	---	---	---	---
	75.0	23.5	43.5	34.0	1.24	---	---	---	---
UT-7205	122.0	24.5	40.0	------	------	28	18	10	---
	91.5	22.0	47.5	27.0	1.77	---	---	---	---

completely rectiradiate, whereas *F. roemeri* loses the peripheral nodes on the body chamber and has more falcoid ribs.

Approximately 40 specimens of *Faraudiella roemeri* (Lasswitz) have been identified in the collections of the Texas Memorial Museum, The University of Texas at Austin, Texas. No apertures have been seen, although a few specimens obviously contain parts of the body chamber.

Horizon and localities.—*Faraudiella roemeri* (Lasswitz) is known only from the zone of *Budaiceras hyatti,* upper part of the Lower Cenomanian. The species is known from the Buda Limestone of Trans-Pecos Texas in Jeff Davis, Terrell, Culberson, and Hudspeth counties. It is known from the Buda Limestone along the central Texas outcrop in Hays, Travis, and Williamson counties, and from the southern Edwards Plateau in Uvalde, Val Verde, and Edwards counties. Part of the evidence supporting the Buda Limestone equivalency of the upper part of the Grayson Formation (Stephenson, 1944) is the occurrence of *F. roemeri* in the upper part of the Grayson Formation at Grayson Bluff, Denton County, Texas.

STOLICZKAIA (FARAUDIELLA) BORACHOENSIS, n. sp.
pl. 4, figs. 1-3; text fig. 11g

Holotype.—*UT 14515, from the* upper beds of the Kent Station Limestone, bed 9, section 2 of grant Moyer (1952), San Martine Quadrangle, Reeves County, Texas; it is deposited with the Texas Memorial Museum, The University of Texas at Austin, Texas.

Specific description.—Conch with a few rapidly expanding whorls and with umbilical walls sloping into a narrow umbilicus. The venter is rounded intercostally and faintly fastigate with shoulders costally. U ranges from around 21 to about 29 and slowly expands with the increasing diameter of the conch. Height is greater than width, H/W

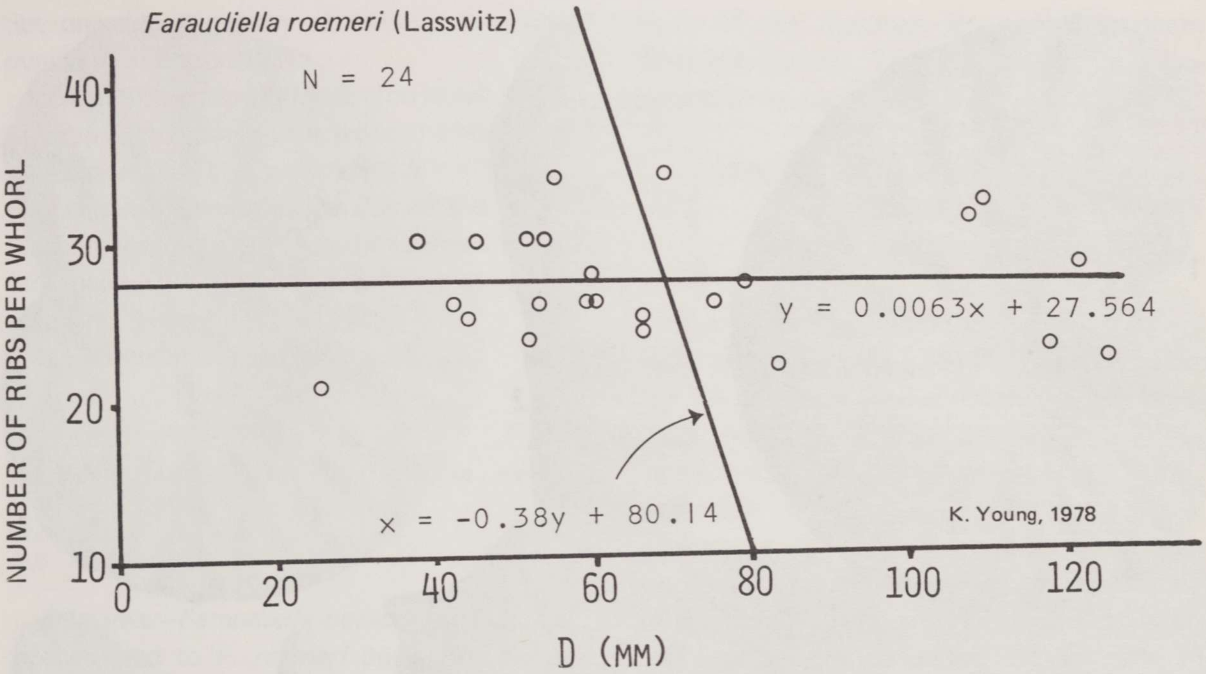

FIGURE 15

Regression of number of ribs per whorl and diameter in *Faraudiella roemeri* (Lasswitz).

ranging from around 1.1 at smaller diameters to something greater, but since the specimens known to me have been distorted by sedimentary load at the greater diameters, an interpretation of H/W at greater diameters is difficult. The intercostal section is oval with the greatest width at about one-third of the flank; the costal section is subquadrate, with the greatest costal width at the umbilical bulla. Costation consists of approximately 28 ribs on the holotype, 14 primary and 14 secondary, not alternating directly, but rather unevenly. The ribs are strong, broad, about twice the width of the intercostae, and each rib expands in width peripherally. The ribs are rectiradiate and cross the venter strongly, even on the outermost whorls.

Tuberculation consists of low umbilical bullae, ventrolateral nodes that may be faintly clavate, and peripheral nodes, which are strong to a diameter of 60 mm or so, at which they begin to weaken, and are weak,

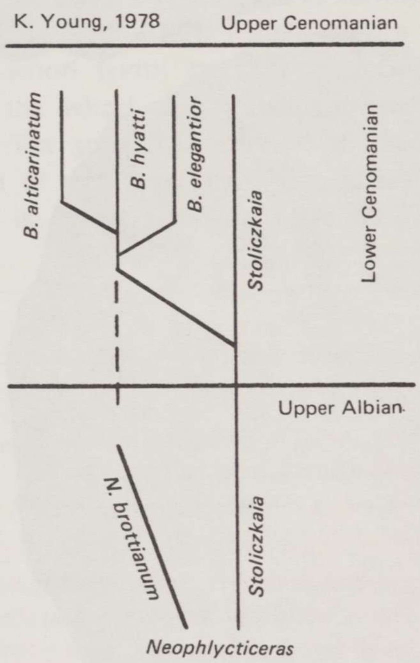

FIGURE 16

The presumed evolution of species of *Budaiceras*.


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but present, at greater diameters; they also may be faintly clavate.

The umbilicus has expanded so much in the holotype, that part of the body chamber may be represented, but since septa are irrecoverable on this specimen, the size of the phragmacone and the body chamber cannot be determined. The suture is unknown as is the aperture.

Measurements of holotype are:

D	U	H	W	H/W	T	P	S	B
77.0	20.0	43.0	30.0	1.43	28	14	14	---
60.0	26.0	41.5	-------	-------	----	----	----	---
50.0	22.0	-------	-------	-------	----	----	----	---
40.0	21.5	36.5	32.5	1.12	----	----	----	---

Remarks.—*Faraudiella borachoensis,* n. sp., is compared to *F. roemeri* under the discussion of *F. roemeri. F. borachoensis* has a less acute venter than *F. texana,* and the whorl height-whorl width ratio is considerably less. It is a larger species than *F. archerae,* n. sp., and is much less densicostate than *F. franciscoensis* (Kellum and Mintz).

Horizon and localities.—*Faraudiella borachoensis,* n. sp., is known only from Trans-Pecos Texas; the holotype is from very high in the Kent Station Limestone, San Martine Quadrangle, Pecos County, Texas, and was collected by Grant Moyer; another individual was collected by D. F. Reaser from the east flank of the Quitman Mountains, southern Hudspeth County, Texas. It is from the Eagle Mountain Sandstone.

STOLICZKAIA (FARAUDIELLA) ARCHERAE, n. sp
pl. 6, figs. 3-9; text fig. 11k-o

Holotype.—The holotype of *Faraudiella archerae,* n. sp., is UT-16746, from 0.6 m below the top of the lower member of the Buda Limestone, Round Rock, Williamson County, Texas, collected by F. L. Whitney.

Specific description.—Conch with a few regularly expanding whorls and with steep umbilical walls sloping into a moderately narrow umbilicus, venter rounded in intercostal section, shouldered and fastigate in costal section, prior to the body chamber, but rounded both costally and intercostally on the body chamber. *F. archerae,* n. sp., is a small species, with no specimens exceeding 50 mm in diameter. U usually ranges around 20.0, but in larger specimens ranges up to 31, and ranges down to as narrow as 10 in juveniles. Undistorted shells have a whorl height-whorl width ratio of around 1.1 to 1.35, the whorl section being higher than wide. The greatest intercostal width is just dorsad of the umbilicus. The greatest costal width is at the umbilical bulla. Whorl sec-

PLATE 4

Figs. *1-3*—***Faraudiella borachoensis,*** n. sp.; lateral and ventral views of UT-14515, the holotype *(see also* text fig. 11g), from near the top of the Kent Station Limestone, San Martine Quadrangle, Reeves County, Texas, collected by Grant Moyer, X 1.

4-14—***Faraudiella texana*** (Shattuck); *4,* lateral view of WSA-6115 *(see also* pl. 5, fig. 10, and text fig. 11t), from the nodular (middle) member of the Buda Limestone, near Rock Springs, Edwards County, Texas, collected by R. T. Hazzard; *5, 8,* ventral and lateral views of UT-31813, a juvenile specimen from the lower member of the Buda Limestone, Manchaca, Travis County, Texas, F. L. Whitney Collection; *6, 10,* lateral and ventral views of UT-16761, a juvenile from the Buda Limestone on Shoal Creek, Austin, Travis County, Texas, F. L. Whitney Collection; *7, 9, 11,* ventral and lateral views of UT-18001, a juvenile from the lower member of the Buda Limestone, Round Rock, Williamson County, Texas, F. L. Whitney Collection; *12,* lateral view of UT-6269, from the top of the upper member of the Buda Limestone, just upstream from the Missouri Pacific Railroad trestle on lower Shoal Creek, Austin, Travis County, Texas, collected by K. Young; *13,* ventral view of UT-16749, a juvenile from 0.6 m below the top of the lower member of the Buda Limestone, Round Rock, Williamson County, Texas, F. L. Whitney Collection; *14,* lateral view of UT-32977 *(see also* text fig. 11s), from the nodular (middle) member of the Buda Limestone, southern Van Horn Mountains, Jeff Davis County, Texas, collected by Page C. Twiss; *all,* X 1.

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tion is oval intercostally to subquadrate to subtrapezoidal prior to the body chamber costally; it is oval costally on the body chamber. Ribbing consists of broad, highly rounded ribs that cross the venter without appreciable diminution. The number of ribs per whorl ranges from 22 to 30, and the majority of the ribs are usually primary, but there are also intercalated secondary ribs, and some specimens show some bifurcating pairs. Ribs are usually rectiradiate, except on the body chamber where they become sigmoid, and are slightly reduced near the aperture. Tuberculation consists of umbilical bullae on the primary ribs, ventrolateral nodes on all ribs, and peripheral clavi on all ribs. The umbilical bullae persist throughout the phragmacone and onto the body chamber, the last visible rib on the incomplete body chamber having only a slightly diminished bulla. The ventrolateral nodes persist onto the body chamber, but are not present on the last quarter of the last volution. The peripheral clavi just barely persist onto the body chamber.

The suture is not known, and neither is the aperture, although UT-16746 does seem to retain most of a body chamber, since the ribs are beginning to diminish on the last part, as they so often do on the more orad parts of body chambers.

Measurements are shown on page 60.

Remarks.—Faraudiella archerae, n. sp., is one of those species which, because it already occurs with well developed *Mantelliceras,* cannot be considered transitional from *Stoliczkaia* to *Mantelliceras,* but must represent a deadend offshoot of the genus *Faraudiella.* It may be that some of the juveniles illustrated on plate 6 (especially figs. 12-26) are juveniles of *F. archerae,* n. sp. Some of these late Lower Cenomanian species of *Faraudiella* could be derived from *Stoliczkaia* by the spread of the tubercles back onto the adult whorls of the younger species. However, the phylogeny is not yet sufficiently well known to merit the separation of these species as a distinct lineage at the present time, especially when mostly they represent the end product of an isolate *Faraudiella* lineage in North America.

Faraudiella archerae is a small species, the maximum diameter, with most of the body chamber preserved, not exceeding 45 to 50

PLATE 5

Figs. *1-3, 5-7, 9, 11, 12, 14, 16—Faraudiella roemeri* (Lasswitz); *1, 6, 11,* lateral and ventral views of UT-18017-C *(see also* text fig. 11bb), a juvenile specimen from the Buda Limestone, Shoal Creek, Austin, Travis County, Texas, F. L. Whitney Collection; *2,* apertural view of UT-16760 *(see also* pl. 6, figs. 1, 2, and text fig. 11s), from 0.6 m below the top of the lower member of the Buda Limestone, Round Rock, Williamson County, Texas, F. L. Whitney Collection; *3, 7,* ventral and lateral views of WSA-6120, from the nodular (middle) member of the Buda Limestone, near Rock Springs, Edwards County, Texas, collected by R. T. Hazzard; *5, 9,* ventral and lateral views of WSA-10837, from the Buda Limestone, Southern Van Horn Mountains, Jeff Davis County, Texas, collected by R. T. Hazzard; *12, 16,* ventral and lateral views of WSA-6088 *(see also* text fig. 11g), from the nodular (middle) member of the Buda Limestone, near Rock Springs, Edwards County, Texas, collected by R. T. Hazzard; *14,* lateral view of a large specimen, UT-15510, from the lower member of the Buda Limestone, Bear Creek, Travis County, F. L. Whitney Collection; *all* X 1.

4, 8, 10—Faraudiella texana (Shattuck); *4,* lateral view of UT-30542, from the base of the nodular (middle) member of the Buda Limestone, west side of Van Horn Creek, Jeff Davis County, Texas, collected by Philip Braithwaite; *8,* ventral view of UT-18082 *(see also* text fig. 11v), from the lower member of the Buda Limestone, Blanco River, Hays County, Texas, F. L. Whitney Collection; *10,* ventral view of WSA-6115 *(see also* pl. 4, fig. 4, and text fig. 11u), from the nodular (middle) member of the Buda Limestone, near Rock Springs, Edwards County, Texas, collected by R. T. Hazzard; *all,* X 1.

13, 15—Faraudiella sp. cfr. *F. rhamnonota* (Seeley); lateral and ventral views of UT-1350 *(see also* pl. 3, fig. 11, and text fig. 11b), from about 5 ms below the top of the Georgetown Limestone, Barrow Branch, Austin, Travis County, Texas, collected by S. E. Clabaugh; X 1.

	D	U	H	W	H/W	T	P	S	B
UT-18034	34.0	28.0	41.0	34.0	1.25	28	28	--	--
WSA-6112	39.0	31.0	41.0	31.0	1.35	28	18	2	4
UT-16746	30.0	20.0	45.0	33.5	1.25	22	5	5	6
	25.0	20.0	40.0	36.0	1.12	----	----	--	--
	20.0	20.0	47.5	40.0	1.19	----	----	--	--
UT-18017	19.0	21.0	44.5	31.5	1.41	27	19	8	--
	15.0	10.0	46.5	36.5	1.25	----	----	--	--
	10.0	10.0	50.0	40.0	1.20	----	----	--	--
WSA-256	27.5	23.5	45.5	29.0	1.55	30	7	7	8

mm. Its broad, almost tabulate venter on the adult whorl differentiates it from other species of *Faraudiella.*

Horizons and localities.—*Faraudiella archerae,* n. sp. is known only from the zone of *Budaiceras hyatti,* late Early Cenomanian. It is known from the Buda Limestone of Hays, Travis, and Williamson counties, Texas, and from the middle (nodular) member of the Buda Limestone of Edwards and Val Verde counties, Texas.

STOLICZKAIA (FARAUDIELLA) FRANCISCOENSIS

(Kellum and Mintz, 1962)
pl. 3, figs. 7, 15; pl. 7, fig. 5

Budaiceras franciscoensis Kellum and Mintz, 1962, pp. 277-278, pl. 5, figs. 1, 2, 5.

Holotype.—The University of Michigan, Museum of Paleontology, no. 44717, from the Indidura Formation, Sierra de Tlahualilo, southern Coahuila, and illustrated by Kellum and Mintz (1962, pl. 5, figs. 1, 2, 5).

Measurements are:

	D	U	H	W	H/W	T	P	S	B
Kellum & Mintz	27.*	-------	43.0*	27.5*	1.80	30*	10*	20*	--
WSA-4164	25.0	20.0	50.0	-------	-------	30	16	14	--
UT-31506	25.5	23.5	43.0	29.5	1.47	31	16	16	--
	20.0	25.0	48.5	30.0	1.62	----	----	----	--
	14.0	23.0	57.0	-------	-------	----	----	----	--
UT-43786	28.0	19.5	44.5	-------	-------	----	----	----	--
UT-18065	48.0	21.0	45.0	-------	-------	----	----	----	--

*Figures estimated from illustrated fragment of Kellum & Mintz (1962, Pl. 5, Figs. 1, 2, 5).

Remarks.—A total of nine specimens have been assigned to *Faraudiella franciscoensis* (Kellum and Mintz). Most of them are fragments. It is quite distinct from other species of the genus because of the very falcoid ribs with two or more intercalations between each two primary ribs. The whorl height is much greater than whorl width on all specimens, but how much of this is the result of sedimentary load cannot be estimated. Most of the specimens are only fragments, and the body chamber and suture are not known. The falcoid ribs are wider than the interribs, the ribs are rounded, projected onto the venter, and cross the venter in a chevron. There are no true shoulder nodes, but the rib weakens between the shoulder and the peripheral clavum, of which there is one per rib. Umbilical bullae are very long and indistinct. The entire aspect from the side is similar to that of *Stoliczkaia scotti* Breistroffer, but the ventral clavi on chevronned ribs projected orad are completely different from the rounded venter of *S. scotti.*

Horizon and localities.—*Faraudiella franciscoensis* (Kellum and Mintz) is known only from the zone of *Budaiceras hyatti.* The holotype is from the Indidura Formation of southern Coahuila. One specimen lacks information on the locality. Five specimens are from Travis and Hays counties of central Texas. Another specimen is from the Buda Limestone of the Agua Fria Quadrangle, Brewster County, Texas, collected by C. Gardley Moon; another from the Buda Limestone, middle (nodular member) from near the Devil's Sink Hole, Edwards County, collected by R. T. Hazzard, and still another from the Buda Limestone, along a trail running up the north wall of Frouthrigh Canyon, west trail to the Frautenza Mine, Sierra del Carmen, Coahuila, Mexico, collected by C. L. Baker.

Genus *BUDAICERAS* Böse, 1928

Type species.--The type species of *Budaiceras* Böse, 1928, is *Barroisiceras hyatti* Shattuck, 1903 (= *Budaiceras mexicanum* Böse, 1928, pl. 10, figs. 1-3, pl. 9, figs. 16, 17 only, not pl. 9, figs. 18-23). *Budaiceras mexicanum* was designated the type species ("genotype") by Böse (1928), with his specimen illustrated on his plate 10, figs. 1-3 the type of the species.

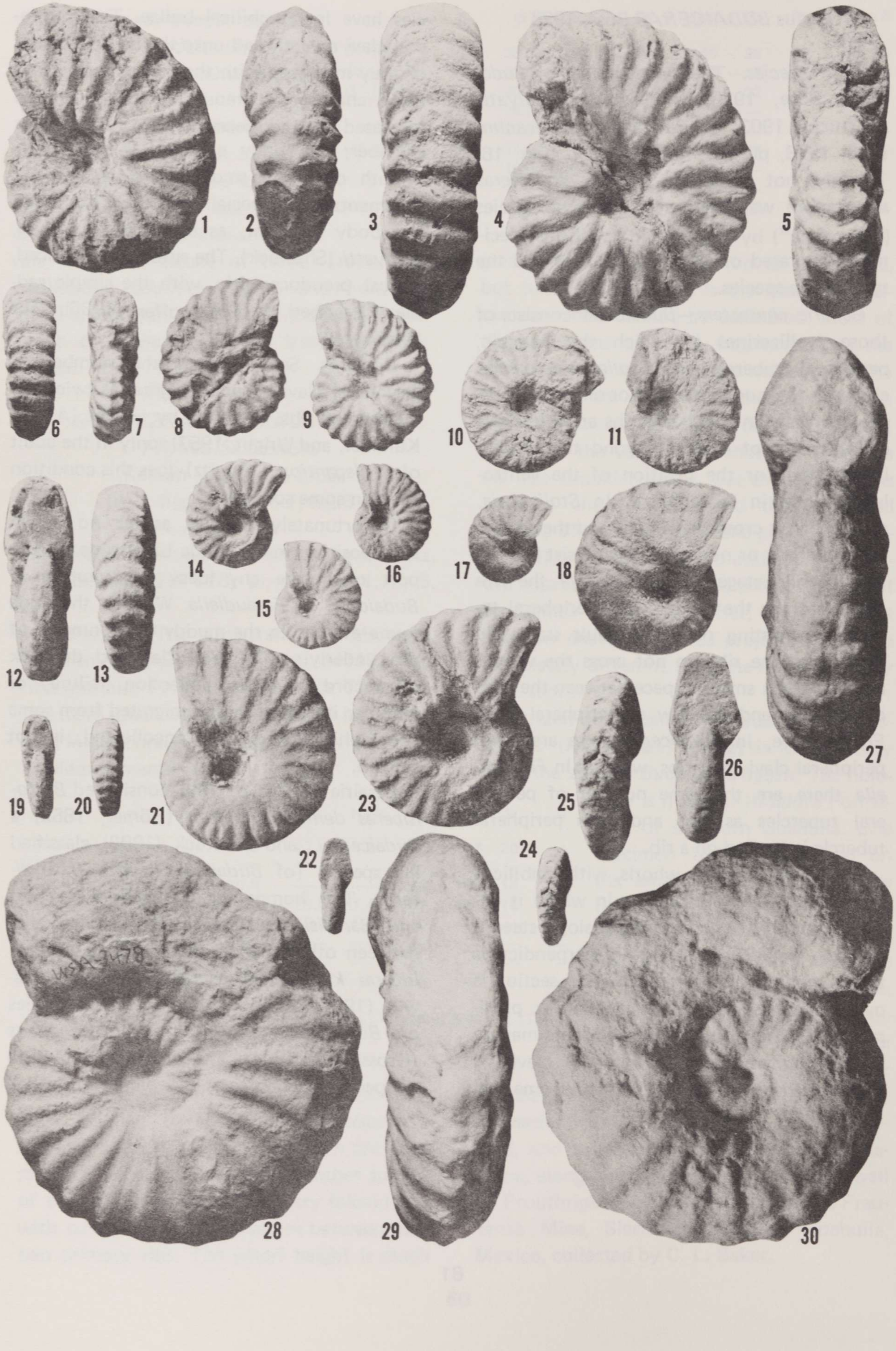
Generic characters.—Budaiceras consists of those lyellicerines in which the juvenile, peripheral tubercles of *Stoliczkaia* persist either to the body chamber or onto the body chamber, and in which the ribs are interrupted and do not extend beyond the ventrolateral node or the position of the ventrolabial node in its absence. In *Stoliczkaia,* s. s., the ribs cross the venter, and the peripheral tubercles or nodes do not persist beyond the juvenile stages. In *Faraudiella* the ribs persist across the venter with peripheral tubercles persisting onto the adult stages. In *Budaiceras* the ribs do not cross the venter, and there is a smooth space between the ends of the ribs and the row of peripheral clavi. Furthermore, in *Budaiceras* there are more peripheral clavi than ribs, whereas in *Faraudiella* there are the same number of peripheral tubercles as ribs and each peripheral tubercle is located on a rib.

Budaiceras has few whorls, with umbilicus regular until the adult stage in which it expands rapidly. Umbilical walls slope steeply into the umbilicus but are not perpendicular to the flank. The intercostal whorl section is oval to suboval; ribs are rectiradiate to prosiradiate, flexuous to straight, and there may be both peripheral and ventrolateral clavi, or there may be only peripheral clavi; some species have low umbilical bullae. The peripheral clavi may extend onto the body chamber or they may stop with the phragmacone. The body chamber is frequently reduced, with increased U and decreased H in the adult chamber; the body chamber is also often smooth or partly smooth, that is, without ornamentation, especially on the last half of the body chamber, as in the type species, *B. hyatti* (Shattuck). The sutures are reduced, almost pseudoceratitic, with the simple saddles described by Breistroffer (1936b) for *Salaziceras.*

Remarks. Seldom does the number of peripheral clavi become as great as twice the number of ribs, as stated by Wright (Arkell, Kummel, and Wright, 1957); only in the adult of *B. elegantior* (Lasswitz) does this condition exist on some specimens.

Unfortunately, there is, as yet, no known superposition in the Buda Limestone to support or negate any ideas of evolution of *Budaiceras* or *Faraudiella.* Whether the Buda fauna evolved in the muddy environments of the underlying Del Rio Clay and the lack of record is from collection failure, or whether it evolved in and migrated from some geographic area as yet uncollected, is not known.

Besairie (1936, p. 199) considered *Barroisiceras dentatocarinatum* (Römer, 1852) a *Budaiceras,* and Shattuck (1903) classified his species [of *Budaiceras,]* with *Barroisiceras.* The homoplasy between *Budaiceras* and *Barroisiceras* is even more remarkable between other species, as for instance *Barroisiceras kayi* Benavides (1956), or as Lasswitz (1904) has shown by confusing a species of *Budaiceras* with *Barroisiceras sequens* (Grossouvre, 1894). The presumed evolution of species of *Budaiceras* is depicted in fig. 16.



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BUDAICERAS HYATTI (Shattuck, 1903)
pl. 7, figs. 1-4, 6-10, 12-14
pl. 8, figs. 19-22, 24; text figs. 11h, j, dd-jj

Barroisiceras hyatti Shattuck, 1903, p. 36, pl. 25, figs. 2, 3

Schloenbachia roemeri var. *harpax* Lasswitz, 1904, p. 27-28, pl. 6, fig. 4

Budaiceras mexicanum Böse, 1928, pp. 259-262, pl. 10, figs. 1-3 and pl. 9, figs. 16, 17; Adkins, 1928, p. 127 (pro parte); Adkins and Lozo, 1951, pl. 1, figs. 6-8; Young, 1959, p. 84, figs. 1-6, 9; Young, 1960, p. 47, figs. 1-6, 9; Kellum and Mintz, 1962, pl. 4, fig. 2

Budaiceras hyatti (Shattuck) in Adkins, 1928, p. 237; Young and Powell (in press, 1978), pl. 6, figs. 5-6, 17.

non Budaiceras mexicanum Böse, 1928, pl. 9, figs. 18-23, only.

Holotype.—The holotype is the specimen illustrated as *Barroisiceras hyatti* by Shattuck (1903, pl. 25, figs. 3, 4) by monotypy, since it is the only specimen Shattuck illustrated. This specimen is from the Buda Limestone on Shoal Creek, at Austin, Travis County, Texas, and is on repository at the United States National Museum.

Specific description.—Conch with few whorls; umbilical wall sloping into a narrow, but rapidly expanding umbilicus. U increases with diameter of the shell, and the body chamber is subscaphitoid. In young whorls (diameters of less than 40 mm) U ranges from 17.5 to 26.5; at larger diameters U ranges from 16.0 to 33.0, and those figures greater than 26.0 are probably from adult whorls. Whorl height-whorl width ratios range from 1.1 up, but figures above 1.3 probably represent compaction under sedimentary load. The greatest width is at about one-third of the flank both costally and intercostally, umbilical bullae being absent on larger whorls, and with greatest development away from the umbilicus on younger whorls. Ribbing is somewhat sparse, the number of ribs per whorl ranging from 9 to 24; the ribs tend to disappear or be only faint on the body chamber. Intercostae and costae are about the same width, and the costae are only very slightly flexed to straight, rectiradiate to very slightly prosiradiate. Some costae may cross over the venter at diameters prior to 30 mm, indicating the stoliczkaiine ancestry, but on most specimens, even prior to the 30 mm diameter and on all specimens subsequent to that diameter the ribs end with the ventrolateral

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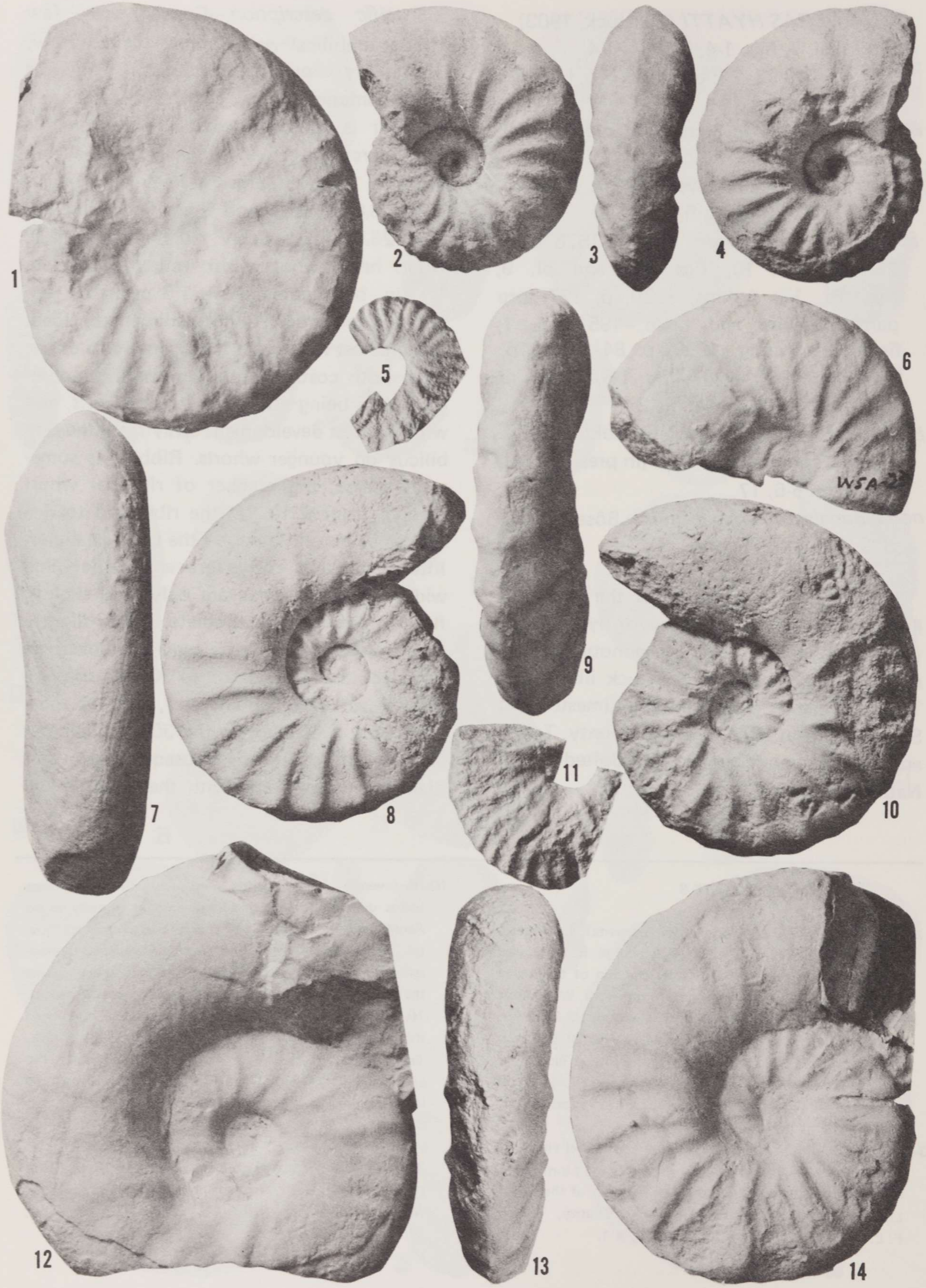
PLATE 6

Figs. *1, 2, 27-30*—***Faraudiella roemeri*** (Lasswitz); *1, 2,* lateral and ventral views of UT-16760 *(see also* pl. 5, fig. 2, and text fig. 11r), from 0.6 m below the top of the lower member of the Buda Limestone, Round Rock, Williamson County, Texas; F. L. Whitney Collection; *27-30,* apertural, lateral, and ventral views of WSA-3478 *(see also* text fig. 11p), a plaster cast of the holotype illustrated by Lasswitz (1904, pl. 6, fig. 3), from the Buda Limestone, Shoal Creek, Austin, Travis County, Texas; *all,* X1.

3-9—***Faraudiella archerae***, n. sp.; ventral and lateral views of the holotype, UT-16746 *(see also* text figs. 11-k-n), from 0.6 m below the top of the lower member of the Buda Limestone, Round Rock, Williamson County, Texas, F. L. Whitney Collection; *3-5,* X 2; *6-9,* X 1.

10-26—juvenile mantellicerids and/or lyellicerids; these forms do not develop mid-line tubercles as early as do ***Faraudiella archerae,*** n. sp., and ***Budaiceras*** sp. juv. (pl. 9, figs. 6-8). On the other hand, since species of ***Mantelliceras*** are so rare in the Buda Limestone, it is probable that these are juveniles of ***Faraudiella texana*** (Shattuck); *10,* lateral view of UT-17374 *(see also* text fig. 11y), from the lower member of the Buda Limestone, Bear Creek, Travis County, Texas, F. L. Whitney Collection; *11,* lateral view of UT-18007-B *see also* text fig. 11p), from the lower member of the Buda Limestone, Bear Creek, Travis County, Texas, F. L. Whitney Collection; *12-15, 19-23,* views of UT-31847-B, and *16-18, 22-26,* views of UT-31847-A, from the lower member of the Buda Limestone, Round Rock, Williamson County, Texas, F. L. Whitney Collection; *10-13, 18, 21, 23, 25, 26,* X 2; *14-17, 19, 20, 22, 24,* X1.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clavi until near or on the body chamber.

Nodation consists of weak, unpronounced, umbilical bullae and strong, ventrolateral clavi prior to the body chamber, and the latter may be slightly projected. In addition there are peripheral clavi on the midline. The number of peripheral clavi varies, but is always more than the number of ribs, and may range up to twice as many as there are ribs. Overlap is to about two-thirds of the flank, being greater prior to the body chamber, and less on the body chamber. On UT-10755 there are no ribs on the last one-fourth of the body chamber, and the body chamber constitutes about 180° of arc. Ventral clavi die out early on the body chamber. On UT-18004 there are no ribs on the last half of the steinkern, but the body chamber is incomplete.

On UT-18036 the ribs efface near the apperture and are weaker on the last one-half of the body chamber than on the phragmacone (pl. 7, figs. 8, 10, 13, and pl. 8, fig. 22); on this specimen the aperture is at 70 mm diameter, and the last suture is at a 53 mm diameter, resulting in a body chamber, complete, of about 120° of arc. On UT-19836 there are 16 peripheral clavi for nine ribs at a diameter of 39 mm.

The suture (text figs. 11h, 11jj) has all elements very much reduced, with simple saddles and a wide first lateral saddle that is at least twice as wide as the first lobe; the ventral lobe is longer than the first lateral lobe, and suspensive lobes are almost undeveloped at the 45 mm diameter.

Measurements are shown on page 66.

Remarks. Budaiceras hyatti (Shattuck) differs from species of *Faraudiella* in that species of *Faraudiella* have ribs continuing across the venter, have only one peripheral clavus per rib, and do not have smooth areas ventral of the ventrolateral nodes. Comparisons of *Budaiceras hyatti* with *B. elegantior* (Lasswitz) are made below under remarks for that species. One would like to derive *Budaiceras* from some species, such as *Neophlycticeras brottianum* (d'Orbigny), which already has a smooth area just laterad to the peripheral tubercles and ventrad to the ends of the ribs, but no intervening species with this condition are known from the lower part of the Lower Cenomanian. Therefore, one probably needs to evolve *Budaiceras* from some species of *Faraudiella* or *Stoliczkaia,* especially since the juveniles of *Budaiceras* bear a strong resemblance to the juveniles of *Stoliczkaia,* in which there is a great weakening of ribs between the ventrolateral nodes and the peripheral nodes.

There are over 150 specimens in the collections of the Texas Memorial Museum that

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PLATE 7

Figs. *1-4, 6-10, 12-14—Budaiceras hyatti* (Shattuck); *1, 9, 14,* lateral and ventral views of BEG-45248, a plaster cast of the specimen illustrated by Böse (1928, pl. 10, figs. 1-3) as *Budaiceras mexicanum,* n. sp., from the Buda Limestone, El Remolino, region of Jiménez, Coahuila, Mexico, collected by Emil Böse; *2-4,* lateral and ventral views of UT-16743 *(see also* pl. 8, fig. 19 and text fig. 11ii), from the lower member of the Buda Limestone, Shoal Creek, Austin, Travis County, Texas; F. L. Whitney Collection; *6,* lateral view of WSA-2345 *(see also* text fig. 11j), from the lower part of the Buda Limestone, Gray Hill, Agua Fria Quadrangle, Brewster County, Texas, collected by C. Gardley Moon; *7, 12,* ventral and lateral views of UT-6622, from about 3 ms above the base of the Buda Limestone (as float), west flank of Love Anticline, Kelcy Ranch, Hudspeth County, Texas, collected by D. F. Reaser; note smooth body chamber; *8, 10, 13,* lateral and ventral views of UT-18036 *(see also* pl. 8, fig. 22, and text figs. 11dd-gg, kk), from the Buda Limestone, Austin, Travis County, Texas; F. L. Whitney Collection; *all* X 1.

5—Faraudiella franciscoensis (Kellum and Mintz); lateral view of UT-43786, from the Buda Limestone, but no locality data other than Trans-Pecos Texas; X 1.

11—Stoliczkaia scotti Breistroffer; lateral view of WSA-6032 *(see also* pl. 8, fig. 11, and text fig. 10e), from the upper 8 ms of the Grayson Formation, Grayson Point, northeast of Roanoke, Denton County, Texas; collected by Roy T. Hazzard; X 1.

	D	U	H	W	H/W	T	P	S	B
UT-43374	66.0	23.0	38.0	35.0	1.08	18	?	?	?
WSA-266-A	39.5	28.0	47.0	27.0	1.75	20	14	6	--
WSA-9687	------	------	------	------	------	20	20	--	--
WSA-267-A	54.5	17.5	46.0	31.0	1.48	20	16	4	--
WSA-11815	50.0	------	------	------	------	21	17	4	--
UT-38275	61.0	19.5	45.0	39.0	1.15	20	?	?	?
WSA-4496	84.0	31.0	39.0	38.0	1.03	17	16	1	--
UT-16744	60.0	20.0	47.0	31.0	1.52	21	18	3	--
WSA-6704	62.5	24.0	51.0	34.5	1.54	17	14	3	--
UT-259	58.0	31.0	47.5	32.0	1.48	----	----	--	--
WSA-5717	34.0	17.5	45.5	------	------	23	17	--	1
WSA-2345	58.0	26.0	45.5	------	------	24	10	4	--
UT-19667	68.0	23.5	45.0	28.0	1.60	----	----	--	--
UT-36909-A	56.0	------	------	------	------	10	10	--	--
UT-18028	64.0	18.7	47.5	31.5	1.50	10	10	--	--
UT-31480	73.0	33.0	42.5	26.0	1.63	13	8	3	1
UT-19836-B	58.0	28.5	43.0	31.0	1.38	9	9	--	--
UT-11368	41.0	28.0	46.5			18	18	--	--
UT-31564	48.0	28.0	47.0	------	------	21	14	7	--
UT-32223	63.0	17.5	41.5	------	------	26	20	6	--
WSA-2838	63.5	19.0	48.0	37.0	1.30	24	18	6	--
UT-18035	41.5	24.0	43.5	------	------	----	----	--	--
WSA-12457	44.0	21.5	49.0	34.0	1.44	24	16	8	--
UT-18061	59.0	16.0	47.5	35.5	1.34	20	20	--	--
UT-35611	66.0	19.5	36.5	------	------	----	----	--	--
UT-18033	71.5	31.0	38.5	31.0	1.25	----	----	--	--
UT-18047	81.0	30.5	37.5	32.0	1.17	18	18	--	--
UT-265	59.0	16.0	55.0	41.0	1.34	12	12	--	--
UT-10593	57.5	17.5	35.5	26.0	1.37	21	15	6	--
UT-32977	63.0	15.5	42.5	32.5	1.31	21	20	1	--
UT-42855	88.0	26.0	41.5	------	------	22	19	3	--
UT-38279	51.5	19.5	48.5	35.0	1.38	21	21	--	--
WSA-267-A	88.0	29.5	43.0	------	------	20	20	--	--
UT-18190	46.0	17.5	51.0	39.0	1.31	21	18	3	--
UT-38288	90.5	22.0	43.0	34.0	1.30	19	19	--	--
WSA-267-B	44.5	22.5	47.0	------	------	19	17	2	--
WSA-267-C	51.0	24.5	46.0	------	------	19	19	--	--
UT-19022	43.0	21.0	46.5	------	------	20	18	2	--
WSA-6142	54.0	26.0	43.5	31.5	1.38	24	18	6	--
WSA-12447	42.0	------	------	------	------	20	16	4	–
WSA-2017	41.5	26.5	42.0	------	------	24	22	2	--
UT-10755	83.0	26.5	38.5	26.5	1.45	28	9	9	--
	75.0	26.5	39.0	28.0	1.38	----	----	--	--
	60.0	25.0	48.0	31.5	1.50	----	----	--	--
UT-16743-A	50.0	27.0	45.0	35.0	1.28	19	17	2	--
	40.0	24.0	46.0	37.5	1.23	----	----	--	--
	30.0	20.0	50.0	36.5	1.36	----	----	--	--
UT-16751	50.0	27.0	50.0	36.0	1.39	17	13	4	--
	40.0	21.0	46.5	35.0	1.32	----	----	--	--
	30.0	18.5	51.5	36.5	1.41	----	----	--	--
UT-16758	50.0	20.0	49.0	40.0	1.22	18	15	3	--
	40.0	21.0	47.5	37.5	1.27	----	----	--	--
UT-18004	99.0	28.5	39.0	27.5	1.43	----	----	--	--
	75.0	26.5	41.0	32.0	1.29	----	----	--	--
	60.0	23.5	46.5	34.0	1.37	----	----	--	--
	50.0	------	49.0	34.0	1.44	----	----	--	--
UT-18029	72.0	24.5	48.5	36.0	1.35	18	18	--	--
	47.0	19.5	52.0	42.5	1.22	----	----	--	--
UT-18036	69.0	31.0	37.0	27.0	1.43	19	11	8	--
	60.0	30.0	40.0	30.0	1.33	20	11	9	--

Continued on page 67

can be assigned to *Budaiceras hyatti* (Shattuck). Most are incomplete phragmacones, but two or three contain most of the body chamber. *B. hyatti* differs from *B. alticarinatum*, n. sp., primarily in the development of the very high keel in *B. alticarinatum*. Comparisons with *B. elegantior* (Lasswitz) are given with the description of that species.

Horizon and localities.—*Budaiceras hyatti* (Shattuck) defines the zone carrying that name. Where this fossil occurs in clay formations, as in the upper part of the Del Rio Formation in northeast Chihuahua and in the upper part of the Grayson Formation of north Texas, those occurrences are thought to be equivalent to the Buda Limestone of central Texas. There are many specimens from Hays, Travis, and Williamson counties of central Texas. In Trans-Pecos Texas *B. hyatti* has been collected in Brewster, Jeff Davis, Val Verde, Terrell, and Hudspeth counties. On the Edwards Plateau the species has been collected from Val Verde, Edwards, Sutton, and Uvalde counties. In north Texas *B. hyatti* has been collected from the upper part of the Grayson Formation in Hill County, and from the Modlin Limestone Member of the Grayson Formation in Denton and Grayson counties. Böse collected *B. hyatti* from the Buda Limestone at El Remolino and Tinaja de la Huerfana, Coahuila, and Kellum and Mintz (1962) described the species, as *Buda-*

iceras mexicanum Böse, from the Indidura Formation, Sierra de Tlahualilo, southwestern Coahuila. The species has also been collected from the Sierra Pinosa and Sierra Pilares, northeastern Chihuahua.

	D	U	H	W	H/W	T	P	S	B
	50.0	29.0	46.0	32.0	1.44	20	12	8	--
	40.0	26.0	46.5	32.5	1.42	20	13	7	--
	30.0	26.5	43.5	33.5	1.30	----	----	--	--
	25.0	26.0	42.0	------	------	----	----	--	--
UT-19836-A	39.0	25.5	43.5	31.0	1.43	17	15	--	1
	30.0	25.0	41.5	31.5	1.32	----	----	--	--
	25.0	24.0	44.0	36.0	1.22	----	----	--	--
UT-19844	50.0	27.0	45.0	------	------	23	17	6	--
	40.0	26.0	42.5	------	------	----	----	--	--
	30.0	26.5	48.5	------	------	----	----	--	--
	20.0	------	57.5	------	------	----	----	--	--
UT-31480	77.0	33.0	38.5	26.0	1.47	----	----	--	--
	52.0	28.0	46.0	31.0	1.50	----	----	--	--
BEG-35248	76.5	30.0	37.5	27.5	1.36	20	20	--	--
	60.0	25.0	45.0	31.5	1.42	20	20	--	--
	50.0	26.0	50.0	32.0	1.56	----	----	--	--
	40.0	23.5	52.5	34.0	1.56	----	----	--	--
Lasswitz	38.5	24.5	41.5	------	------	14	14	--	--
Pl. 6	30.0	23.5	41.5	------	------	----	----	--	--
Fig. 4	25.0	20.0	46.0	------	------	----	----	--	--

BUDAICERAS ELEGANTIOR (Lasswitz, 1904)

pl. 8, figs. 1-9, 12-14, 16, 18; pl. 9, figs. 3-5, 9-12, 16; text figs. 11i, w, z, kk, nn-rr

Schloenbachia roemeri var. *elegantior* Lasswitz, 1904, p. 28, pl. 6, fig. 5a

Schloenbachia evae Lasswitz, 1904, p. 29, pl. 8, fig. 2

Budaiceras mexicanum Böse, 1928, pro parte, pl. 9, figs. 18-23 only

Budaiceras sp. Böse, 1928, pl. 18, fig. 7; Adkins, 1928, p. 236, pl. 23, fig. 1

Budaiceras evae (Lasswitz) in Adkins, 1928, p. 237, pl. 23, fig. 2

Budaiceras roemeri var. *elegantior* (Lasswitz) in Adkins, 1928, p. 237, pl. 23, fig. 4

Holotype.–The holotype is the specimen figured by Lasswitz (1904, pl. 6, fig. 5a) and Adkins (1928, pl. 23, fig. 4); it was from the Buda Limestone at Austin, Travis County, Texas. The specimen was at the University of Breslau (Wroklaw) when Adkins photographed it prior to 1928. The collection at Breslau now seems to have been either lost or destroyed. As a neolectotype I select UT-16750, from the Buda Limestone, Barton Creek, Austin, Travis County, Texas, F. L. Whitney Collection, illustrated on plate 8, figures 1-3.

Specific description.—Conch with few whorls; the umbilical walls slope into a narrow, rapidly expanding umbilicus. At diameters of less than 60 mm U ranges from 12.5 to 26.5, whereas at greater diameters U ranges from 19.0 to 34.5. The higher figures probably represent adult specimens on which the body chamber overlaps less of the flank. Whorl height is greater than whorl width, H/W ranging from 1.2 to 1.5; greater figures in the table probably represent specimens that have been flattened by sedimentary load. The whorl section is suboval intercostally and costally, the intercostal appearing slightly tabulate on some specimens, and the costal section appearing more shouldered when ventrolateral clavi are present, and with a peak peripherally where there are peripheral clavi. Greatest whorl width is just ventrad of the umbilicus, and when umbilical bullae are present the greatest width is at the umbilical bullae, at about one-fifth of the flank, and intercostally at from one-third to one-half of the flank.

Costation is sparse to moderate, the number of ribs per volution ranging from 18 to 42. The number of primary ribs ranges from 11 to 28 per volution, and the number of secondary from 2 to 14; ribs are frequently falcoid, and the greater the number of ribs on the whorl, the greater the falcoid shape of those ribs. Umbilical bullae and ventrolateral nodes are small, the latter being slightly projected and clavate. Small, peripheral clavi


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PLATE 8

Figs. *1-9, 12-14, 16, 18—Budaiceras elegantior* (Lasswitz); *1-3,* lateral and ventral views of UT-16750, the neolectotype, from the Buda Limestone, Bartons Creek, Travis County, Texas; F. L. Whitney Collection; *4-6,* lateral and ventral views of UT-14132-B *(see also* text fig. 11nn), from the Buda Limestone, Shoal Creek, Travis County, Texas; F. L. Whitney Collection; *7, 8,* lateral and ventral views of UT-19829 *(see also* text fig. 11qq), from the nodular (middle) member of the Buda Limestone, 1.6 kms east of the junction of highways 41 and US 377, Edwards County, Texas; collected by Bob Lowe; *9,* lateral view of UT-47896 *(see also* text fig. 11oo), from the Buda Limestone, Shoal Creek, Austin, Travis County, Texas; F. L. Whitney Collection; *12, 14,* ventral and lateral views of UT-16755 *(see also* text fig. 11z), from the Buda Limestone, Shoal Creek, Austin, Travis County, Texas; F. L. Whitney Collection; *13,* lateral view of UT-17386, a higher whorled specimen *(see also* text figs. 11w, rr), from the Buda Limestone at Manchaca Road and Williamson Creek, Travis County, Texas; collected by W. R. Muehlberger and K. Young; *16, 18,* lateral and ventral views of WSA-12335, from the Buda Limestone near Black Gap, Brewster County, Texas; collected by Duncan Wilson; *all,* X 1.

10, 11, 15, 17, 23—Stoliczkaia scotti Breistroffer; *10, 15,* ventral and lateral views of UT-47893 *(see also* text fig. 10d), from the Del Rio Formation, west side of the Sierra del Carmen, northern Coahuila, Mexico; collected by C. L. Baker; *11,* ventral view of WSA 6032 *(see also* pl. 7, fig. 11, and text fig. 10e) from the upper 8 ms of the Grayson Formation, Grayson Point, northeast of Roanoke, Denton County, Texas; collected by Roy T. Hazzard; *17, 23,* lateral and ventral views of WSA-16205, from the top of the Del Rio Formation, San Rafael, northern Coahuila, Mexico; collected by W. E. Bloxsom; *all,* X 1.

19-22, 24–Budaiceras hyatti (Shattuck); *19,* ventral view of UT-16743 *(see also* pl. 7, figs. 2-4, and text fig. 11ii), from the lower member of the Buda Limestone, Shoal Creek, Austin, Travis County, Texas; F. L. Whitney Collection; *20, 21,* lateral and ventral views of UT-18029 *(see also* text figs. 11h, hh), from the lower member of the Buda Limestone, Onion Creek, Hays County, Texas; F. L. Whitney Collection; *22,* ventral view of UT-18036 *(see also* pl. 7, figs. 8, 10, 13, and text figs. 11dd-gg, jj), from the Buda Limestone, Austin, Travis County, Texas; F. L. Whitney Collection; *24,* lateral view of WSA-6142, from the nodular (middle) member of the Buda Limestone, highway 41, near the junction with the road to the Devils Sink Hole, Edwards County, Texas; collected by Roy T. Hazzard; *all,* X 1.

appear on the venter at all stages. There are many more siphonal (peripheral) clavi than ribs, and it is on specimens assigned to this species by the writer for which the two-to-one ratio is given by Wright (Arkell, Kummell, and Wright, 1957, p. L410). UT-957, pl. 9, figs. 9, 10, has approximately 13 peripheral clavi per 8 ribs. On WSA-6136 there is one peripheral clavum per rib to the 22 mm diameter; on this specimen there are no ribs prior to the 20 mm diameter, although there are already peripheral clavi. UT-14132-A shows 21 peripheral clavi per 10 ribs; on the first half of this specimen there are good ventrolateral clavi at the ends of the ribs, but on the latter part of this whorl fragment there are no clavi at the ends of the ribs. This latter area is apparently approaching the body chamber, although this specimen is septate throughout. Another specimen has 14 clavi per 8 ribs (5 primary and 3 secondary). On UT-17383 there are ribs prior to the 10 mm diameter, crossing the venter up to a diameter of 11 mm. UT-18001 is a small specimen assigned to this species, and on this specimen, which has a maximum diameter of 25 mm, there is only one peripheral clavus per rib; clavi appear at a diameter of 11.5 mm on this specimen. UT-18039, which reaches a diameter of only 42 mm, has only 13 peripheral clavi per 10 ribs. UT-19837 has sharp shoulder clavi throughout, and there is one siphonal clavus per rib up to the 50 mm diameter, and more siphonal clavi than ribs beyond that diameter. UT-31813, which is probably a juvenile of this species, has a maximum diameter of about 20 mm; there is one peripheral clavus per rib at this diameter, and faint ribs connect the peripheral clavae to the ventrolateral ends of the ribs at this diameter; the ribs on the flank appear at about the 14 mm diameter, but peripheral clavi appear a little earlier. BEG-35235, which is a specimen illustrated by Böse (1928, pl. 9, figs. 19-20), has 14 peripheral clavi per 8 ribs, and it is this specimen that is responsible for the statement of Böse

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(1928, p. 260) and presumably the figures given by Wright (Arkell, Kummel, and Wright, 1957, p. L410) that there are twice as many peripheral clavi as ribs. Thus, it is easy to see that beyond the diameter of 40 or 50 mm there are many more peripheral clavi than ribs, but the number of peripheral clavi seems to be independent of the number of ribs and varies greatly from specimen to specimen and from ontogenetic stage to ontogenetic stage. Likewise, there is a variation in the diameter of disappearance of the ventrolateral clavi, some specimens retaining them to near the body chamber, but other specimens losing them much earlier. There is also great variation in the diameters at which ribs and peripheral clavi first appear, but the peripheral clavi almost always appear first.

Overlap is to between one-third and one-half of the flank. The body chamber in this species is unknown, as is the aperture. Although there are some variations, the suture has a wide first lateral saddle, and the first lateral lobe is narrow and is likely to be as long as or longer than the siphonal lobe. Sutural elements are generally reduced.

Measurements are shown on page 72.

Remarks.—*Bucaiceras elegantior* (Lasswitz) is well named and constitutes a very pretty little ammonite species. It does not have the more robust ribbing of *B. hyatti* (Shattuck). *B. elegantior* differs from *B. alticarinatum*, n. sp., in the development of the high carina, upon which the peripheral clavi are situated, in the latter. Also the suture of *B. alticarinatum* has a narrower saddle than does that of *B. elegantior,* based on the rather limited sample of sutures available. Well over 100 specimens from the Texas Memorial Museum's collections, The University of Texas at Austin, have been assigned to Lasswitz's species, *B. elegantior.*

There is a rather continuous morphological gradation from *B. hyatti* to *B. elegantior,* and one might claim that they do not constitute two separate species, and at the most are subspecies or varieties. Since they can be differentiated, it seemed convenient to keep the two species separate; one of Böse's species and one of Lasswita's species have been placed in synonymy with *B. elegantior.* The usual measurements that are reported for ammonites are at best unsatisfactory, and when there is distortion by sedimentary and diagenetic processes they become even worse. When one compares U against D for *B. elegantior* and *B. hyatti,* there is no significant difference (text figs. 17 and 18). The same statement can be made for comparisons of H versus D and U versus H (text figs. 19-22). However, a comparison of the means of the number of ribs per whorl resulted in a highly

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PLATE 9

Figs. *1, 2, 15, 17-19*—***Budaiceras alticarinatum***, n. sp.; *1, 15, 19,* ventral and lateral views of UT-18018 *(see also* text fig. 11x), from the Buda Limestone, central Texas; F. L. Whitney Collection; *2, 18,* lateral and ventral views of UT-19695, the holotype *(see also* text fig. 11cc), from the Buda Limestone on Sink Creek, Hays County, Texas; collected by Kenneth J. DeCook; *17,* lateral view of WSA-13669, from the Buda Limestone, Shoal Creek, Austin, Texas; *all,* X 1.

3-5, 9-12, 16—***Budaiceras elegantior*** (Lasswitz); *3, 4, 16,* lateral and ventral views of a juvenile, UT-18014-A, from the Buda Limestone, Bear Creek, Travis County, Texas; F. L. Whitney Collection; *5, 11, 12,* lateral and ventral views of UT-18002, a sutured specimen *(see also* text figs. 11i, pp), from the lower member of the Buda Limestone, Manchaca, Travis County, Texas; F. L. Whitney Collection; *9, 10,* lateral and ventral views of UT-957 *(see also* text fig. 11kk), from the Buda Limestone, Blanco River, Hays County, Texas; F. L. Whitney Collection; *3, 11, 12,* X 2; *4, 5, 9, 10, 16,* X 1.

6-8—***Budaiceras*** sp. juv.; lateral and ventral views of WSA-6200 *(see also* text fig. 11aa), a specimen showing an unornamented venter, except for peripheral clavi at a very early diameter, from the Buda Limestone, nodular (middle) member, at the intersection of highway 41 and the road to the Devil's Sink Hole, Edwards County, Texas; collected by Roy T. Hazzard; X 2.

13, 14—***Stoliczkaia scotti*** Breistroffer; lateral and ventral views of UT-47890, from the Del Rio Formation, west side of the Sierra del Carmen, northern Coahuila, Mexico; collected by C. L. Baker; X 1.

	D	U	H	W	H/W	T	P	S	B
UT-19845	44.5	15.7	52.0	30.5	1.70	42	28	14	--
UT-17384	37.0	24.5	67.5	28.5	2.34	24	22	2	--
BEG-35235	46.0	-------	49.0	31.5	1.55	28	24	4	--
UT-13372	40.5	13.5	50.5	26.0	1.94	28	22	6	--
UT-43364	55.5	17.0	51.5	29.0	1.76	32	26	6	--
UT-18014-B	51.0	17.6	41.0	32.5	1.27	34	?	?	--
UT-14132-A	45.5	19.7	50.5	34.0	1.48	34	26	8	--
UT-31813	20.5	17.0	51.0	34.0	1.50	34	?	?	--
WSA-267-C	47.0	25.5	44.5	-------	-------	24	11	2	--
WSA-266-A	33.5	16.5	49.5	-------	-------	32	?	?	--
UT-6234	48.5	19.5	44.5	-------	-------	26	21	5	--
WSA-266-B	32.5	23.0	44.5	-------	-------	26	18	8	--
WSA-6136	40.0	20.0	47.5	27.5	1.73	----	----	----	--
WSA-12501	62.0	-------	50.0	34.0	1.47	----	----	----	--
WSA-253	61.0	21.5	51.0	35.5	1.44	28	22	6	--
UT-45714	61.0	26.5	44.5	30.5	1.45	34	24	10	--
UT-40661	50.0	18.0	50.0	-------	-------	24	22	2	--
WSA-4497	63.0	19.0	47.5	30.0	1.58	----	----	----	--
UT-19844	57.0	17.5	51.0	33.5	1.52	32	14	10	2
UT-19837-A	46.5	17.0	51.5	31.5	1.62	25	?	?	?
UT-38273	56.5	26.5	47.0	27.5	1.71	----	----	----	--
UT-43373	48.0	21.0	52.0	-------	-------	18	16	2	--
UT-43365	55.0	12.5	38.0	19.0	2.00	26	22	4	--
UT-957	68.0	23.5	41.0	27.0	1.51	28	22	6	--
WSA-13685	83.5	21.5	47.0	23.0	2.05	----	----	----	--
	32.0	18.5	50.0	34.5	1.45	----	----	----	--
WSA-18054	73.0	20.5	48.0	31.0	1.56	----	----	----	--
WSA-4231	33.0	21.0	42.5	32.0	1.36	28	22	6	--
UT-267-D	26.0	23.0	44.5	27.0	1.65	26	20	6	--
UT-38267	24.0	16.5	53.5	31.0	1.74	34	?	?	?
UT-6623	82.0	24.0	42.0	-------	-------	22	18	4	--
UT-43790	73.5	23.0	45.0	-------	-------	25	20	5	--
UT-18044	43.0	15.0	37.0	25.5	1.45	28	27	1	--
UT-270	78.0	29.5	43.0	31.5	1.37	27	14	13	--
	60.0	26.0	46.0	31.0	1.45	----	----	----	--
	50.0	20.0	45.0	-------	-------	----	----	----	--
WSA-6136	40.0	28.5	42.5	32.5	1.31	25	15	10	--
	29,0	19.0	48.5	32.5	1.47	----	----	----	--
	23.0	15.0	50.0	32.5	1.53	----	----	----	--
	18.0	14.0	52.5	36.0	1.46	----	----	----	--
UT-14132-B	43.5	22.0	49.5	32.0	1.54	----	----	----	--
	30.0	-------	50.0	30.0	1.67	----	----	----	--
UT-16744	60.0	20.0	47.0	31.0	1.51	23	15	8	--
	50.0	20.0	50.0	36.0	1.38	----	----	----	--
	40.0	21.0	50.0	37.5	1.33	----	----	----	--
	26.0	19.0	54.0	-------	-------	----	----	----	--
UT-16745	45.0	20.0	50.0	35.5	1.41	----	----	----	--
	40.0	18.5	50.0	35.0	1.43	----	----	----	--
	30.0	16.5	50.0	33.5	1.50	----	----	----	--
UT-16750	40.0	22.5	43.5	-------	-------	26	12	14	--
	30.0	23.5	46.5	-------	-------	----	----	----	--
	25.0	22.0	44.0	-------	-------	----	----	----	--
UT-16755	50.0	22.0	44.0	29.0	1.52	25	15	10	--
	40.0	20.0	45.0	32.5	1.38	----	----	----	--
	30.0	20.0	46.5	33.5	1.40	----	----	----	--
UT-17371	47.5	21.0	48.5	30.5	1.52.	----	----	----	--
	30.5	-------	54.0	33.0	1.65	----	----	----	--
UT-17383	24.5	20.5	45.0	35.0	1.29	----	----	----	--
	11.0	22.5	54.5	45.5	1.20	----	----	----	--
UT-18049	42.0	-------	-------	-------	-------	29	16	13	--
UT-19829	44.5	18.0	51.5	31.5	1.64	----	----	----	--
	30.0	-------	46.5	-------	-------	----	----	----	--
	25.0	-------	44.0	-------	-------				

Continued on page 73

significant difference (T= 10.32 at 0.95) (text figs. 23, 24), especially when it is remembered that the continuum was not split entirely on rib differences alone.

Horizon and localities.—*Budaiceras elegantior* (Lasswitz) is not known to occur outside of the zone of *Budaiceras hyatti.* It was collected from north Texas by Adkins from the upper part of the Grayson Formation, 7.2 km east of Denison, Grayson County, Texas. There are specimens from Hays, Travis, and Williamson counties, Texas, from the Buda Limestone. Across the Edwards Plateau specimens have been collected in Crockett, Edwards, Val Verde, and Hudspeth counties. Böse (1928) collected the species at El Remolino, Coahuila, Mexico. All specimens are from the upper part of the Lower Cenomanian, and, except for the collection by Adkins from the Grayson Formation in Grayson County, all specimens are from the Buda Limestone.

BUDAICERAS ALTICARINATUM, n. sp.

pl. 9, figs. 1, 2, 15, 17-19; text figs. 11, 11cc

Budaiceras sp. Young, 1959, p. 82, fig. 16 and p. 83, fig. 1; Young, 1960, p. 45, fig. 16 and p. 46, fig. 1

Holotype.—The holotype is UT-19695, and is float from the Buda Limestone, 30 ms upstream from the crossing of Sink Creek at Lime Kiln Road, Hays County, Texas, collected by Kenneth J. DeCook in 1955.

Specific description.—Conch is with few whorls, and the umbilical wall slopes into a shallow, rapidly expanding umbilicus of moderate width. U ranges from 18 to 21 at the 50 mm diameter and from 20 to 25 at greater diameters. The whorl section is higher than wide, decreasing in height, relative to width, to a diameter of about 75 mm, and thereafter increasing again. The first two steps of this H/W ontogeny are normal to the genus *Budaiceras,* but the third step, of H/W is the result of the rapid rise of the carinate venter ventrad of the ribs. H/W ranges from about 1.35 to 1.63. The whorl section is more oval in the younger whorls, intercostally becoming narrower and fastigate in adult whorls. The costal whorl section is similar to the intercostal but shouldered very remarkably. Although the shoulder is present on the intercostal section, it is not nearly as strong. The greatest whorl width ranges from the first third to the first half of the flank, both costally and intercostally. Costation is moderate, with 27 more or less ribs per whorl. The ribs are straight to slightly sigmoid or flexuous, and rectiradiate to slightly prosiradiate.

Tuberculation consists of very long, low bullae, at or near the umbilicus, frequently so weak as to be difficult to observe, of fairly pronounced ventrolateral clavi, and a series of peripheral clavi that are more numerous than the ribs, but never twice as numerous as the ribs. On the early whorls the peripheral clavi are situated on the midline of the venter, and as the keel develops at about the 40 mm diameter the peripheral clavi are on the raised keel. The ventrolateral clavi are on the ventral ends of regularly and ventrally expanding, club-shaped ribs; nearly all ribs are primary.

	D	U	H	W	H/W	T	P	S	B
UT-19837	56.5	19.5	50.5	33.5	1.50	----	----	----	--
	40.0	-------	47.5	-------	-------	----	----	----	--
UT-30536	54.0	19.5	50.0	31.5	1.59	32	18	14	--
	40.0	21.5	50.0	32.5	1.55	----	----	----	--
	34.0	17.5	47.0	31.0	1.52	----	----	----	--
	25.0	-------	48.0	-------	-------	----	----	----	--
UT-31813	20.0	22.5	50.0	32.5	1.54	----	----	----	--
	13.0	21.5	50.0	34.5	1.43	----	----	----	--
Lasswitz	61.0	22.0	47.5	-------	-------	----	----	----	--
Pl. 8, Fig. 3	50.0	22.0	48.0	-------	-------	----	----	----	--
	40.0	20.0	50.0	-------	-------	----	----	----	--
WSA-12335	51.0	17.5	49.0	27.5	1.78	32	?	?	?
	34.5	19.0	49.0	30.5	1.63	----	----	----	--
UT-16756	53.0	18.0	51.0	36.0	1.42	----	----	----	--
UT-30538	30.0	16.5	48.5	28.5	1.71	----	----	----	--
UT-6622	87.5	34.5	36.5	25.0	1.45	----	----	----	--
	51.0	20.5	49.0	27.5	1.79	----	----	----	--
WSA-2345	60.0	25.0	41.5	25.0	1.76	24	24	----	--
	46.5	-------	40.0	25.0	1.61	----	----	----	--
UT-6200	24.5	12.0	53.0	28.5	1.86	----	----	----	--
UT-6264	102.0	23.0	47.0	24.5	1.92	31	25	6	--
	69.0	17.5	52.0	30.0	1.75	----	----	----	--
	42.0	21.5	51.0	30.0	1.72	----	----	----	--
UT-19852	50.0	19.0	49.0	31.0	1.58	26	20	6	--
WSA-4228-A	57.0	28.0	49.0	-------	-------	26	26	----	--

The aperture is unknown, but the body chamber retains the ornamentation of the phragmacone, except that it is not quite so strong. Whether such ornamentation continued to the aperture is not known. Overlap is to between the first third and half of the flank.

The suture has a very wide siphonal lobe, apparently to make up for the high and broad keel, but surprisingly enough a rather narrow first saddle compared to other species of *Budaiceras.* The first lobe is much shorter and smaller than the ventral lobe; suspensive lobes are foliated and saddles are simple.

Measurements are shown on page 74.

Remarks. The immediately most noticeable difference between *B. alticarinatum,* n. sp., and other species of *Budaiceras* is in the development of the high carina that is broad at the base beyond the diameter of about 10 or so mm. *B. alticarinatum* is also distinctive in a preponderance of primary ribs in all specimens. Whether WSA-6200 (pl. 9, figs. 6-8) is a juvenile of *B. elegantior* or a juvenile of *B. alticarinatum* cannot yet be determined.

Horizon and localities.—Eight specimens of *Budaiceras alticarinatum*, n. sp., are known. One of these, UT-18018, has no locality or horizon data. Insofar as is known, *B. alticarinatum* does not occur outside of the zone of *Budaiceras hyatti*. The holotype was found as float from the Buda Limestone, Hays County, central Texas. UT-13669 and UT-18026 are from the Buda Limestone, Shoal Creek, Austin, Travis County, F. L. Whitney Collection. UT-9091 was collected by J. R. Underwood from the Buda Limestone, Eagle Mountains, Hudspeth County, Texas, and UT 19904 was collected by D. L. Amsbury from the Buda Limestone, Pinto Canyon Area, Hudspeth County, Texas. Still another specimen was collected by Adkins and Twining on Dagger Flat, Big Bend National Park, Brewster County, Texas and there is an eighth specimen from Hays County, Texas.

	D	U	H	W	H/W	T	P	S	P
UT-18018	88.5	25.0	45.0	29.5	1.54	----	----	----	--
	72.5	20.5	45.5	33.0	1.37	----	----	----	--
	64.5	19.5	48.0	34.0	1.41	----	----	----	--
	49.0	18.5	49.0	-------	-------	----	----	----	--
WSA-13669	90.0	23.0	46.0	30.0	1.54	23	23	----	--
	66.0	21.0	53.0	33.5	1.58	----	----	----	--
	34.0	------	56.0	29.5	1.90	----	----	----	--
UT-19695	75.0	24.5	46.5	33.5	1.40	25	25	----	--
	50.0	21.5	48.5	32.5	1.52	----	----	----	--
	40.0	21.0	47.0	29.0	1.63	----	----	----	--

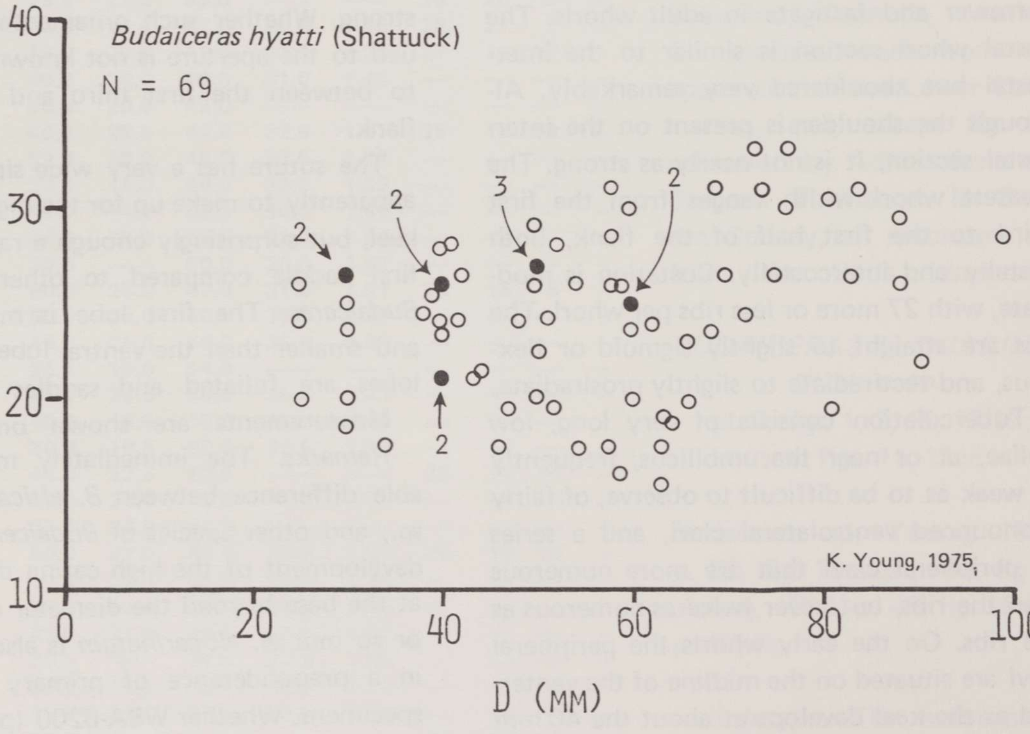

FIGURE 17

Scatter plot of U and D for *Budaiceras hyatti* (Shattuck); compare with figure 18.

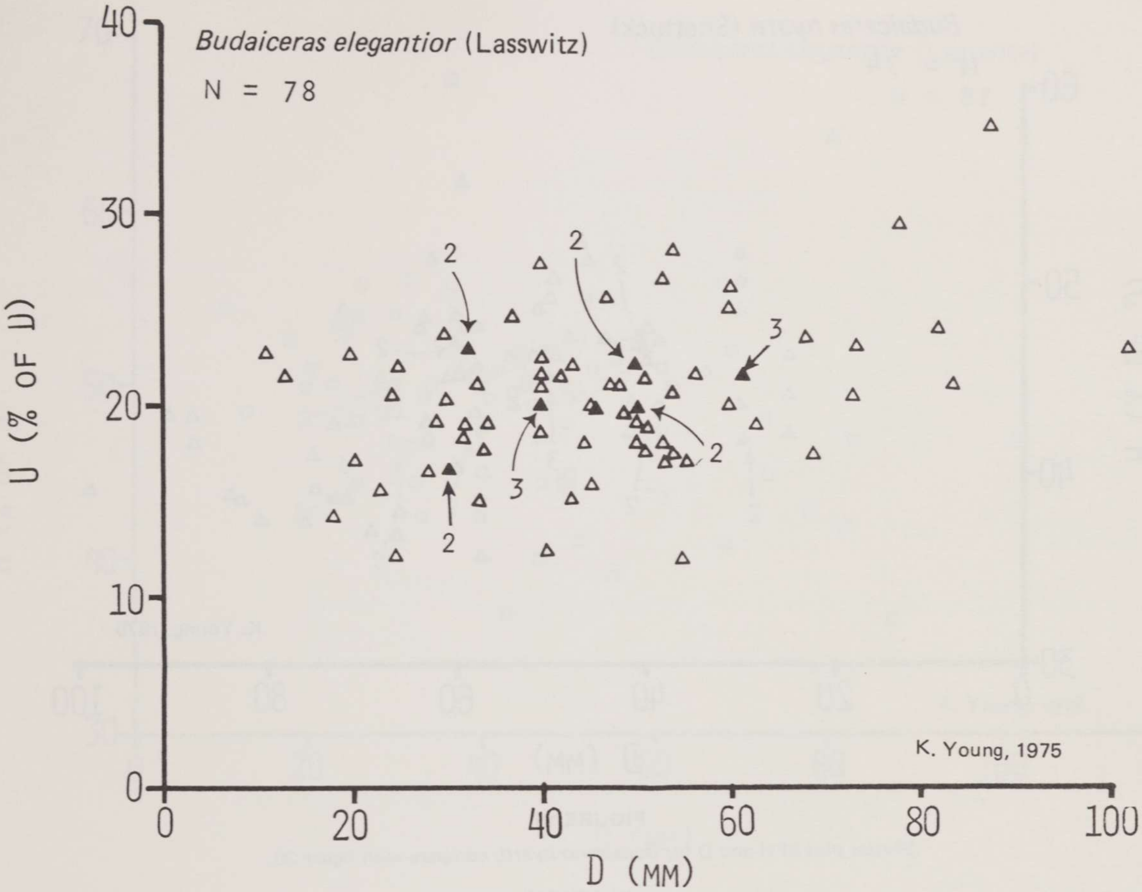

FIGURE 18

Scatter plot of U and D for *Budaiceras elegantior* (Lasswitz); compare with figure 17.

REGISTER OF LOCALITIES

This register of localities contains locality descriptions for all collections of ammonites from the Buda Limestone known to me. The register for other formations includes only localities of collections I have studied and is incomplete.

ARIZONA

Molly Gibson Formation, west of the Molly Gibson Mine, Patagonia Mountains, Ariz.; Alexander Stoyanow.
Stoliczkaia scotti Breistroffer
[= *S. Scotti* Stoyanow,
S. arizonica Stoyanow,
and *S. excent rumbilicata* Stoyanow]

BELL COUNTY, TEXAS

Denton Formation, between 31°00′ and 31°05″ latitudes N and 97°25′ and 97°30′ longitudes W, vicinity of Belton, Bell County; W. S. Adkins.
Faraudiella sp. cf. *F. rhamnonota* (Seeley)

Main Street Limestone, top; Love Farm, 3.7 kms south of Salado, Bell County; W. S. Adkins.
Stoliczkaia crotaloides (Stoliczka)

Main Street Limestone, Love Farm, 3.7 kms south of Salado, Bell County; W. S. Adkins.
Faraudiella sp. cf. *F. rhamnonota* (Seeley)

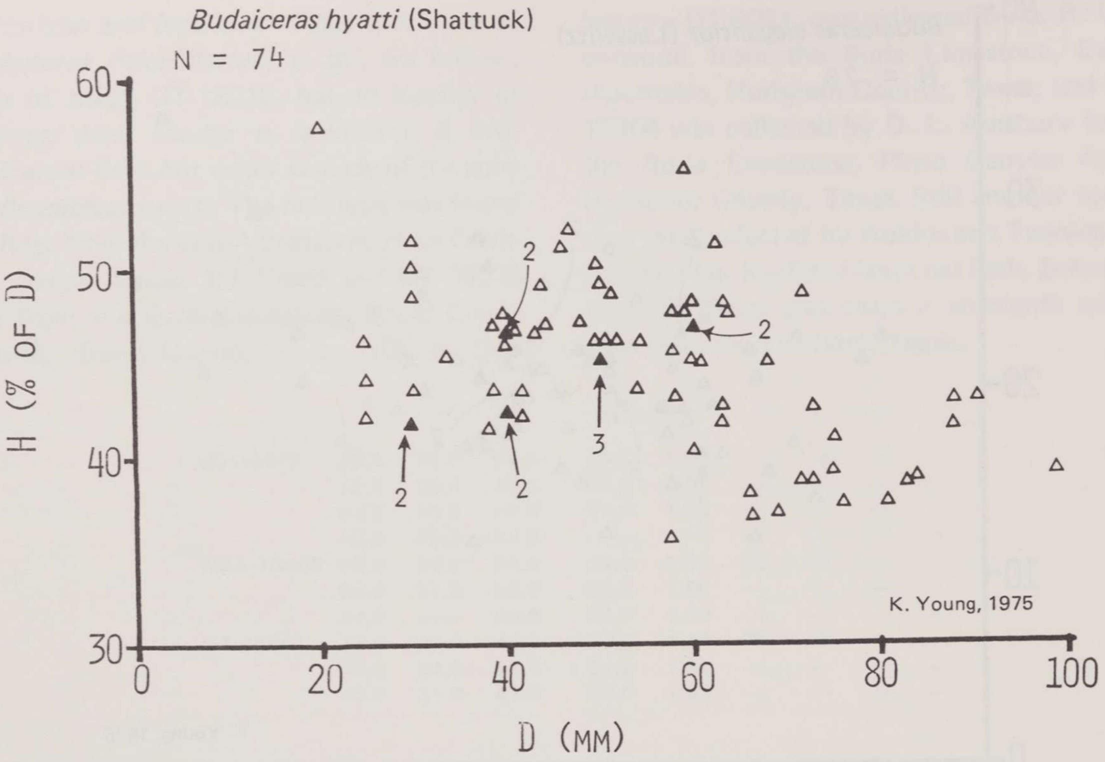

FIGURE 19

Scatter plot of H and D for *Budaiceras hyatti;* compare with figure 20.

Main Street Limestone, top; south bank of Lampasas River, east of Interstate Hwy. 35 along county road, Bell County; K. Young.

Graysonites adkinsi Young

BREWSTER COUNTY, TEXAS

Buda Limestone; Gray Hill, Agua Fria Quadrangle, Brewster County; C. Gardley Moon; Bob F. Perkins.

Budaiceras hyatti (Shattuck)

Faraudiella franciscoensis (Kellum and Mintz)

11-14 ms above base; Bob F. Perkins

Budaiceras elegantior (Lasswitz)

Buda Limestone; Hood Springs Quadrangle, Brewster County; Roy Graves.

Budaiceras elegantior (Lasswitz)

Buda Limestone; Dagger Flat, Big Bend Park; W. S. Adkins and John T. Twining.

Budaiceras alticarinatum, n. sp.

Buda Limestone; north of road and northeast of Black Gap, Black Gap Area, Brewster County, Texas; Roy T. Hazzard.

Faraudiella roemeri (Lasswitz)

F. texana (Shattuck)

Budaiceras hyatti (Shattuck)

B. elegantior (Lasswitz)

Buda Limestone; Black Gap Area, Brewster County; Roy T. Hazzard; Duncan Wilson.

Faraudiella texana (Shattuck)

Budaiceras hyatti (Shattuck)

B. elegantior (Lasswitz)

13-15 ms above base

Budaiceras elegantior (Lasswitz)

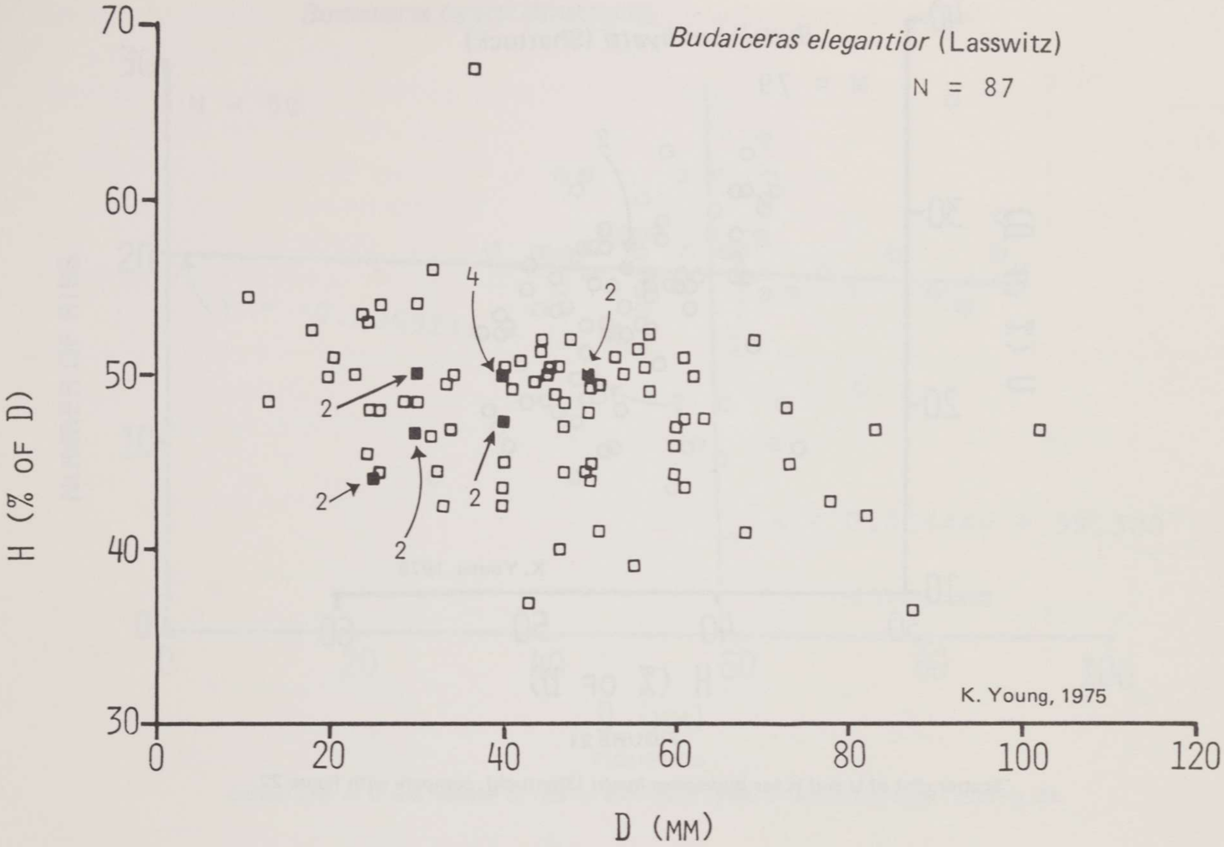

FIGURE 20

Scatter plot of H and D for *Budaiceras elegantior* (Lasswitz); compare with figure 19.

Buda Limestone, San Francisco Creek, Brewster County, Bob F. Perkins.

Budaiceras hyatti (Shattuck)

22 ms below base of overlying Boquillas Formation; Bob F. Perkins.

Budaiceras elegantior (Lasswitz)

Buda Limestone, 17-18 ms above base, northwest corner of section 60, San Francisco Creek, Brewster County; Bob F. Perkins.

Faraudiella texana (Shattuck)

CHIHUAHUA, MEXICO

Del Rio Formation; Rancho la Bamba, northwest side of small hill of Buda Limestone, two-thirds km west of ranch house, west side of the Sierra Lágrima, northeastern Chihuahua; W. T. Haenggi, John Gries, K. Young.

Sciponoceras sp. cf. *S. baculoides* (Mantell)

Turrilites bosquensis (Adkins)

T. multipunctatus (Böse)

Scaphites bosquensis (Adkins)

Otoscaphites subevolutus (Böse)

Eoscaphites sp. cf. *E. tenuicostatus* Pervinquière

Scaphites sp. cf. *S. hugardianus* d'Orbigny

Ficheuria sp. aff. *F. pernoni* Dubourdieu

Prionocycloides sp. cf. *P. proratum* (Pervinquière)

Graysonites (?) sp. juv.

Del Rio Formation [float (?)]; northern Sierra Pilares, Northeastern Chihuahua; Alton Ferrell.

Budaiceras hyatti (Shattuck)

Faraudiella texana (Shattuck)

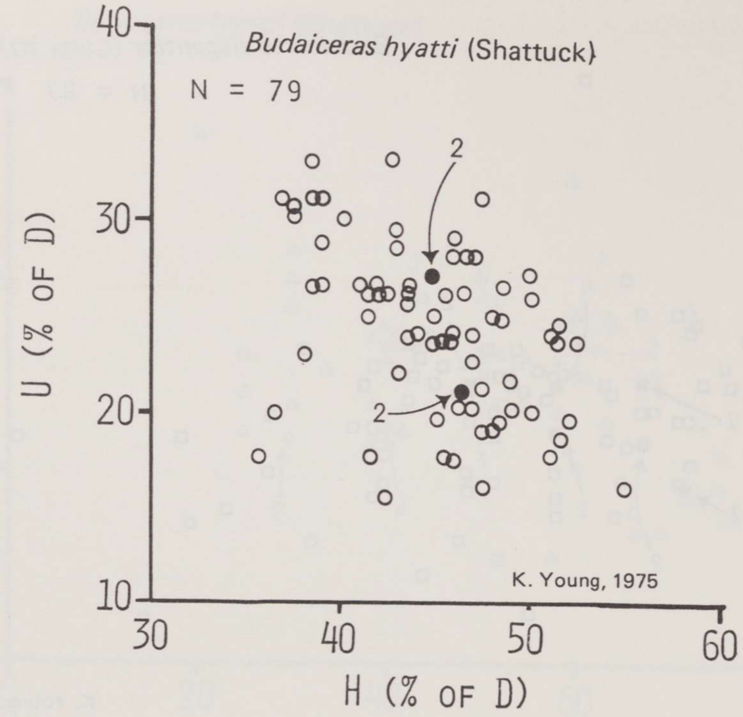

FIGURE 21

Scatter plot of U and H for *Budaiceras hyatti* (Shattuck); compare with figure 22.

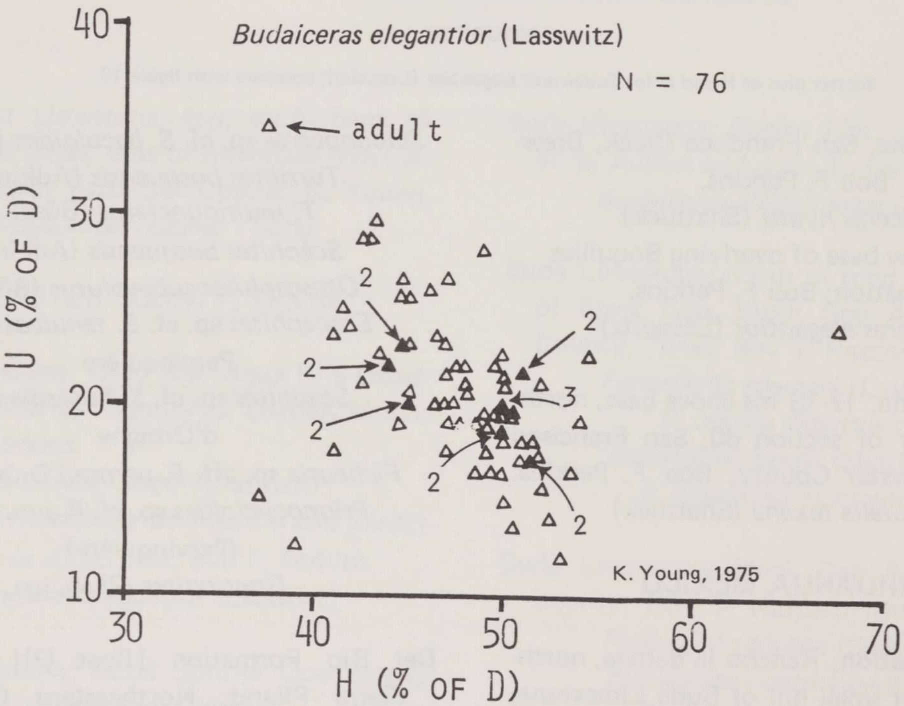

FIGURE 22

Scatter plot of U and H for *Budaiceras elegantior* (Lasswitz); compare with figure 21.

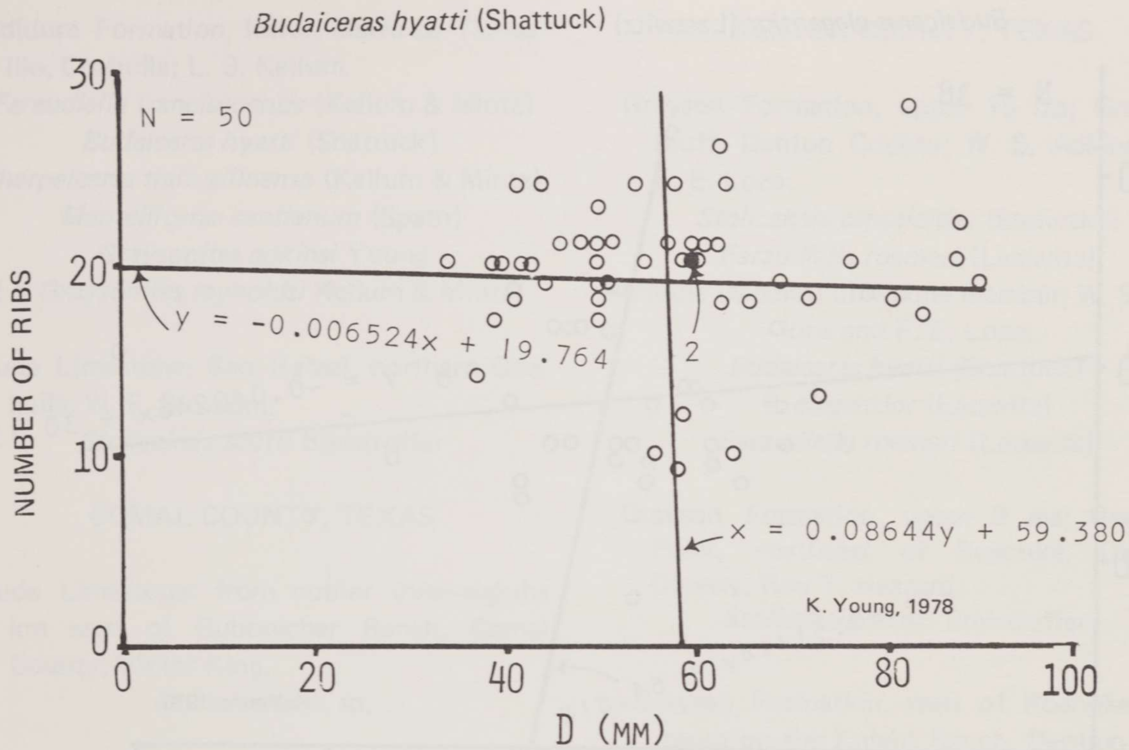

FIGURE 23

Scatter plot of D and number of ribs for *Bucaiceras hyatti* (Shattuck); compare with fig. 24.

Buda Limestone, 39 ms from the top; Sierra Piñosa, northeast Chihuahua; J. C. Nichols.
Budaiceras hyatti (Shattuck)

Buda Limestone; El Banquete, Chihuahua, 8 kms west of Ruidosa, Texas; W. T. Haenggi.
Faraudiella texana (Shattuck)
Budaiceras hyatti (Shattuck)

COAHUILA, MEXICO

Salmon Peak Formation, near top; Arroyo del Tule, cliff 2.5 kms from San Lorenzo, 50 kms from Villa Acuña on the road to the headquarters of the San Miguel Ranch, Coahuila; Emil Böse.
Graysonites wooldridgei Young
Plesioturrilites brazoensis (Römer)

Del Rio Formation; west side of the Sierra del Carmen, northern Coahuila; C. L. Baker.
Stoliczkaia scotti Breistroffer

Del Rio Formation, near base; small hill just south of road to new quarry on southwest flank of Sierra de la Gloria, south of Monclova, Coahuila; F. E. Lozo.
Stoliczkaia crotaloides (Stoliczka)

Del Rio Formation; south end of Encantada Valley, about latitude N. 28° 20′ by longitude W. 102°30′, Coahuila; C. L. Baker.
Scaphites sp. cf. *S. bosquensis* (Böse)
Faraudiella texana (Shattuck)
Graysonites sp. juv.

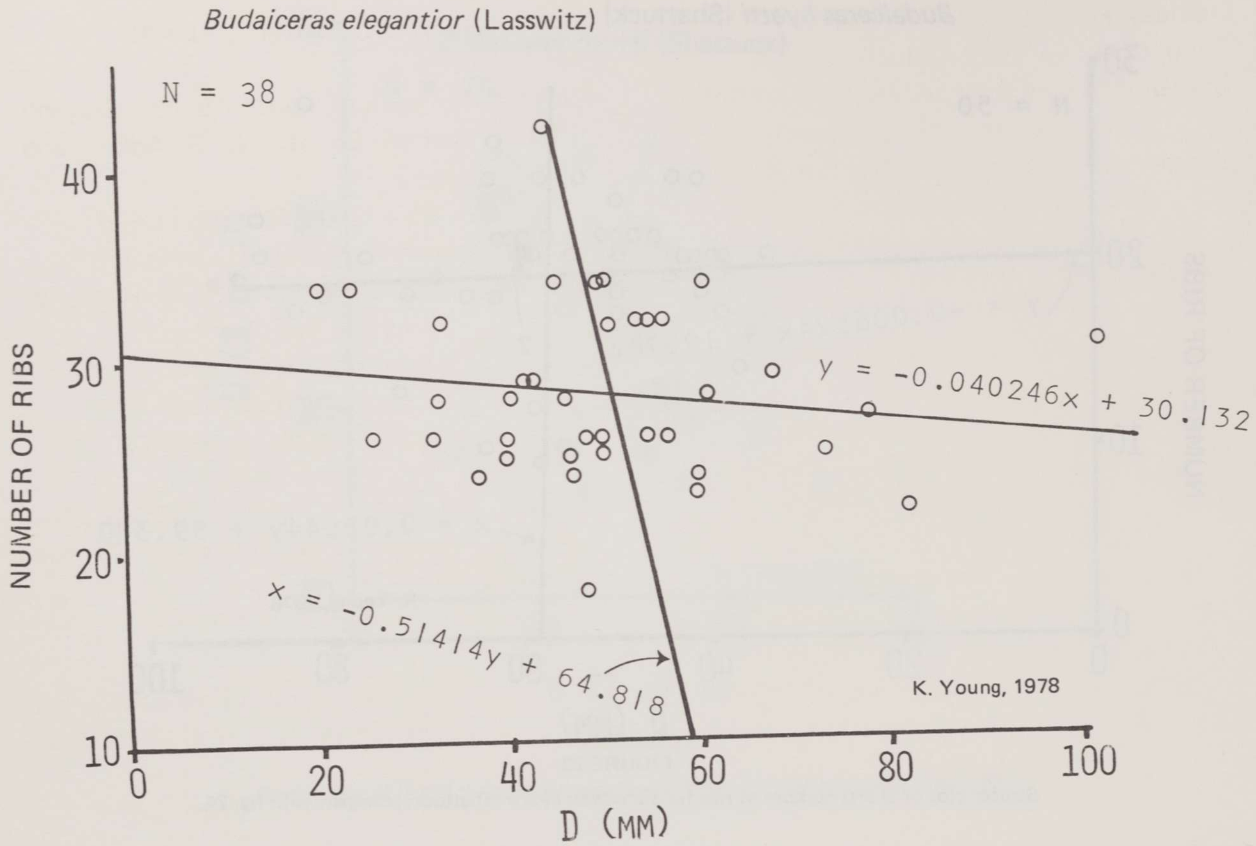

FIGURE 24

Scatter plot of D and number of ribs for *Budaiceras elegantior* (Lasswitz); compare with fig. 23.

Del Rio Formation; 4.9 kms from El Orégano on road to San Carlos, Jiménez Area, Coahuila; Emil Böse.

Stoliczkaia crotaloides (Stoliczka)
S. scotti Breistroffer
"Mantelliceras" brazoense Böse
Engonoceras bravoense Böse

Del Rio Formation; south of Villa Acuña, Coahuila; Emil Böse.

Turrilites bosquensis Adkins

Buda Limestone; El Remolino, Jiménez Area, Coahuila; Emil Böse.

Euhystrichoceras remolinense Böse
Budaiceras hyatti (Shattuck)
B. elegantior (Lasswitz)
Mantelliceras sp. cf. *M. martimpreyi* (Pervinquière *pro parte, non* Coquand)
Sharpeiceras mexicanum (Böse)

Buda Limestone; locality unknown, probably Coahuila; El Aguila Collection; W. R. Fehr no. F 615.

Paracalycoceras sp.

Buda Limestone 1.6 kms east of Quatro Ciénegas on the Monclova hwy., Coahuila; F. E. Lozo, Teodoro Díaz, Bob F. Perkins, and C. I. Smith.

Faraudiella texana (Shattuck)
Mantelliceras sp. cf. *M. martimpreyi* (Pervinquière *pro parte*, *non* Coquand)
Mantelliceras saxbii (Sharpe)

Buda Limestone; on trail running up north wall of Frouthrigh Canyon, west trail to Frautenza Mine, Sierra del Carmen, Coahuila; C. L. Baker.

Faraudiella franciscoensis (Kellum & Mintz)

Indidura Formation, lower; Sierra de Tlahualilo, Coahuila; L. B. Kellum.

Faraudiella franciscoensis (Kellum & Mintz)
Budaiceras hyatti (Shattuck)
Sharpeiceras tlahualiloense (Kellum & Mintz)
Mantelliceras cantianum (Spath)
Graysonites adkinsi Young
[= *Graysonites reynoldsi* Kellum & Mintz]

Buda Limestone; San Rafael, northern Coahuila; W. E. Bloxsom.

Stoliczkaia scotti Breistroffer

COMAL COUNTY, TEXAS

Buda Limestone: from outlier three-eighths km west of Rubbrecher Ranch, Comal County; Victor King.

Lewesiceras n. sp.

COOKE COUNTY, TEXAS

Grayson Formation; Hemming, Cooke County.

Stoliczkaia crotaloides (Stoliczka)

CROCKETT COUNTY, TEXAS

Buda Limestone, middle (nodular) member; Ozona-Sheffield hwy. at tank on north side of highway, 2 kms east of top of Pecos River Valley (top of Lancaster Hill), Crockett County; Roy T. Hazzard.

Faraudiella texana (Shattuck)

Buda Limestone, middle (nodular) member; Powell Field, Crockett County; Bob. F. Perkins.

Budaiceras elegantior (Lasswitz)

CULBERSON COUNTY, TEXAS

Buda Limestone; B-Mesa, near Boracho, Culberson County.

Faraudiella texana (Shattuck)

DENTON COUNTY, TEXAS

Grayson Formation, upper 15 ms; Grayson Bluff, Denton County; W. S. Adkins and F. E. Lozo.

Stoliczkaia crotaloides (Stoliczka)
Faraudiella roemeri (Lasswitz)

Middle (Modlin) limestone member; W. S. Adkins and F. E. Lozo.

Budaiceras hyatti (Shattuck)
B. elegantior (Lasswitz)
Faraudiella roemeri (Lasswitz)

Grayson Formation, upper 9 ms; Grayson Point, northeast of Roanoke, Denton County; Roy T. Hazzard.

Stoliczkaia scotti Breistroffer

Grayson Formation, west of Roanoke, barranca on the Knight Ranch, Denton County; W. S. Adkins.

Budaiceras hyatti (Shattuck)

Grayson Formation; 1.2 kms west and 1.6 kms south of B. M. 634, east of Grayson Bluff, Denton County; W. S. Adkins.

Stoliczkaia crotaloides (Stoliczka)

Grayson Formation; just below contact with Dexter Sandstone, just west of Pilot Point, northeastern Denton County; Roy T. Hazzard.

Stoliczkaia scotti Breistroffer
S. crotaloides (Stoliczka)

Grayson Formation, Denton Creek, near Roanoke, Denton County; Gayle Scott.

Stoliczkaia scotti Breistroffer
[= *S. dispar* Scott, *non* d'Orbigny]

EDWARDS COUNTY, TEXAS

Buda Limestone, middle (nodular) member; Edwards County.

Budaiceras hyatti (Shattuck)
Faraudiella archerae, n. sp.

Buda Limestone, middle (nodular) member; near Rock Springs, Edwards County.

Faraudiella texana (Shattuck)
Budaiceras elegantior (Lasswitz)
Plesioturrilites brazoensis (Römer)
Graysonites sp.

Buda Limestone, middle (nodular) member; borrow pit south of county road at turnoff to R. H. Cloudt Ranch, about 22 kms northwest of Rock Springs, Edwards Co.; Bob Lowe.

Budaiceras hyatti (Shattuck)

Buda Limestone, middle (nodular) member, 1.1 m above top of Devils River Limestone; entrance to Denman Moody Ranch on co. rd. 11 kms northwest of Rock Springs, Edwards Co. Bob Lowe.

Faraudiella texana (Shattuck)

Buda Limestone, middle (nodular) member; borrow pit north of state hwy. 55, 11 kms northwest of Rock Springs, Edwards Co. Bob Lowe.

Budaiceras hyatti (Shattuck)
B. elegantior (Lasswitz)

Buda Limestone, middle (nodular) member; approximately 12 kms northwest of Rock Springs on the northwest branch of a gravel road, Edwards Co.; Bob Lowe.

Budaiceras hyatti (Shattuck)

Buda Limestone, middle (nodular) member; borrow pit 145 ms west of second cattle guard on co. road, 13.5 kms northwest of Rock Springs, Edwards Co. Bob Lowe.

Budaiceras hyatti (Shattuck)

Buda Limestone, middle (nodular) member; about three-eighths km north and 1.1 kms east of Clark Ranch house, the entrance of which is about 4.8 kms west of Rock Springs on hwy. 377, Edwards Co.; S. B. Hixon.

Budaiceras hyatti (Shattuck)

Buda Limestone, middle (nodular) member; 7.5 kms south of Rock Springs, Cowsert Ranch, on hwy. 55, Edwards Co.; Roy T. Hazzard.

Faraudiella texana (Shattuck)
Budaiceras elegantior (Lasswitz)

Buda Limestone, middle (nodular) member; hwy. 41, at intersection with the road to the Devil's Sink Hole; Edwards Co.; Roy T. Hazzard.

Faraudiella texana (Shattuck)
F. franciscoensis *(Kellum & Mintz)*
Budaiceras hyatti *(Shattuck)*
B. elegantior (Lasswitz)
B. alticarinatum, n. sp.

Buda Limestone, middle (nodular) member; borrow pit south of state hwy. 41, 7.5 kms east of junction of highways 41 and 83, Edwards-Kerr Co. line; Bob Lowe.

Budaiceras hyatti (Shattuck)

Buda Limestone, middle (nodular) member; borrow pit on north side of hwy. 41, 1.6 kms east of junction of hwys. 41 and US 377, Edwards Co.; Bob Lowe.

Budaiceras hyatti (Shattuck)
B. elegantior (Lasswitz)

Buda Limestone, middle (nodular) member; 16 kms. north of junction of hwys. 41 and 83, near Edwards-Kerr Co. line; Bob Lowe.

Faraudiella texana (Shattuck)
Budaiceras hyatti (Shattuck)
B. elegantior (Lasswitz)

Buda Limestone, middle (nodular) member; borrow pit south of hwy. in road cut approximately 14.5 kms east of the junction of hwys. 41 and US 377, about 26.5 kms northeast of Rock Springs, Edwards Co.; Bob Lowe.

Budaiceras hyatti (Shattuck)
B. elegantior (Lasswitz)

Buda Limestone, middle (nodular) member; 6.7 kms east of the junction of hwys. 41 and US 377, Edwards Co.; Bob Lowe.
Budaiceras hyatti (Shattuck)

Buda Limestone, middle (nodular) member; pit on north side of highway 41, 1.6 kms. east of junction of highways 41 and US 377, Edwards County; Bob Lowe.
Budaiceras hyatti (Shattuck)

Buda Limestone, middle (nodular) member; 11 kms northeast of the intersection of hwys. 41 and 55 at Rock Springs, Edwards Co.; Roy T. Hazzard.
Budaiceras hyatti (Shattuck)

Buda Limestone, middle (nodular) member; 12 kms east of the junction of hwys. 41 and US 377, Edwards Co.; Bob Lowe.
Budaiceras elegantior (Lasswitz)

Buda Limestone, middle (nodular) member; state hwy. 55, 10 kms northwest of Rock Springs, Edwards Co.; Roy T. Hazzard.
Budaiceras elegantior (Lasswitz)

GRAYSON COUNTY, TEXAS

Grayson Marl; 8.7 kms east of Denison, Grayson Co.; W. S. Adkins.
Budaiceras hyatti (Shattuck)
B. elegantior (Lasswitz)

Grayson Marl; 1.6 kms east and 4.8 kms north of Gordonville, Grayson Co.
Stoliczkaia crotaloides (Stoliczka)

Grayson Marl; eastern gully in headwaters of Little Mineral Creek, east of Pottsboro, Grayson Co.; W. S. Adkins.
Stoliczkaia crotaloides (Stoliczka)
Budaiceras hyatti (Shattuck)

HAYS COUNTY, TEXAS

Buda Limestone, 5 ms above base of lower member; at cave, 15 ms northeast of Viesta and North streets, San Marcos, Hays Co.; Ken G. Martin.
Faraudiella roemeri (Lasswitz)
Budaiceras hyatti (Shattuck)

Buda Limestone, float; southwest corner of San Marcos Cemetery, Hays Co.; K. J. DeCook.
Budaiceras hyatti (Shattuck)

Buda Limestone, float; Sink Creek, upstream from crossing of Lime Kiln Road, Hays Co.; K. J. DeCook.
Budaiceras alticarinatum, n. sp.

Buda Limestone, lower member; sink 0.1 km northwest of Wicker house on Kate Leinnweber Ranch, northwest of San Marcos, Hays Co.; Ken G. Martin.
Faraudiella franciscoensis (Kellum & Mintz)
Budaiceras hyatti (Shattuck)

Buda Limestone; Cowan Ranch, two-thirds km north of Sink Creek, Hays Co.; K. J. DeCook.
Budaiceras hyatti (Shattuck)

Buda Limestone; on the Blanco River about 1.6 kms above the Missouri-Pacific RR bridge, Hays Co.; F. L. Whitney; T. W. Grimshaw; K. J. DeCook.
Faraudiella roemeri (Lasswitz)
F. texana (Shattuck)
F. franciscoensis (Kellum & Mintz)
F. archerae, n. sp.
Budaiceras hyatti (Shattuck)
B. elegantior (Lasswitz)
B. alticarinatum, n. sp.
Ostlingoceras sp.

Buda Limestone, lower member; on the Blanco River about 1.6 kms above the Missouri-Pacific RR bridge, Hays Co.; F. L. Whitney; Hunter Yarborough.
Faraudiella texana (Shattuck)
Budaiceras hyatti (Shattuck)
B. elegantior (Lasswitz)
Stoliczkaia crotaloides (Stoliczka)
Sharpeiceras tlahualiloense (Kellum & Mintz)
Plesioturrilites sp. aff. *S. brazoensis* (Römer)

Buda Limestone; near Kyle, 2.4 kms north of Blanco River, Hays Co.; F. L. Whitney.
Budaiceras hyatti (Shattuck)

Buda Limestone, lower member; near Kyle, 2.4 kms north of the Blanco River, Hays Co.; F. L. Whitney.
Budaiceras hyatti (Shattuck)

Buda Limestone, upper member; Onion Creek, at the Missouri-Pacific RR bridge, Hays Co.; F. L. Whitney.
Faraudiella texana (Shattuck)
Sharpeiceras tlahualiloense (Kellum & Mintz)

3 ms below top of lower member; F. L. Whitney.
Mantelliceras sp. cf. *M. martimpreyi* (Pervinquière, *pro parte, non* Coquand)

lower member; F. L. Whitney
Stoliczkaia scotti Breistroffer
Faraudiella roemeri (Lasswitz)
F. texana (Shattuck)
Budaiceras hyatti (Shattuck)
B. elegantior (Lasswitz)
Mantelliceras sp. cf. *M. martimpreyi* (Pervinquière, *pro parte, non* Coquand)

top of *Plicatula* bed in lower member; F. L. Whitney.
Faraudiella texana (Shattuck)
F. archerae, n. sp.

HILL COUNTY, TEXAS

Main Street Limestone, top; near Mt. Zion Church, upper Rock Creek, Hill Co.; W. S. Adkins.
Graysonites adkinsi Young

Main Street Limestone, top; Tinner Creek, southwest Hill Co.; W. S. Adkins.
Graysonites wooldridgei Young

Grayson Marl, basal; Tinner Creek, southwest Hill Co.; W. S. Adkins.
Graysonites fountaini Young
G. wooldridgei Young

Grayson Marl, base; Brazos River, White Rock Crossing, Hill Co.; W. S. Adkins.
Graysonites wooldridgei Young

Grayson Marl, near the top; Aquilla Creek, Hill Co.; Bernhard Kummel.
Budaiceras hyatti (Shattuck)

Grayson Marl; 3.8 kms west of Aquilla, Hill Co.; Bernhard Kummel.
Sciponoceras sp. cf. *S. baculoides* (Mantell)
Otoscaphites subevolutus (Böse)
Adkinsia bosquensis (Adkins)

Woodbine Formation; about 26 ms above the top of the Grayson Formation, Alligator Creek, 8.0 kms westnorthwest of West, Hill Co., Texas; W. S. Adkins.
Forbesiceras sp. cf. *F. brundrettei* Young

HUDSPETH COUNTY, TEXAS

Buda Limestone, lower part; just south of Indio Pass Road, 1.6 kms south of intersection of Indio Pass Road and the outcrop of the Espy Limestone, Evans and Williamson ranches, Hudspeth Co.; J. R. Underwood.
Faraudiella texana (Shattuck)

Eagle Mountains Sandstone; east flank of the Quitman Mountains, southern Hudspeth Co.; D. F. Reaser.

Faraudiella borachoensis, n. sp

Buda Limestone, lower unit (e.g., lower 14 ms); 1.6 kms south of Indio Pass Road, Eagle Mountains, Hudspeth Co.; J. R. Underwood.

Faraudiella texana (Shattuck)

Buda Limestone; Eagle Mountains, Hudspeth Co.; J. R. Underwood.

Faraudiella texana (Shattuck)
Budaiceras alticarinatum, n. sp.

Buda Limestone, 36 ms above the contact with the Eagle Mountains Sandstone; Carpenter Springs, Hudspeth Co.; exposures in creek bed in Carpenter Canyon northnortheast of Carpenter Springs on Lock Ranch, Eagle Mountains; Bob F. Perkins.

Faraudiella texana (Shattuck)

Buda Limestone, Speck Ranch, Eagle Mountains, Hudspeth Co.; J. R. Underwood.

Faraudiella roemeri (Lasswitz)

Buda Limestone; from lower shelf where road climbs up and over hill, near USBM, southeast of intersection on Speck Road, Eagle Mountains, Hudspeth Co.; J. R. Underood.

Faraudiella texana (Shattuck)

Buda Limestone, Speck Ranch Road, Eagle Mountains, Hudspeth Co.; J. R. Underwood.

Faraudiella texana (Shattuck)

Buda Limestone; North Cedar Creek, Quitman Mountains, Hudspeth Co.; Bill Jones.

Faraudiella texana (Shattuck)

Buda Limestone (30 ms above base as float); west flank of Love Anticline, Love Station, Hudspeth Co.; D. F. Reaser.

Faraudiella texana (Shattuck)

float from 42 ms more or less above base; D. F. Reaser.

Budaiceras hyatti (Shattuck)

40 ms more or less above base; D. F. Reaser

Budaiceras elegantior (Lasswitz)

float from 30 ms more or less above base; D. F. Reaser.

Budaiceras elegantior (Lasswitz)

Buda Limestone; Pinto Canyon Area, Hudspeth Co.; D. L. Amsbury.

Budaiceras alticarinatum, n. sp.

JEFF DAVIS COUNTY, TEXAS

Kent Station Limestone, uppermost; 4 kms south and 0.6 km east of Davis Mountain Filling Station, Jeff Davis Co.; Grant Moyer.

Faraudiella borachoensis, n. sp.

Buda Limestone, lowest bed of middle member; northeast of P. Ranch house and west of Diezyocho Creek, dip slope of Espy thrust, Jeff Davis Co.; Philip Braithwaite.

Mariella wysogorskii (Lasswitz)
Faraudiella roemeri (Lasswitz)
F. texana (Shattuck)
Budaiceras elegantior (Lasswitz)

upper part of middle member; Philip Braithwaite.

Budaiceras hyatti (Shattuck)

Buda Limestone; southern Van Horn Mountains, Jeff Davis Co.; Page C. Twiss; Roy T. Hazzard.

Faraudiella roemeri (Lasswtiz)
Faraudiella texana (Shattuck)
Budaiceras hyatti (Shattuck)

Buda Limestone, middle (nodular) member; Diezyocho Creek, Jeff Davis Co.; Philip Braithwaite.

Budaiceras elegantior (Lasswitz)

lower bed of middle (nodular) member; Philip Braithwaite.

Faraudiella texana (Shattuck)

Buda Limestone, 15-17 ms above the top of the Eagle Mountains Sandstone; south-central Van Horn Mountains, Jeff Davis Co.; Bob F. Perkins.

Faraudiella texana (Shattuck)

lower part; Bob F. Perkins.

Budaiceras elegantior (Lasswitz)

Buda Limestone, massive bed below sandstone member; north side of Cherry Draw, north of Cherry Ranch Road on KC Ranch, northeast flank of Davis Mountains, Jeff Davis Co.; Jess Brundrett.

Budaiceras elegantior (Lasswitz)

Buda Limestone; 5/6 km south of Tank no. 1, Gomez Peak Area, Jeff Davis Co.; Dennis Taylor.

Faraudiella texana (Shattuck)

Buda Limestone; Chispa Summit, Jeff Davis Co.; John A. Wilson.

Budaiceras hyatti (Shattuck)

Boquillas Limestone, basal; first two draws just north of the first large draw south of the Cherry Ranch Road, just north of the east-west fence on the D. Kingston Ranch, NW corner of sec. 33, Block 57, Township 9, Texas and Pacific RR, Jeff Davis Co.; Jess Brundrett.

Hypoturrilites youngi Clark
Ostlingoceras brandi Young
O. davisense Young
Forbesiceras brundrettei (Young)
Pseudouhligella elgini Young

KINNEY COUNTY, TEXAS

Buda Limestone; 2.4 kms north of Brackettville on state hwy. 674, east side of road, Kinney Co.; S. B. Hixon.

Faraudiella texana (Shattuck)
Budaiceras hyatti (Shattuck)

MCLENNAN COUNTY, TEXAS

Del Rio Formation; 140 ms upstream from the Speegleville road bridge, 9 kms west of Waco, McLennan Co.; W. S. Adkins.

Turrilites bosquensis Adkins
Adkinsia bosquensis (Adkins)

Del Rio Formation, upper part; northern part of McLennan Co.; W. S. Adkins.

Stoliczkaia crotaloides (Stoliczka)

Del Rio Formation; east side of Santa Fe RR track; 7.2 kms south of McGregor, McLennan Co.; W. S. Adkins.

Tetragonites brazoensis (Böse)
Turrilites bosquensis Adkins
Sciponoceras sp. cf. *S. baculoides* (Mantell)
Otoscaphites subevolutus (Böse)
Graysonites (?) *wacoense* (Böse)
Engonoceras bravoense (Böse)

Del Rio Formation; east bank of South Bosque River, 2 miles south of South Bosque, near Bickle no. 2, well, McLennan Co; W. S. Adkins.

Sciponoceras sp. cf. *S. baculoides* (Mantell)
Scaphites bosquensis Böse
Otoscaphites subevolutus (Böse)
Adkinsia bosquensis (Adkins)

REAL COUNTY, TEXAS

Buda Limestone; 4.8 kms. east of the Edwards-Real county line, on state highway 41, borrow pit on south side of highway, 28.6 kms northeast of Rock Springs; Bob Lowe.

Budaiceras hyatti (Shattuck)

REEVES COUNTY, TEXAS

Buda Limestone, 5.3 kms east of Davis Mountain Filling Station, San Martine Quadrangle, Reeves Co.; Grant Moyer.

Faraudiella roemeri (Lasswitz)

F. texana (Shattuck)

SCHLEICHER COUNTY, TEXAS

Buda Limestone, middle (nodular) member; southeast of Junction on road to Rock Springs, Schleicher Co.; Roy T. Hazzard.

Budaiceras elegantior (Lasswitz)

SUTTON COUNTY, TEXAS

Buda Limestone, middle (nodular) member; 24 kms southeast of Sonora, Sutton Co.; Roy T. Hazzard.

Budaiceras elegantior (Lasswitz)

Buda Limestone, middle (nodular) member; near Sonora, Sutton Co.; Bob Lowe.

Faraudiella texana (Shattuck)

Budaiceras hyatti (Shattuck)

B. elegantior (Lasswitz)

TARRANT COUNTY, TEXAS

Pawpaw Formation; Sycamore Creek, southeast of Fort Worth, Tarrant Co.; W. S. Adkins.

Stoliczkaia adkinsi Böse

Pawpaw Formation; Glen Garden Country Club, Fort Worth, Tarrant Co.; W. S. Adkins.

Stoliczkaia adkinsi Böse

Main Street Limestone, upper 2 ms, Wildcat Branch, a tributary to Village Creek, 2.4 kms from the center of the business district, Tarrant County; J. P. Conlin.

Graysonites wooldridgei Young.

Main Street Limestone, upper 1 m, below transition zone to the Grayson Formation; Calloway (Walker) Branch, 6 kms northeast of intersection of hwy 121 (Grapevine) and hwy 377 (Denton) in Halton City; J. P. Conlin.

Graysonites adkinsi Young

Grayson Formation; Rock Creek, near Dexter; Roy T. Hazzard.

Graysonites fountaini Young

G. adkinsi Young

TERRELL COUNTY, TEXAS

Buda Limestone, 1 m below top of middle (nodular) member; 14.5 kms east of Sanderson, 2.7 kms west of Dryden, on north side of the Southern Pacific Railroad, hwy 90, on the slope of a low hill opposite the International Boundary Commission core house; Fred L. Stricklin.

Faraudiella roemeri (Lasswitz)

F. texana (Shattuck)

F. archerae, n. sp.

Budaiceras elegantior (Lasswitz)

Buda Limestone; 4.0 kms east of Comstock on hwy 90.

Budaiceras elegantior (Lasswitz)

B. hyatti (Lasswitz)

Buda Limestone; 1.1 kms west of Dryden on hwy 90; R. T. Hazzard.

Faraudiella roemeri (Lasswitz)

F. texana (Shattuck)

Buda Limestone, middle (nodular) member; about 11.5 ms above base of Buda Limestone; 10 kms southeast of Dryden on hwy 90; K. Young.

Budaiceras hyatti (Shattuck)

Sharpeiceras tlahualiloense (Kellum & Mintz)

upper member; K. Young.

Budaiceras hyatti (Shattuck)

TRAVIS COUNTY, TEXAS

Georgetown Limestone, 5 ms below top, zone of *Drakeoceras drakei;* Pease Park, Shoal Creek, just below 19th St., Austin; K. Young.

Stoliczkaia adkinsi Böse

Stoliczkaia sp. cf. *S. rhamnonota* (Seeley)

Buda Limestone, upper member; Bear Creek, south of Manchaca; F. L. Whitney.

Faraudiella roemeri (Lasswitz)

Mantelliceras cantianum Spath

lower member; F. L. Whitney; Ken G. Martin.

Hypophylloceras sp. cf. *H. tanit* (Pervinquière)

Faraudiella roemeri (Lasswitz)

F. texana (Shattuck)

Budaiceras elegantior (Lasswitz)

B. hyatti (Shattuck)

Buda Limestone, lower member, *Gastrochaena ruperti* bed; Manchaca; F. L. Whitney.

Faraudiella roemeri (Lasswitz)

F. texana (Shattuck)

lower member; F. L. Whitney.

Budaiceras elegantior (Lasswitz)

Buda Limestone, lower member; Williamson Creek and Manchaca Road, F. L. Whitney; Hunter Yarborough; W. R. Muhlberger and K. Young; Ken G. Martin; and others.

Hypophylloceras sp. cf. *H. tanit* (Pervinquière)

Faraudiella roemeri (Lasswitz)

F. texana (Shattuck)

F. franciscoensis (Kellum & Mintz)

Budaiceras hyatti (Shattuck)

B. elegantior (Lasswitz)

Sharpeiceras tlahualiloense (Kellum & Mintz)

Top of lower member; F. L. Whitney; Ken G. Martin.

Stoliczkaia crotaloides (Stoliczka)

Faraudiella texana (Shattuck)

Pseudohligella sp. indet.

base of upper member; W. R. Muhlberger and K. Young.

Faraudiella roemeri (Lasswitz)

F. texana (Shattuck)

Budaiceras elegantior (Lasswitz)

Buda Limestone; southwest Austin, near the intersection of West Loop (Loop 360) and South Lamar; Billy M. Cobble.

Faraudiella roemeri (Lasswitz)

Buda Limestone, lower member; about 9th St., Lamar Boulevard and Shoal Creek, Austin; Ken G. Martin.

Bucaiceras hyatti (Shattuck)

Buda Limestone; Barton Springs, Austin.

Stoliczkaia scotti Breistroffer

Buda Limestone, lower member, 4.5 ms above the base; 70 ms south of the intersection of Lamar Boulevard and Barton Springs Road, Austin; Ken G. Martin.

Budaiceras elegantior (Lasswitz)

B. hyatti (Shattuck)

Buda Limestone; mouth of Barton Creek, Austin; F. L. Whitney; K. Young.

Plesioturrilites brazoensis (Römer)?

Budaiceras elegantior (Lasswitz)

Buda Limestone; Shoal Creek, Austin; F. L. Whitney; R. T. Hill; George Stolley; Ken G. Martin; many others.

Mariella wysogorskii (Lasswitz)
Faraudiella roemeri (Lasswitz)
F. texana (Shattuck)
Budaiceras elegantior (Lasswitz)
B. hyatti (Shattuck)
B. alticarinatum, n. sp.
Mantelliceras saxbii (Sharpe)
[= *Acanthoceras hoplitoides* Lasswitz]
M. sp. cf. *M. martimpreyi*
(Pervinquière, *pro parte, non* Coquand)

lower member; F. L. Whitney; Ken G. Martin.

Puzosia sp. cf. *P. crebrisulcata* Kossmat
Budaiceras hyatti (Shattuck)

Buda Limestone, upper 1 m of upper member; mouth of Shoal Creek at Colorado River, Austin; Wally Shirah, Jr.

Mantelliceras saxbii (Sharpe)

Buda Limestone, lower member; 8th St. at Shoal Creek, Austin; F. L. Whitney.

Faraudiella texana (Shattuck)

Buda Limestone, lower member; 19th St. at Shoal Creek, Austin; F. L. Whitney.

Budaiceras elegantior (Lasswitz)
B. alticarinatum, n. sp.

Buda Limestone; 24th St. and Shoal Creek, Austin; F. L. Whitney.

Faraudiella franciscoensis (Kellum & Mintz)

Buda Limestone; 27th St. and Shoal Creek, Austin; F. L. Whitney.

Faraudiella texana (Shattuck)
Budaiceras elegantior (Lasswitz)
B. hyatti (Shattuck)
B. alticarinatum, n. sp.

Buda Limestone; 29th St. and Shoal Creek, Austin, F. L. Whitney.

Plesioturrilites brazoensis (Römer)?
Hypophylloceras ? sp. juv.
Adkinsia knikerae, n. sp.
Faraudiella texana (Shattuck)
F. archerae, n. sp.
Budaiceras hyatti (Shattuck)

lower member; F. L. Whitney

Hypophylloceras sp. cf. *H. tanit*
(Pervinquière)
Budaiceras elegantior (Lasswitz)

Buda Limestone; 30th St., Shoal Creek, Austin; F. L. Whitney

Faraudiella texana (Shattuck)
Budaiceras elegantior (Lasswitz)
B. hyatti (Shattuck)

Buda Limestone; 31st St. and Shoal Creek, Austin; F. L. Whitney.

Faraudiella archerae, n. sp.
Budaiceras elegantior (Lasswitz)

lower member; F. L. Whitney.

Faraudiella texana (Shattuck)
F. franciscoensis (Kellum & Mintz)
F. archerae, n. sp.
Budaiceras elegantior (Lasswitz)
B. hyatti (Shattuck)

Buda Limestone, at top of lower member, within one-eighth m; 32nd St. and Shoal Creek, Austin; K. Young.

Budaiceras hyatti (Shattuck)

Buda Limestone; 34th St. and Shoal Creek, Austin; F. L. Whitney.

Faraudiella texana (Shattuck)
Budaiceras hyatti (Shattuck)

Buda Limestone, lower member; 38th St. and Shoal Creek, Austin; F. L. Whitney.

Faraudiella roemeri (Lasswitz)

Buda Limestone; Catamount (Hancock) Creek, Austin; F. L. Whitney.

Faraudiella texana (Shattuck)

Buda Limestone, lower member; about 49th St. and Shoal Creek (Fizet Dam), Austin; F. L. Whitney.

Plesioturrilites brazoensis (Romer)?
Ostlingoceras sp.
Budaiceras hyatti (Shattuck)

Buda Limestone; Shoal Creek at the Oaks, just north of the former site of the Brown Schools, Austin; F. L. Whitney.

Stoliczkaia crotaloides (Stoliczka)
S. scotti Breistroffer
Faraudiella roemeri (Lasswitz)
F. texana (Shattuck)
Budaiceras elegantior (Lasswitz)
B. hyatti (Shattuck)

UVALDE COUNTY, TEXAS

Buda Limestone, middle (nodular) member; northern Uvalde Co.; R. T. Hazzard.

Faraudiella roemeri (Lasswitz)
F. texana (Shattuck)
Budaiceras elegantior (Lasswitz)
B. hyatti (Shattuck)

VAL VERDE COUNTY, TEXAS

Buda Limestone, middle (nodular) member; 27.5 kms southeast of Pandale Store on road to Comstock; K. Young.

Budaiceras elegantior (Lasswitz)
B. hyatti (Shattuck)

Buda Limestone, middle (nodular) member; just below U. S. Geol. Survey triangulation station and BM (Harrison 2145), Dry Devil Quadrangle; John O. Spice.

Faraudiella roemeri (Lasswitz)
F. texana (Shattuck)
Budaiceras elegantior (Lasswitz)
B. hyatti (Shattuck)

Buda Limestone, middle (nodular) member; J. L. Nettleton Ranch, 41.5 kms north of Comstock on the Pandale Road; R. T. Hazzard.

Budaiceras elegantior (Lasswitz)
B. hyatti (Shattuck)

Buda Limestone; Dry Devil Quadrangle; John O. Spice.

Budaiceras elegantior (Lasswitz)

Buda Limestone; near Langtry; S. B. Hixon.

Budaiceras hyatti (Shattuck)

WALKER COUNTY, TEXAS

Maness Shale; depth of 3747.5 ms, Smithers no. 1, Union Producing Company; F. E. Lozo.

Forbesiceras sp. cf. *F. brundrettei* (Young)

WILLIAMSON COUNTY, TEXAS

Buda Limestone; Round Rock; Taylor.

Budaiceras hyatti (Shattuck)

0.6 m below top of lower member; F. L. Whitney.

Faraudiella roemeri (Lasswitz)
F. texana (Shattuck)
F. archerae, n. sp.

lower member; F. L. Whitney.

Faraudiella roemeri (Lasswitz)

F. texana (Shattuck)

Budaiceras elegantior (Lasswitz)

B. hyatti (Shattuck)

Buda Limestone, float from the lower part; Hawkins Farm, 5 kms north of Round Rock; D. E. Atchison.

Stoliczkaia scotti Breistroffer

ZACATECAS, MEXICO

"Vraconian;" small hill of the railroad between Camacho and the Trinidad Mine, northeastern Zacatecas; Emil Böse (1923).

Tetragonites zacatecanus Böse

Turrilites multipunctatus Böse

Anisoceras camachoense Böse

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