

UPPER JURASSIC AMMONITES FROM MEXICO

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ABSTRACT

Near-shore deposits of Upper Jurassic age occur along the margin of the former Coahuila Peninsula of northern Mexico and along the site of the Sierra Madre Oriental in eastern Mexico. These deposits contain a mixed bivalve and ammonite fauna whose description will furnish a means of correlation between various facies in the Mexican Geosyncline. Studies of the ammonites, undertaken in the present paper, confirm the validity of most of Burckhardt's stratigraphic divisions for the off-shore deposits and show that they can be traced into the near-shore deposits. New information concerning the stratigraphic ranges of certain ammonite genera and the discovery of the presence of other genera have made necessary slight changes in Burckhardt's subdivisions and have shown that the succession of ammonite assemblages in the Upper Jurassic of Mexico agrees fairly well with that of the Mediterranean province.

INTRODUCTION

Present knowledge of the Upper Jurassic faunas of the Mexican Geosyncline is due principally to Burckhardt (1906, 1912, 1919) who made monographic studies of the ammonites from the regions of Mazapil in northern Zacatecas, Symón in eastern Durango, and San Pedro del Gallo in northeastern Durango. An earlier paper by Castillo and Aguilera (1895) on the fossil faunas of the Sierra de Catorce in northern San Luis Potosí was revised in part by Burckhardt (1930, p. 79, 80). The former authors described a few pelecypods and brachiopods, as well as ammonites, but Burckhardt described only ammonites although he mentioned pelecypods in stratigraphic discussions. A near-shore mollusk fauna of the northern edge of the Mexican Geosyncline, near Torcer, Texas, was described by Cragin (1905), and some ammonites from the same area have recently been described by Albritton (1937). Burckhardt's last monograph (1930) summarizes all the earlier work.

Studies of the mountain ranges bordering the Coahuila Peninsula by Kellum (1932, 1936) and the writer (1936, 1937) revealed thick Jurassic sections in the centers of the highest uplifts. The Jurassic beds were found to represent near-shore deposits and to contain a mixed bivalve and ammonite fauna. The study of this mixed fauna was deemed desirable as a means of correlating near-shore with off-shore deposits, as a foundation for future studies in other parts of the Mexican Geosyncline, and as a contribution to the knowledge of Jurassic faunas. Preliminary to the laboratory studies of the fauna, the writer visited several type localities described by Böse and Burekhardt in northern Mexico, checked the geology, and made collections of type fossils. Additional collections were made from fossil localities previously discovered by Kellum in the Sierra de Jimulco and Sierra de Mapimí, and several new localities were discovered in the course of reconnaissance studies in southern Coahuila and northern Zacatecas. The present paper deals only with the ammonites. It confirms the validity of most of Burekhardt's stratigraphic divisions based on ammonites for the off-shore deposits of the Upper Jurassic and shows that they can be traced into the near-shore deposits.

ACKNOWLEDGMENTS

The fossils described in this report were collected during the summers of 1931 to 1937 in the course of stratigraphic and structural studies in northern Mexico. The field and laboratory work were financed jointly by the Penrose Bequest of the Geological Society of America and by the Horace H. Rackham School of Graduate Studies of the University of Michigan. This paper is one of a series dealing with the Jurassic and Cretaceous faunas of Mexico.

STRATIGRAPHIC SUMMARY

The Upper Jurassic stratigraphy of north-central Mexico has recently been summarized by the writer in a paper comparing the facies of sedimentation in the Mexican Geosyncline (Imlay, 1938). The near-shore deposits have been called La Gloria and La Casita formations, and the off-shore deposits the Zuloaga limestone and La Caja formation. La Gloria formation and Zuloaga limestone are probably equivalent and are mainly, or entirely, of Oxfordian age. The Zuloaga limestone is identical with the "Nerinea" limestone of Burekhardt. La Casita and La Caja formations likewise are in general equivalent and represent the younger Jurassic stages, although in some sections the highest beds of La Casita formation may not include the Tithonian. Near-shore deposits of Upper Jurassic age have been found along the margin of the former Coahuila

Peninsula (Kellum, Imlay, and Kane, 1936, p. 978-980) and along the site of the Sierra Madre Oriental. The Coahuila Peninsula was probably the principal source of sediment of the north-central part of the Mexican Geosyncline during the Upper Jurassic and Neocomian. However, the deposits along the Sierra Madre Oriental must have had a different source. Burekhardt (1930, p. 84-91, 101) has summarized the work of several geologists in that region and has concluded that there must have been an island in the vicinity of Miquihuana and a large landmass, probably a peninsula, farther east along what is now the coastal plain. He recognized that this landmass ended toward the south in the State of Vera Cruz and Hidalgo and was partially broken on the east by an embayment in the region of Tampico (Burekhardt, 1930, p. 94-96). Later fossil discoveries by Hegwein (Burekhardt, 1930, p. 266; Kellum, 1937, p. 70, 86-91) in the San Carlos Mountains indicate the presence of Upper Jurassic deposits on the site of the Coastal Plain and may be taken as evidence against the presence of a continuous, large landmass in eastern Mexico during Upper Jurassic time. The near-shore deposits found in the Sierra Madre Oriental might have been derived from islands situated on or at the eastern margin of the cordillera and forming an archipelago, such as has been suggested by Böse (1927, p. 81-82). These islands might, of course, be the continuation of a peninsula extending southward from the main landmass in the region of Texas.

EUROPEAN EQUIVALENTS

The Upper Jurassic ammonite assemblages of Mexico are sufficiently well known to permit comparisons of the Mexican section with the standard European sections. For purposes of discussion and correlation it is convenient to use the large stratigraphic subdivisions called "stages." The difficulty in using stage-names lies in the disagreement among authorities as to the proper limits of the stages, and it seems unlikely that the attempt of any one worker to secure a uniform terminology would meet with general acceptance. The matter will probably have to be ruled on by an international committee. Until uniformity is attained it will be necessary for each author to define his usage. In the present paper the works of Spath (1933, p. 864, 872) are followed for the definition of European stage names. For purposes of comparison, several recent usages of Upper Jurassic stage-names are given in Table 1.

FOSSILS

LOCALITIES

Sierra de Parras.—The position of the fossil localities in the Sierra de Parras is indicated in published papers (Imlay, 1936, fig. 3; 1937, fig. 3).

TABLE 1.—Comparison of Upper Jurassic stage-names

After L. F. Spath (1933) Tables I and II		After C. Burekhardt (1930) Table 6 and p. 42	After compilation by E. Dacque (1934) p. 546-547	Ammonite zones after L. F. Spath (1933) Tables I and II
Tithonian		Upper Portlandian	Upper Tithonian	<i>privasensis</i>
Portlandian				Lower Tithonian
Kimmeridgian	Neokimmeridgian or Bononian	Lower Portlandian	Upper Kimmeridgian	
	Mesokimmeridgian or Havrian			Middle Kimmeridgian
	Eokimmeridgian or Sequanian	Kimmeridgian	Lower Kimmeridgian	
	Oxfordian			Neoxfordian or Argovian
(Mesoxfordian) or Divesan		Lower Oxfordian	Callovian	<i>cordatus</i> <i>lamberti</i> <i>athleta</i>
(Eoxfordian) or Callovian				Callovian
Bathonian		Bathonian	Bathonian	

LOCALITY 34: About $1\frac{1}{2}$ miles southwest of Rancho Astillero, on trail to La Unión. Fossils occur in a thin lens of dark-gray limestone enclosed in gray and pinkish shale. Represents beds with *Durangites*. Fossils: *Durangites astillerensis* Imlay, n. sp.; *D.* cf. *acanthicus* Burekhardt; *D.* sp.; *Hildoglochiceras grossicostatum* Imlay, n. sp.; *H. ecarinatum* Imlay, n. sp.

LOCALITY 43: Right bank of Cañón de la Casita, about three-quarters of a mile north of Rancho La Casita. Fossils occur in limestone concretions in black shale of upper 83 feet of measured section (Imlay, 1937, p. 602). Probably represents beds with *Glochiceras fialar* and *Waagenia*. Fossils: *Aulacosphinctoides?* (*Subdichotomoceras?*) sp.; *A.?* aff. *diversecostatus* (Burekhardt); *Waagenia parrasensis* Imlay, n. sp.; *Glochiceras* sp.

LOCALITY 46: On trail $3\frac{1}{2}$ miles up Cañón del Orango. Fossils obtained from limestone lenses in carbonaceous shale. Represents beds with *Mazapilites*. Fossils: *Torquatisphinctes?* sp.; *Idoceras?* sp. (small fragment); *Mazapilites zitteli* Burekhardt; *M.* sp.

LOCALITY 51: About a quarter of a mile west of Cañón de la Casita, 400 yards northwest of a big spring and on south flank of an anticline. Fossils occur in limestone concretions near the top of the formation. Collected by R. W. Imlay, September 2, 1935. Includes *Subplanites?* sp. and *Haploceras* sp.

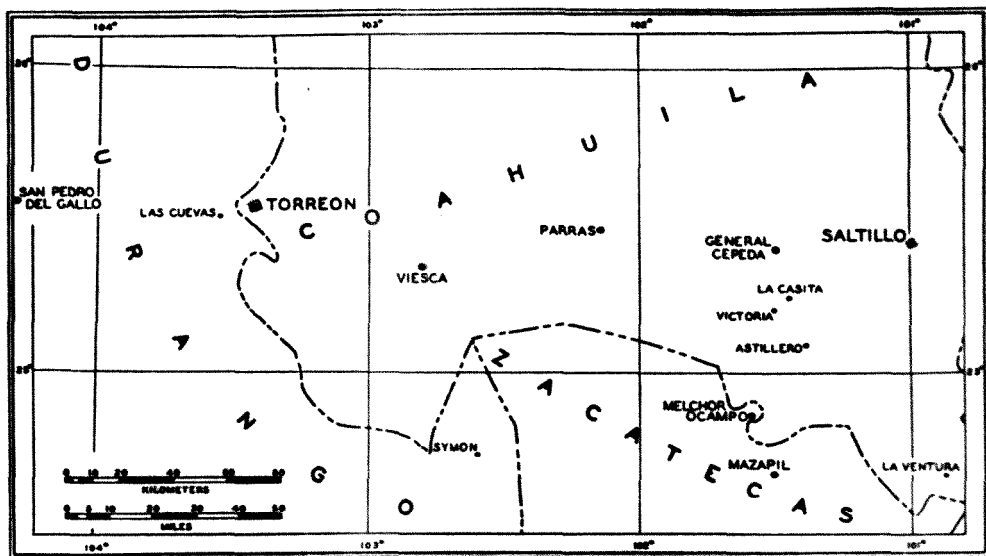


FIGURE 1.—Index map of fossil localities in north-central Mexico

LOCALITY 57: About 450 yards east of Cañón de la Casita near the mouth of Cañón del Buey and on south flank of an anticline. Fossils found in limestone concretions about 50 feet below the top of the formation. Represents beds with *Aulacosphinctoides* and *Mazapilites*. Fossils: *Aulacosphinctoides?* sp.; *A. (Subdichotomoceras?)* sp.; *Pachysphinctes?* sp.; *Subdichotomoceras?* sp.; *Torquatisphinctes?* aff. *bangei* Burckhardt; *Haploceras* sp.; *Pseudolissoceras?* sp.; *Aspidoceras* aff. *bispinosum* Quenstedt; *A. casitense* Imlay, n. sp.

LOCALITY 59: Head of short canyon in Sierra San Angel south of Rancho Victoria. Fossils occur in limestone bed in black shale. Represents beds with *Glochiceras falar*. Fossils: *Glochiceras falar* (Oppel); *Haploceras costatum* Burckhardt; *H. transatlanticum* Burckhardt; *Involuticeras* aff. *mazapilense* (Burckhardt).

Sierra de Jimulco.—The localities along the south side of Cañón Alamo, about 4 miles southwest of Viesca, Coahuila (Kellum, 1932, fig. 5) are as follows: The section in Cañón Alamo is shown in Figure 3.

LOCALITY K1: On ridge between localities K5 and K2 and a few feet below top of gypsiferous shale. Ammonite horizon contains same fossils

as at K5. Represents beds with *Substeueroceras*. Fossils: *Hildoglochiceras inflatum* Imlay, n. sp.; *H. alamense* Imlay, n. sp.; *Himalayites?* sp.; *Substeueroceras alticostatum* Imlay, n. sp.; *S. kellumi* Imlay, n. sp.; *S. subquadratum* Imlay, n. sp.; *Virgatosphinctes* sp.

LOCALITY K2: On ridge S. 12° W. of Puerto Santiago. Ammonite bed

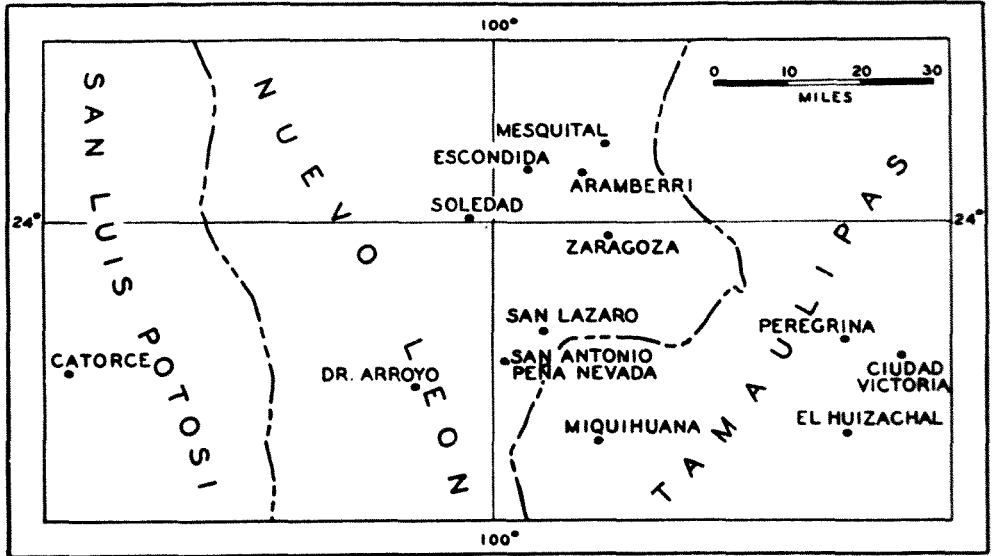


FIGURE 2.—Index map of fossil localities in eastern Mexico

near top of gypsiferous shale but represents same horizon as K4 of the measured section. Represents beds with *Durangites*. Fossils: *Hildoglochiceras grossicostatum* Imlay, n. sp.; *Durangites rarifurcatus* Imlay, n. sp.; *D. aff. rarifurcatus* Imlay; *D. sp.*

LOCALITY K3: Section S. 18° W. of Puerto Santiago and 200 feet west of K2. Belemnite from black shale nodule in float on hillside just above ammonite horizon K4 but a little lower stratigraphically.

LOCALITY K4: Section S. 18° W. of Puerto Santiago. Shaly limestone, 20 feet below top of La Casita formation in measured section. Represents beds with *Durangites*. Includes *Durangites* n. sp. ind.

LOCALITY K5: Section S. 18° W. of Puerto Santiago. Red shaly limestone 6 feet from top of La Casita formation in measured section. Beds with *Substeueroceras*. Fossils: *Proniceras aff. pronum* (Oppel); "*Aegocrioceras*" sp.; *Aulacosphinctes* sp.; *Berriasella?* sp.; *Hildoglochiceras alamense* Imlay, n. sp.; *Micracanthoceras alamense* Imlay, n. sp.; *M. n. sp. ind.*; *M. sp.*; *M.?* sp.; *Parodontoceras* sp.; *Substeueroceras alticostatum* Imlay, n. sp.; *S. kellumi* Imlay, n. sp.; *S. subquadratum* Imlay, n. sp.; *S. aff. subfacciatum* (Steuer).

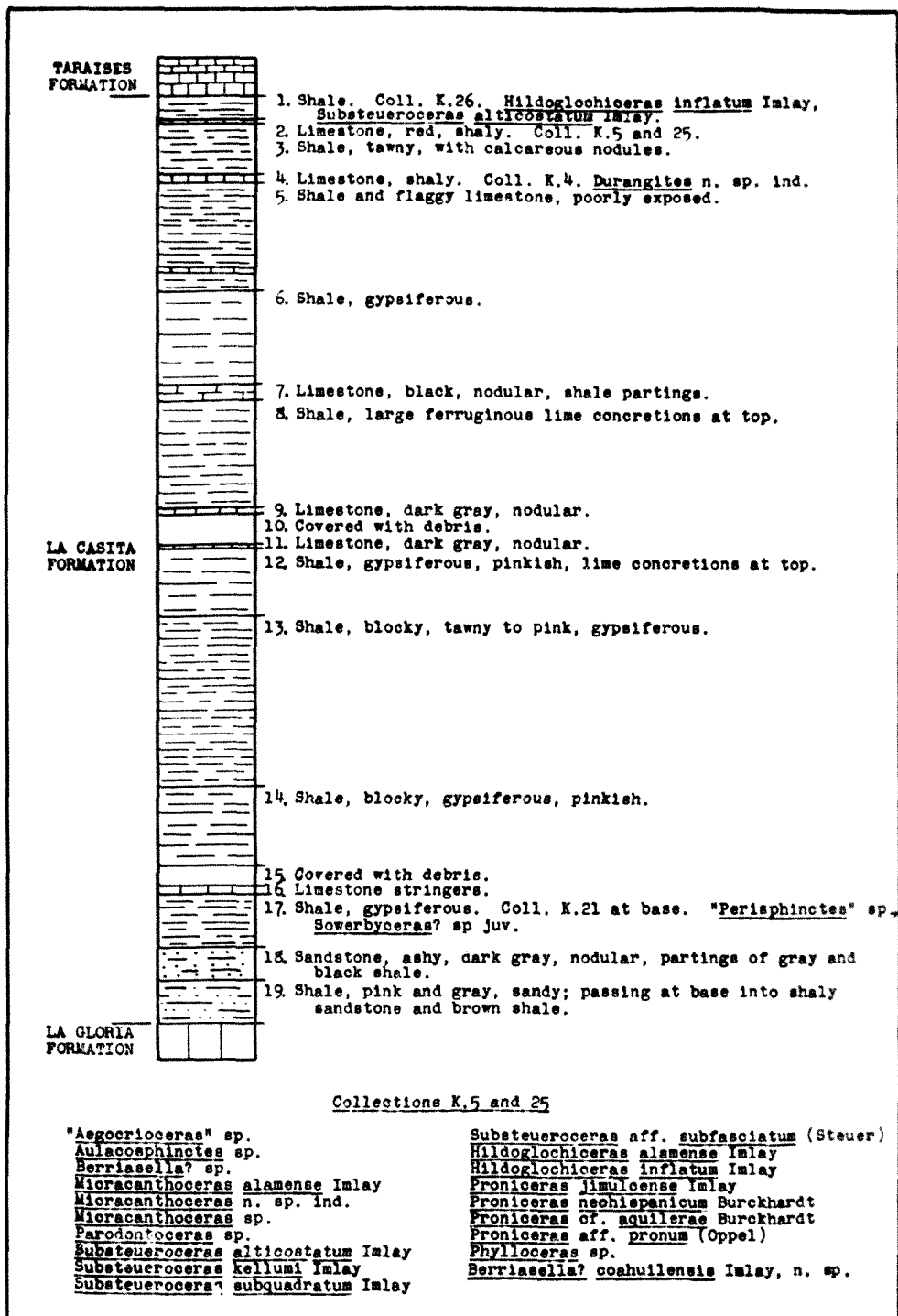


FIGURE 3.—Stratigraphic section in Cañón Alamo, Sierra de Jimulco, Coahuila

Scale 1:50. (For details see Imlay, 1938, p. 1683-1684.)

LOCALITY 21: Section S. 18° W. of Puerto Santiago. Ammonites at base of gypsiferous shale. Fossils: "*Perisphinctes*" sp. and *Sowerbyceras*? sp. juv.

LOCALITY 25: Section S. 18° W. of Puerto Santiago. Kellum made collection K5 presumably from the same beds and about 6 to 7 feet stratigraphically below top of La Casita formation. The fossils of the two collections are identical. Fossils: *Hildoglochiceras inflatum* Imlay, n. sp.; *H. sp. aff. alamense* Imlay; *Proniceras jimulcense* Imlay, n. sp.; *P. neohispanicum* Burekhardt; *P. cf. aguilerae* Burekhardt; *Phylloceras* sp.; *Micracanthoceras alamense* Imlay, n. sp.; *Substeueroceras subquadratum* Imlay, n. sp.; *S. kellumi* Imlay, n. sp.; *S. aff. alticostatium* Imlay, n. sp.; *Berriasella? coahuilense* Imlay, n. sp.

LOCALITY 26: Section S. 18° W. of Puerto Santiago. Ammonites collected 5 to 8 feet stratigraphically above Collection 25, but the species are identical. Represents beds with *Substeueroceras*. Fossils: *Hildoglochiceras inflatum* Imlay, n. sp.; *Substeueroceras alticostatium* Imlay, n. sp.

Sierra del Chivo.—This name is applied to a range of hills east and northeast of Symón, Durango. About 2½ miles east of Symón rises a prominent hill capped with the Taraises formation and exposing a fairly complete section of La Caja formation on its steep south flank. At the southern base of the hill rises a low ridge composed of Zuloaga limestone. The pass between the hill and ridge is called Cañón del Toboso. The Jurassic section on the north wall of Cañón del Toboso was originally studied by Böse and later restudied by the writer in July, 1936.

The section on the north side of Cañón del Toboso, Sierra del Chivo, near Symón, Durango, measured by R. W. Imlay, from top to bottom, is as follows:

Taraises formation

Unit	Feet
16. Limestone, at base thin-bedded, nodular, gray. <i>Thurmannites</i> ? sp. obtained from basal bed (Coll. 1).	

La Caja formation

15. Shaly limestone, ashy in texture, light gray, poorly exposed. Coll. 2 obtained 18 feet from top contains <i>Berriasella</i> sp. Coll. 3 obtained 27½ feet from top contains <i>Substeueroceras</i> sp., <i>Berriasella?</i> sp., <i>Berriasella zacatecana</i> Imlay, n. sp., <i>Aulacosphinctes?</i> sp. Coll. 4 obtained 40 feet from top contains <i>Parodontoceras</i> sp., and <i>Parodontoceras cf. calistoides</i> (Behrendsen). Coll. 5 obtained 46 feet from top contains <i>Proniceras</i> sp. juv., <i>P. cf. idocerooides</i> Burekhardt, and <i>Parodontoceras</i>	70
14. Covered. Probably dark gray shale.....	28
13. Limestone, dark pinkish gray.....	1
12. Shaly limestone, dark gray. <i>Berriasella</i> n. sp. ind. (Coll. 6) from middle	2

Unit	Feet
11. Limestone, granular to bladed.....	1+
10. Shale and shaly limestone, dark gray. Coll. 7, obtained 2 feet from top, contains <i>Kossmatia</i> sp.	25
9. Limestone, compact, dark gray.....	4
8. Limestone, shaly to thin-bedded, dominantly gray but in places pinkish gray. Coll. 8 made 4 feet from top contains <i>Virgatosphinctes?</i> aff. <i>mexicanus</i> Burckhardt, <i>Torquatisphinctes</i> sp., and " <i>Phylloceras</i> " sp. Coll. 9 made 22½ feet from top consists of <i>Mazapilites tobosensis</i> Burckhardt. Coll. 10 made 25 feet from top contains <i>Mazapilites</i> sp. and <i>Taramelliceras</i> sp. Coll. 11 made 35½ feet from top contains <i>Mazapilites symonensis</i> Burckhardt, <i>M.</i> sp., and <i>Torquatisphinctes</i> sp. Coll. 12 made 39 feet from top contains <i>Mazapilites tobosensis</i> Burckhardt, <i>Taramelliceras</i> sp., and <i>Torquatisphinctes?</i> cf. <i>symonensis</i> Burckhardt. Coll. 13 made 42½ feet from top contains <i>Mazapilites carinatus</i> Burckhardt, <i>M.</i> sp., and <i>Torquatisphinctes</i> sp. Coll. 14 made 45½ feet from top contains <i>Mazapilites</i> n. sp. ind. and <i>Torquatisphinctes</i> sp. Coll. 15 made 50½ feet from top contains <i>Mazapilites crassicostratus</i> Burckhardt, <i>M. carinatus</i> Burckhardt, <i>M. tobosensis</i> Burckhardt, <i>M. symonensis</i> Burckhardt, <i>M.</i> n. sp. ind., " <i>Phylloceras</i> " sp., <i>Aulacosphinctoides?</i> sp., <i>Taramelliceras</i> sp., <i>Torquatisphinctes?</i> aff. <i>bangei</i> Burckhardt, <i>T.?</i> aff. <i>kokeni</i> Burckhardt, <i>T.</i> sp. ind. (many fragments). Coll. 16 made 55½ feet from top consists of <i>Mazapilites tobosensis</i> Burckhardt. Coll. 17 made 58 feet from top consists of <i>Mazapilites</i> sp.	64
7. Shale, gray. Coll. 18 made from top contains <i>Mazapilites</i> sp., <i>Torquatisphinctes</i> sp., and <i>Waagenia</i> sp.....	8½
6. Limestone, pinkish gray.....	1½
5. Shale mainly, gray; beds of dark gray limestone every few feet.....	47
4. Limestone, black.....	1½
3. Shale, gray.....	3
2. Covered with debris except for a few beds of dark coarse-grained limestone.....	42
Total.....	298±

Zuloaga limestone

1. Limestone, thick-bedded, gray, bearing *Nerineas*.

Comparisons of the same section measured by Emil Böse (Burckhardt, 1930, p. 56) are given in Figure 4.

Sierra de Mazapil.—The fossil localities in the vicinity of Mazapil have been indicated by Burckhardt (1906a) on geologic maps by means of asterisks. As these maps may not be readily available to the reader the most important Jurassic localities are listed below with reference to Mazapil.

1. Cañón de San Matias, near Casa Sotelo in Santa Rosa Valley, about 6 miles southeast of Mazapil. Fossil lists by Burckhardt (1906b, p. 154-156; revised 1930, fig. 13a, p. 50).

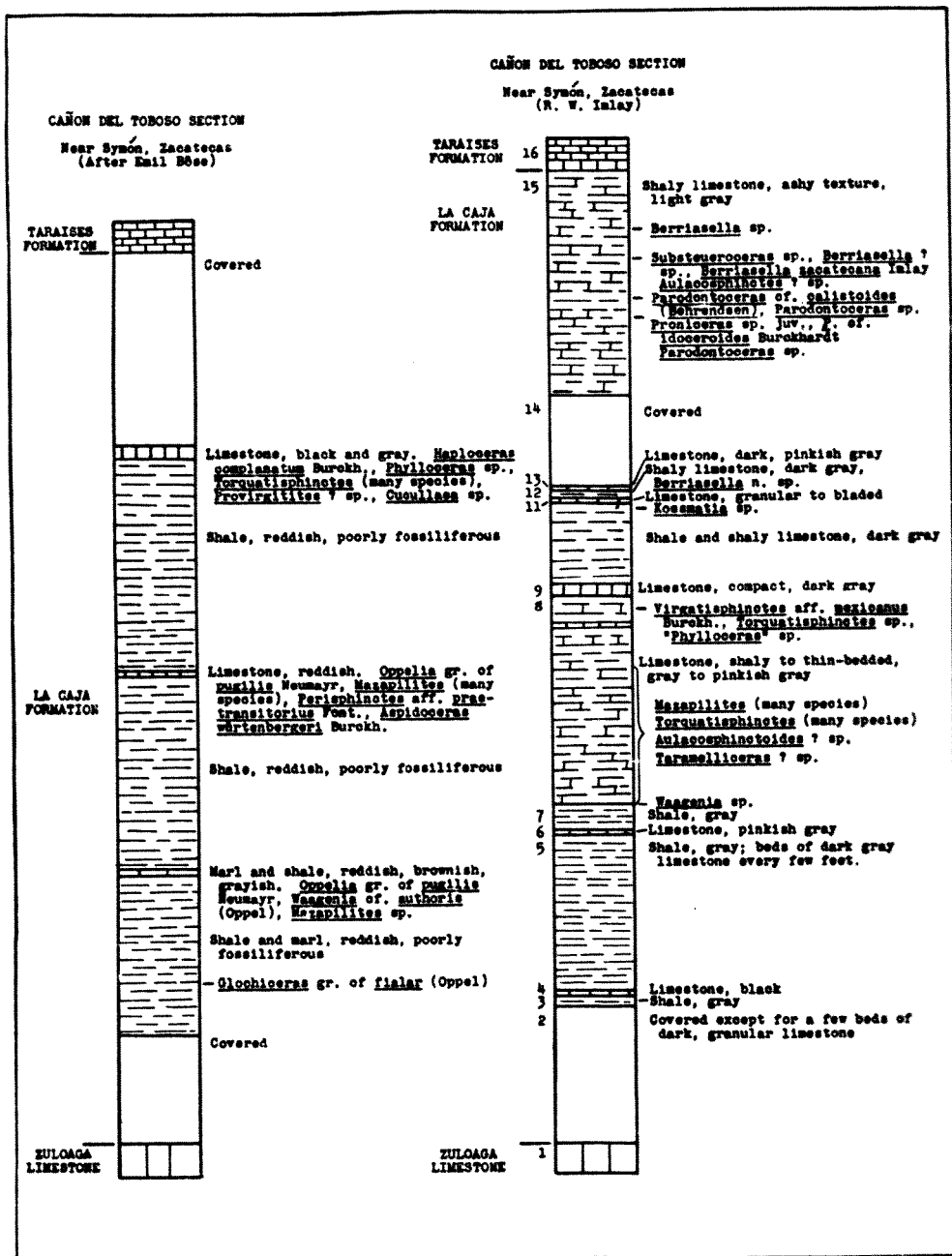


FIGURE 4.—Stratigraphic section on north side of Cañon del Toboso, Sierra del Chivo Near Symón, Durango.

2. Puerto Blanco in the Sierra de Santa Rosa is a divide between Cañon de las Bocas and Santa Rosa Valley, about 4 miles southeast of Mazapil. Fossils listed by Burckhardt (1906b, p. 157-159; revised 1930, p. 51). In addition the writer collected the following:

(a) In brown to gray shale with *Waagenia* were obtained *Waagenia* sp.; *Virgatosphinctes?* sp.; *Physodoceras* cf. *avellanoides* Uhlig; *Subdichotomoceras* sp.

(b) In a bed of compact black limestone with *Glochiceras fialar* were obtained *Glochiceras fialar* (Oppel); *G.* aff. *fialar* (Oppel); *Haploceras mexicanum* Burekhardt; *H. transatlanticum* Burekhardt; *H. zacatecanum* Burekhardt; *H. costatum* Burekhardt; *H.* n. sp. aff. *transatlanticum* Burekhardt; *Aspidoceras inflatum binodum* Burekhardt (not Quenstedt); *Taramelliceras* sp.

(c) In brownish shale and marl with *Idoceras* gr. of *balderus* were obtained *Idoceras humboldti* Burekhardt; *Idoceras mexicanum* Burekhardt; *Vermetus* sp.

3. Vereda del Quemado, Sierra de la Caja, about 3½ miles northwest of Mazapil. Fossils listed by Burekhardt (1906b, p. 153-154; revised 1930, fig. 14, p. 52). On the ridge between Vereda del Quemado and Cuesta del Gato the writer obtained the following: *Idoceras canelense* Burekhardt; *I. humboldti* Burekhardt; *I. mexicanum* Burekhardt; *I. neogaeum* Burekhardt.

4. Cuesta de los Colorines, Sierra de la Caja, about 4 miles northwest of Mazapil and 0.6 mile west of Vereda del Quemado. The writer obtained the following fossils:

(a) In beds with *Substeueroceras* was obtained *Berriasella* cf. *oppeli* Kilian.

(b) In beds with *Mazapilites* and *Aulacosphinctoides* were obtained *Virgatosphinctes?* cf. *mexicanus* (Burekhardt); *Phylloceras* sp.; *Oppelia mazapilensis* (Burekhardt); *Pseudolissoceras* sp.

(c) In beds with *Glochiceras fialar* were obtained *Glochiceras fialar* (Oppel); *Haploceras costatum* Burekhardt; *H. transatlanticum* Burekhardt; *H. zacatecanum* Burekhardt.

5. Cuesta de la Caja, Sierra de la Caja, about 5½ miles west-northwest of Mazapil.

6. To the east of Cuesta del Gato, Sierra de la Caja, about 3¼ miles northwest of Mazapil and half a mile east of Vereda del Quemado.

7. Rancho de la Canela, Sierra de Santa Rosa, about 3½ miles south-southwest of Mazapil.

8. Cañón del Aire, Sierra de Santa Rosa, about 2½ miles southwest of Mazapil.

9. Puerto del Aire, a divide between two canyons about 3½ miles southwest of Mazapil and one mile east of locality in Cañón del Aire.

10. Puerto del Chorreadero, Sierra de Santa Rosa, on ridge 4½ miles south-southeast of Mazapil.

Sierras de Zuloaga and Sombreretillo.—Their most important Jurassic fossil localities are as follows:

1. Marls 100 feet from base of La Caja formation about 2 miles south-southeast of Melchor Ocampo just south of crest of the Sierra Zuloaga. Represents beds with *Glochiceras fialar* (Oppel). Fossils: *Glochiceras fialar* (Oppel); *Haploceras* aff. *mexicanum* Burekhardt; *H. transatlanticum* Burekhardt; *H. zacatecanum* Burekhardt; *Involuticeras* sp.

2. Collection made 50 feet from base of the formation about 2 miles northwest of Melchor Ocampo on the east side of Cañón Sombreretillo. Represents beds with *Glochiceras fialar* (Oppel). Fossils: *Glochiceras fialar* (Oppel); *Haploceras costatum* Burekhardt; *H. mexicanum* Burekhardt; *H. transatlanticum* Burekhardt; *H. zacatecanum* Burekhardt.

3. Three miles northeast of Melchor Ocampo in Cañón del Escorpión. Fossils obtained from whitish-gray, platy limestone and black limestone concretions forming upper 25 feet of La Caja formation. Beds with *Substeueroceras*. The specimens of *Proniceras* were obtained from concretions in the lower part of the unit. Fossils: *Parodontoceras* cf. *calistoides* (Behrendsen); *Substeueroceras* sp.; *Proniceras subpronum* Burekhardt; *P. scorpionum* Imlay, n. sp.; *P.* cf. *torresense* Burekhardt; *P.* sp.

4. Todos Santos mine, southern flank of Sierra Zuloaga south of Melchor Ocampo (Burekhardt, 1930, p. 49, 54).

Sierra de la Ventura.—East front of mountain about 6 miles southwest of La Ventura. Fossils obtained from limestone concretions in black shales about 40 feet from base of La Caja formation. Main localities 900 feet and one mile south of Mina de San Francisco. The mine is located in a syncline exposing the basal Taraises formation in its center. About one mile north of the mine the mountain front breaks up into strike ridges and swings from north to northwest.

1. Nine hundred feet south of Mina de San Francisco and 40 feet above base of La Caja formation. Represents beds with *Glochiceras fialar* (Oppel). Fossils: *Glochiceras fialar* (Oppel), *Idoceras tuttlei* Burekhardt, *I.* cf. *balderus* (Loriol).

A few feet higher in the section a limestone concretion yielded many specimens of *Glochiceras fialar* (Oppel), *Haploceras costatum* Burekhardt, *H. felixi* Burekhardt, *H. transatlanticum* Burekhardt, *H. zacatecanum* Burekhardt, *H. mexicanum* Burekhardt.

2. One mile south of Mina de San Francisco on the northern slope of an eastward-trending spur from the main range the beds with *Glochiceras fialar* (Oppel) occur 40 feet above the base of the La Caja formation. Fossils: *Glochiceras fialar* (Oppel), *Idoceras* aff. *soteloii* Burek-

hardt, *Subneumayria ordoñezi* Burekhardt, *Subdichotomoceras?* sp., *Haploceras cornutum* Burekhardt, *H. costatum* Burekhardt, *H. n. sp. aff. costatum* Burekhardt, *H. felixi* Burekhardt, *H. mexicanum* Burekhardt, *H. transatlanticum* Burekhardt, *H. aff. transatlanticum* Burekhardt, *H. zacatecanum* Burekhardt.

Sierra Madre Oriental.—The most important Jurassic fossil localities are:

1. Bed No. 3 of section on the west flank of the San Lazaro Anticline about 0.6 mile (1 km.) south of the pass on the San Lazaro-Zaragoza trail, Nuevo León (Imlay, 1937b, p. 555). Limestone, argillaceous, finely laminated, gray, black, brownish-black and ashy, containing fossiliferous phosphatic concretions. Represents beds with *Idoceras*. Fossils: *Idoceras cf. santarosatum* Burekhardt, *I. aff. zacatecanum* Burekhardt.

2. East flank of San Lazaro-Peña Nevada Anticline along strike north of Diablo Cañón, Nuevo León. Fossils from ashy, concretionary, phosphatic shale. Fossils: *Glochiceras diaboli* Imlay, n. sp., *G. aff. diaboli* Imlay.

3. Road from La Escondida to Soledad, Nuevo León, 7 miles (11.2 km.) from La Escondida, and 100 yards up small arroyo south of road. Fossils occur in nodular concretions in soft pink bed. Represents beds with *Idoceras*. Fossils: *Idoceras humboldti* Burekhardt; *I. soteloi* Burekhardt; *I. submalleti* Burekhardt; *I. densicostatum* Imlay, n. sp.; *I. cf. densicostatum* Imlay, n. sp.; *I. aff. striatum* Imlay, n. sp.; *I. sp.*; *Involuticeras* sp. juv. aff. *mazapilense* (Burekhardt); *Nebroditis* n. sp. aff. *N. doublieri* (D'Orbigny); *Ochetoceras* sp.; *Sutneria* aff. *cyclodorsatus* (Moesch); *Taramelliceras* aff. *nereus* Fontannes; *Glochiceras falar* (Oppel); *Haploceras transatlanticum* Burekhardt; *H. zacatecanum* Burekhardt.

4. Near San Lazaro the Jurassic section is complicated and difficult to determine. (See Figure 5.) Much clearer and probably similar is the Mesquital section (Fig. 6) concerning which Burekhardt (1930, p. 85) incorrectly stated that the Cretaceous limestones rest directly on the red beds.

Bed No. 3 of section on west bank of Arroyo San Lazaro (Imlay, 1937b, p. 557) opposite a spring at the mouth of Cañón Tijera, about a mile north of Rancho San Lazaro, Nuevo León. Most of the Jurassic fossils from this locality are not especially designated as occurring in bed No. 3 and are merely labeled Cañón San Lazaro. Fossils occur in blue-gray, thin-bedded, phosphatic limestone which is interbedded with ashy marls. Represents beds with *Idoceras*. Fossils: *Idoceras soteloi* Burekhardt; *I. viverosi* Burekhardt; *I. zacatecanum* Burekhardt; *I. sanlazarense* Imlay, n. sp.; *I. involutum* Imlay, n. sp.; *I. striatum* Imlay, n. sp.; *I. tamau-*

lipanum Imlay, n. sp.; *I. balderus* (Oppel) Burckhardt; *Ochetoceras sanzazarensis* Imlay, n. sp.; *Subneumayria* aff. *ordoñezi* (Burckhardt); *Involuceras* sp. juv. aff. *mazapilense* (Burckhardt); *Rasenia profulgens* Burckhardt.

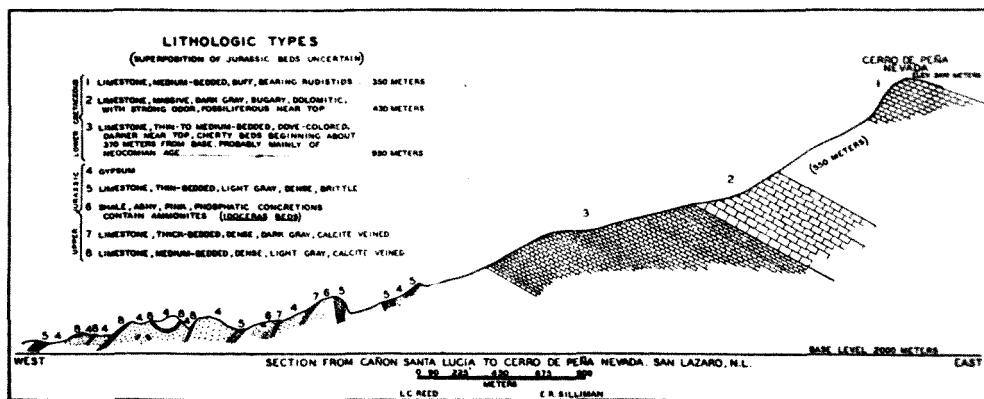


FIGURE 5.—Structure section from Cañon Santa Lucia to Cerro de Peña, Nevada Near San Lazaro, Nuevo León.

Mountains west of Laguna district.—The most important Jurassic fossil localities are:

LOCALITY A-16. Cañon Maravillas, about $2\frac{1}{4}$ miles southwest of Las Cuevas Ranch (Kellum, 1936, p. 1056, 1066, pl. 13), Durango, Mexico. Fossils occur in dark gray, nodular limestone 580 feet above the base of unit D. Probably represents the middle Oxfordian. Fossils: *Indosphinctes?* (several species), *Subgrossouvria?* sp., *Pseudopeltoceras?* sp.

San Pedro del Gallo.—Burckhardt collected fossils at a number of localities which he designated on the geologic map by means of numbers (Burckhardt, 1910, pl. XLIX). At localities 4, 5, 11, 16, 22, 23, the fossils occur in black limestone concretions in gray to black shale and marl. The stratigraphy has been discussed by Burckhardt (1910, p. 309-321, pl. XLIX; 1912, p. 203-226; 1930, p. 59-61, figs. 20, 21). The writer visited the locality in 1936 and made the collections listed below.

LOCALITY 4: About 2 miles north-northwest of village at side of road to Mapimí. Probably represents only upper part of beds with *Idoceras*. Fossils: *Idoceras complanatum* Burckhardt; *I. johnsoni* Burckhardt; *I. lorioli* Burckhardt; *I. sauteri* Burckhardt; *I. aff. neohispanicum* Burckhardt; *I. aff. tuttlei* Burckhardt; *Nebroditis haizmanni* Burckhardt; *N. sp.*; *Sutneria* aff. *cyclodorsatus* Moesch; *Phylloceras* cf. *subplicatus* Burckhardt, *Physdoceras* sp.; *Streblites complanatus* Burckhardt; *S.*

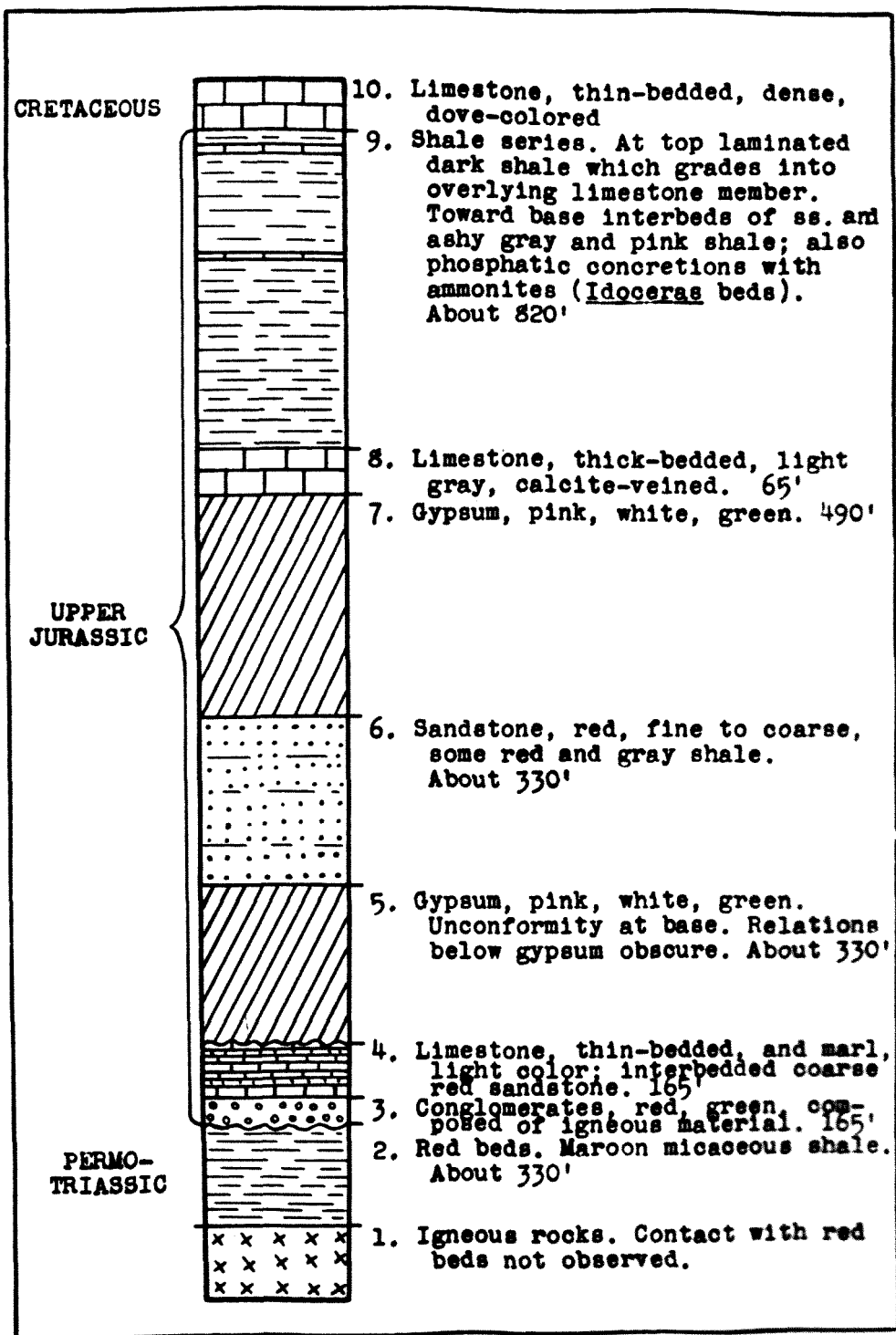


FIGURE 6.—Stratigraphic section on northwest flank of Barrier Anticline

On north side of Rio Blanco, near Mesquital, Nuevo León. (Measured by L. C. Reed and E. R. Silliman; checked by C. L. Baker.) Not published previously.

serratus Burckhardt; *S. uhligi* Burckhardt; *Sowerbyceras inflatum* Burckhardt; *Subplanites?* sp.

LOCALITY 5: About 2¾ miles north of village at side of road to Mapimí. Represents beds with *Idoceras*. Fossils: *Idoceras disciforme?* Burckhardt; *I. aff. dedalus* (Gemmellaro) Burckhardt; *I. lorioli* Burckhardt; *I. aff. mutabile* Burckhardt; *I. aff. tuttlei* Burckhardt; *Nebroditis burckhardti* Imlay, n. sp.; *N. sp.*; *Taramelliceras aff. nereus* Fontannes; *Sutneria aff. cyclodorsatus* Moesch; *Aspidoceras* aff. *longispinum* Sowerby; *Phylloceras subplicatius* Burckhardt; *Physodoceras* sp.; *Sowerbyceras inflatum* Burckhardt; *Streblites* sp., *Virgatites?* sp.

LOCALITY 6: Small hill south of Rancho de las Lagunitas.

LOCALITY 8: One mile north of village at northern base of Cerro del Volcán.

LOCALITY 10: About 1½ miles northeast of village at southeastern edge of Cerro del Volcán above Locality 11. Red and green marl and shale alternating with gray limestone. Probably represents upper Oxfordian. Fossils: *Ochetoceras mexicanum* Burckhardt; *O. sp.*; "*Perisphinctes*" *lagunitasensis* Burckhardt; "*P.*" aff. *virgulatus* Quenstedt; "*P.*" (many fragments).

LOCALITY 11: About 1⅓ miles northeast of village at southeastern base of Cerro del Volcán. Represents beds with *Idoceras*. Fossils: *Glochiceras fialar* (Oppel); *G. angustiumbilicatum* Imlay, n. sp.; *Haploceras?* sp.; *Idoceras aguilerae* Burckhardt; *I. complanatum* Burckhardt; *I. aff. cragini* Burckhardt; *I. aff. dedalum* (Gemmellaro) Burckhardt; *I. cf. durangense* Burckhardt; *I. lorioli* Burckhardt; *I. sauteri* Burckhardt; *I. cf. mutabile* Burckhardt; *Nebroditis?* sp.; *N. nodosocostatus* Burckhardt; *Ochetoceras cf. neohispanicum* Burckhardt; *Sutneria aff. cyclodorsatus* Moesch; *Taramelliceras aff. nereus* Fontannes; *Aspidoceras bispinosoides* Burckhardt; *A. aff. bispinosum* Quenstedt; *A. cf. longispinum* Sowerby; *Physodoceras aff. americanum* (Burckhardt); *P. cf. laevigatum* (Burckhardt); *Sowerbyceras inflatum* Burckhardt; *Streblites* sp.; *Phylloceras aff. consanguinum* Gemmellaro; *P. reticulatum* Burckhardt.

Some fossils were collected by native helpers supposedly from locality 11 but probably from the northeastern part of Cerro de la Cruz as they are probably of Tithonian age. Considering the strong deformation at San Pedro del Gallo, it is not improbable that a lense of Tithonian age has been pushed into beds of Kimmeridgian age. Fossils: *Micracanthoceras* n. sp. aff. *koellikeri* (Oppel); *M. cf. microanthum* (Oppel); *M. aguajitense* Imlay, n. sp.; *M. acanthellum* Imlay, n. sp.; *M. sp.*; *Spiticeras uhligi* Burckhardt.

LOCALITY 12: About 0.9 mile north of village at southern base of Cerro del Volcán. Represents beds with *Idoceras*. Fossils: *Idoceras aff. du-*

rangense Burckhardt; *I. sp.*; *I. durangense* Burckhardt; *Sutneria* aff. *cyclodorsatus* Moesch; *Nebroditis flexuosus* Burckhardt; *Aspidoceras* aff. *longispinum* Sowerby; *A. sp.*; *Physodoceras pavlowi* (Burckhardt); *Sowerbyceras inflatum* Burckhardt; *Streblites* sp.; *Subplanites?* sp.; *Pachysphinctes?* sp.

LOCALITY 15: Immediately west of village at east side of Cerro del Panteón. Gray argillaceous shale, in places yellowish or reddish. Represents beds with *Substeuerocheras*.

LOCALITY 16: At southern edge of village near Tanque. Represents beds with *Idoceras*. Fossils: *Idoceras durangense* Burckhardt; *I. aff. tuttlei* Burckhardt; *I. sp.*; *I. n. sp. ind.*; *Nebroditis* aff. *argentinus* Burckhardt; *Sutneria* aff. *cyclodorsatus* Moesch; *Taramelliceras* aff. *nereus* Fontannes; *Streblites* aff. *durangensis* Burckhardt.

LOCALITY 22: About 0.5 mile east of village.

LOCALITY 23: About 0.6 mile southeast of village to the north of Cerro de Las Liebres.

LOCALITY 24: About one mile east of village near Arroyo Aquajito.

LOCALITY 25: About 2 miles southeast of village at west base of La Sierrita.

To Burckhardt's localities the writer adds the following:

LOCALITY a: Unnamed beds transitional from Jurassic to Lower Cretaceous (mapped by Burckhardt as Lower Cretaceous). Fossils occur in thin-bedded limestone which is mainly gray but in part reddish. Near center of low hill, Cerro del Panteón, about 1,000 feet west of San Pedro del Gallo and 150 feet northwest of graveyard. Beds are stratigraphically slightly higher than the *Substeuerocheras* beds of Burckhardt's Locality 15 but are probably of Jurassic age. Fossils: *Aulacosphinctes?* sp.; *Phylloceras?* sp.; *Thurmannites* sp.; *Simoceras* sp.

LOCALITY b: About a quarter of a mile east of southeast corner of Cerro del Volcán on road nearest hill. Black shale and marl with limestone concretions. *Nebroditis crassicosatus* Burckhardt.

STATE OF PRESERVATION

Many of the Upper Jurassic fossils were obtained from phosphatic limestone concretions of which most are dark gray or black in the interior and coated with iron oxide on the surface. The fossils found in the concretions are excellently preserved and have not been distorted by the compressive forces to which the surrounding shales and marls have been subjected. A few of the shells, especially the body chamber, have been partly crushed, probably before burial. The association of concretions and fossils is apparently accidental as most of the concretions do not

contain fossils. For example, at San Pedro del Gallo, only about one concretion in a hundred contained fossils. Commonly, however, a number of fossils are found in a single concretion.

A second type of preservation is represented by the beds with *Glochiceras* in the Sierra de la Ventura. Here some limestone beds of varying hardness weather into large spheroidal masses. The fossils are mainly distorted internal molds.

A third type of preservation is represented by the beds in Cañón Alamo of the Sierra de Jimulco where the fossils occur as integral parts of the limestones and marls, retain part of their shells, and have been more or less distorted by earth movements.

External molds, usually crushed and distorted, are common in the Portlandian and Tithonian beds. Genera can usually be recognized from these molds, but specific identifications are difficult.

BIOLOGICAL ANALYSIS

In Tables 3-8 are listed the ammonites described by Burckhardt and the writer from north-central Mexico and from the San Lazaro region of eastern Mexico. These include about 300 species distributed as shown in Table 2.

TABLE 2.—*Distribution of ammonites*

Stage	Subdivision	Number of species
Tithonian	<i>Substeuerocheras</i> and <i>Proniceras</i>	56
Portlandian	<i>Durangites</i> and <i>Kossmatia</i>	33
Upper Kimmeridgian	<i>Torquatisphinctes</i> and <i>Mazapilites</i>	48
Middle Kimmeridgian	<i>Waagenia</i>	10
	<i>Glochiceras</i> gr. of <i>fialar</i> (Oppel) and <i>Idoceras</i> gr. of <i>durangense</i> Burckhardt	80
Lower Kimmeridgian	<i>Idoceras</i> gr. of <i>balderus</i> (Oppel)	49
Upper Oxfordian	<i>Dichotomosphinctes</i>	20
Middle Oxfordian	<i>Indosphinctes?</i>	3

In this paper are described 53 species, nearly all of which are new. Those represented only by external molds or fragmentary specimens have not been described unless they were of special paleontological or stratigraphical interest. No varieties of forms which are already well represented have been described. Many genera, especially the perisphinctids, show great variation, and it would be possible to increase the number of species or varieties manifold from a purely taxonomic viewpoint. However, the writer believes that the purposes of stratigraphy and paleontology are better served at present by allowing a certain degree of latitude in the definition of species which belong to rapidly evolving groups.

The affinities of the Upper Jurassic faunas of Mexico are predominantly with the faunas of the Mediterranean province and to a lesser extent with the Andean and Indian provinces. These relationships have been discussed by Burckhardt (1930, p. 105-114) whose conclusions have lately been evaluated by Spath (1933, p. 879-880).

The Phylloceratidae are poorly represented, but specimens have been found at many horizons. The Opperlidae comprise five genera which occur in many beds from the upper Oxfordian to the lower Portlandian but, with the exception of *Streblites*, are represented by few specimens. The Haploceratidae comprise five genera which are well represented by species and individuals. *Glochiceras* and *Haploceras* are abundant in the middle Kimmeridgian. *Pseudolissoceras* characterizes the boundary beds of the Kimmeridgian and Portlandian. *Mazapilites* is common in the upper Kimmeridgian. *Hildoglochiceras* occurs in the upper Portlandian and Tithonian.

The Perisphinctidae comprise about 17 genera but with the exception of *Idoceras* and *Torquatisphinctes* are poorly represented in numbers and species. This is due in part to failure in finding deposits favorable for their burial and preservation. After all, the deposits of the Mexican Geosyncline have been very briefly studied.

The Virgatitidae are poorly represented by a few specimens and probably include the genera *Epivirgatites* and *Provirgatites*. *Subneumayria* and *Epicephalites* may belong in this family.

The Berriasellidae are well represented by 10 genera and many species. In Mexico *Durangites* and *Kossmatia* are restricted to the Portlandian; *Micracanthoceras* occurs in both the Portlandian and Tithonian; *Substeuerocheras*, *Aulacosphinctes*, *Berriasella*, and *Parodontoceras* are common in the Tithonian. *Himalayites* and *Thurmannites* occur rarely in the highest Tithonian.

The Olcostephanidae are represented only by *Proniceras* which appears to range from late Portlandian to late Tithonian. The Aspidoceratidae are represented in considerable numbers by *Aspidoceras*, *Physodoceras*,

and *Nebroditcs*. *Waagenia* is rather uncommon. *Simoceras* and *Pseudopeltoceras* are probably present.

CORRELATION

Middle Oxfordian.—Fossils of this age have been found only in eastern Durango about 2¼ miles southwest of Las Cuevas. Many fragments have been provisionally assigned to the genera *Subgrossouvria*, *Indosphinctes*, and *Pseudopeltoceras*.

Upper Oxfordian.—The only described ammonites of this age are from San Pedro del Gallo, Durango, and are listed in Table 3 of this report. The dominant genus is *Dichotomosphinctes*, which is represented by at least six species, but the genera *Prososphinctes*, *Otosphinctes*, and *Biplices* are probably present. The forms which Burckhardt (1912, p. 35) referred to *Perisphinctes* group of *virgulatus* Quenstedt are possibly closer to *Dichotomosphinctes* than to *Lithacoceras*.

Lower Kimmeridgian.—The lower Kimmeridgian is richly fossiliferous and is dominated by *Idoceras* group of *balderus* (Oppel). (See Table 4.) Other characteristic forms are *Nebroditcs* cf. *doublieri* (D'Orbigny), *N. aguilerae* (Burckhardt), *Rasenia profulgens* (Burckhardt), *Subneumayria ordoñezi* (Burckhardt), *Metahaploceras* aff. *nereus* (Fontannes), *Epi-cephalites epigonus* (Burckhardt), *Aspidoceras* cf. *acanthicum* Loriol, *Aspidoceras* (many species), *Pararasenia zacatecana* (Burckhardt).

Middle Kimmeridgian.—The lower part of the middle Kimmeridgian is characterized by *Idoceras* group of *durangense* Burckhardt and by *Glochiceras* group of *fialar* (Oppel). (See Table 5); the upper part is characterized by *Waagenia* and *Physodoceras*. At San Pedro del Gallo, Durango, many species of *Idoceras* group of *durangense* occur at the same localities as *Glochiceras* group of *fialar*, but the conditions of collecting are such that their occurrence in the same beds is somewhat uncertain. However, in the Sierra de la Ventura of southeastern Coahuila *Idoceras tuttlei* Burckhardt and *I.* cf. *balderus* (Oppel) were found associated with *Glochiceras fialar* (Oppel) in the same bed. Although the two groups of *Idoceras*, distinguished by Burckhardt, almost certainly overlap in time, the evidence to date indicates that the group of *durangense* is slightly younger. The forms commonly associated with *Glochiceras fialar* (Oppel) are *Haploceras* of the *zacatecanum-mexicanum* group and *Involuticeras*. The forms commonly associated with *Idoceras durangense* Burckhardt are *Nebroditcs*, *Streblites*, *Aspidoceras*, *Sowerbyceras*, and *Metahaploceras*. It appears, therefore, that two fairly distinct faunal assemblages existed simultaneously in the lower part of the middle Kimmeridgian; that associated with *Glochiceras fialar* has much the wider

distribution. However, the distinctness of these faunas may be more apparent than real as local conditions of burial might explain the abundance of certain forms at San Pedro del Gallo and their scarcity in other areas.

The genus *Waagenia* has been found in Mexico only in the north-central part and in the highest beds of the middle Kimmeridgian. (See Table 6.) In the region of Mazapil, Zacatecas, it is associated with *Physodoceras avellanooides* Burckhardt (not Uhlig). In Cañón del Toboso, near Symón, Durango, *Waagenia* occurs in the same bed with the lowest *Mazapilites* and *Torquatisphinctes* found in the section. In Cañón de la Casita in the Sierra de Parras, *Waagenia* occurs with *Torquatisphinctes?* aff. *diversecostatus* (Burckhardt) and *Subdichotomoceras?* sp.

Upper Kimmeridgian.—The beds placed here were considered by Burckhardt (1930, Table 6, p. 68, 69) as Portlandian and were divided into the *Aulacosphinctes* beds above and the *Mazapilites* beds below. Spath (1931, p. 465, 466) pointed out that many of the perisphinctids from the upper beds greatly resemble the Kimmeridgian genus, *Torquatisphinctes* and that the presence of *Mazapilites* and *Aspidoceras* indicates a Kimmeridgian rather than a lower Portlandian age (1933, p. 796). Spath at one time (1931, p. 466, 482, 484) referred many of Burckhardt's species of the *Aulacosphinctes* (*Perisphinctes*) *bangei* group to *Torquatisphinctes* but apparently decided later (1933, p. 865) that these species were closer to *Aulacosphinctoides* which occurs in the upper Kimmeridgian and lower Portlandian (Spath, 1933, p. 850). The writer remeasured the section in Cañón del Toboso, near Symón, Durango, and found that the genera *Torquatisphinctes?* and *Mazapilites* occur together throughout a considerable thickness of strata. Both *Torquatisphinctes* and *Aulacosphinctoides* appear to be represented, if these genera are interpreted in the broad sense. As a consequence of the association of these genera the beds have been renamed. (See Table 7.) In the Cañón del Toboso section, the stratigraphically lowest *Mazapilites* occurs with *Waagenia*, and the stratigraphically highest *Mazapilites* is overlain by a bed containing *Virgatosphinctes* and *Torquatisphinctes?*. The former genus indicates a Portlandian age for the bed in question.

Portlandian.—This stage is represented by the beds with *Durangites* and *Kossmatia* (Table 8) and probably by the upper part of the beds with *Torquatisphinctes?*. The most common genera are *Kossmatia*, *Durangites*, *Micracanthoceras*, and *Hildoglochiceras*. *Grayiceras* and *Virgatosphinctes* are poorly represented, but this may be due to failure in collecting. *Kossmatia* has been found at many places in northern and eastern Mexico. The genus *Durangites* has been found at two localities in southern Coahuila associated with *Hildoglochiceras*, and at San Pedro

del Gallo (Burckhardt, 1912, p. 143, 205) associated with *Kossmatia* and *Micracanthoceras*. One other association of *Durangites* with *Kossmatia* from Mexico has been reported by Burckhardt (1930, p. 91-93) at the gorge of Totolapa to the north of Huauchinango, Puebla. The occurrence of *Micracanthoceras* below the Tithonian is not unprecedented as it is reported from the upper Portlandian of Madagascar (Besaire, 1936, p. 66). The presence of *Hildoglochiceras* is interesting as the genus is characteristic of the Portlandian faunas of India (Spath, 1928, p. 154, 159-161) and Madagascar (Besaire, 1936, p. 51, 53, 65).

Tithonian.—Beds of this age in Mexico have yielded a large fauna dominated by the Berriasellidae. (See Table 9.) The genus *Substeuerceras*, judging from the occurrences recorded by Burckhardt (1930), ranges from the Portlandian to the end of the Tithonian but is most abundant in latest Tithonian. Some of the species are similar to Argentine species which Gerth (1925, p. 128) places in the Berriasian (Infra-Valanginian). But the association of the Mexican species with *Micracanthoceras*, *Hildoglochiceras*, *Aulacosphinctes*, *Virgatosphinctes*, and *Proniceras* definitely places their age as Tithonian. The occurrence of *Hildoglochiceras* in the Tithonian is noteworthy as it has not been recorded previously from beds younger than the Portlandian. *Berriasella* and *Parodontoceras* are represented by species considered more characteristic of the Tithonian than of the Berriasian. *Proniceras* is well represented and is associated with *Substeuerceras* in the Sierra de Jimulco and the Sierra de Sombrerete. Burckhardt (1930, Table 6, p. 63) apparently erred in placing *Proniceras* stratigraphically below *Kossmatia*, as the writer found it above *Kossmatia* in the Cañón del Toboso section, near Symón, Durango. An examination of Burckhardt's writings shows that he had no certain stratigraphic basis for placing *Proniceras* below *Kossmatia*. At San Pedro del Gallo he found *Proniceras* in a small outcrop surrounded by alluvium (Burckhardt, 1912, p. 205; 1930, p. 63). Because this outcrop lies between beds with *Durangites* to the east and beds with *Idoceras* to the west, Burckhardt assumed it was of lower Portlandian age. To the writer this assumption seems risky in view of the intense deformation which has occurred in the region of San Pedro del Gallo. Burckhardt (1930, p. 54) likewise recorded *Proniceras* from the highest unit of the Jurassic section in the Sierra Zuloaga but did not mention finding *Kossmatia* or *Substeuerceras* in the section. In the Sierra Ramirez, Burckhardt (1930, p. 57) depended on the field work of Böse who found a bed with *Proniceras* and *Aulacosphinctes* below beds with *Substeuerceras* and above beds with *Mazapilites*. However, this occurrence does not show the stratigraphic position of *Proni-*

ceras with respect to *Kossmatia*. The present work definitely shows that in Mexico *Proniceras* occurs in younger beds than *Kossmatia* and has about the same range as *Substeueroceras*.

SYSTEMATIC DESCRIPTIONS

Genus *Phylloceras* Suess 1865

"*Phylloceras*" sp.

(Plate 2, figures 1-4)

DESCRIPTION: Two specimens represent a species which perhaps belongs to the genus *Ptychophylloceras* Spath (1927, p. 41). Form discoidal, moderately stout; whorls ovate in section, a little higher than wide, strongly embracing; flanks and venter evenly convex; umbilicus very narrow and fairly deep.

The outer whorl of the figured specimen is sutured to its anterior end. It is marked by five shallow constrictions which are strongest near the umbilicus and on the venter. The constrictions trend nearly radially for a few millimeters near the umbilicus, then curve strongly forward on the lower part of the flanks, recurve slightly on the upper part of the flanks, and cross the venter transversely. The constrictions are bounded on the venter by faint swellings. No indications of ribs or striae are visible.

Dimensions in mm. are as follows:

Specimen	Diameter	Whorl height	Whorl thickness	Umbilical width
19289.....	55	31	28	2.5
19199.....	29	16.5	15	..

OCCURRENCE: La Caja formation (*Torquatisphinctes* and *Mazapilites* beds). Bed 8, collection 8 of Imlay's section on north side of Cañón del Toboso, Sierrita del Chivo, near Symón, Durango.

Genus *Ochetoceras* Haug 1885

Ochetoceras sanlazarensis Imlay, n. sp.

(Plate 1, figures 1-4)

DESCRIPTION: Shell fairly large for genus, flattened, discoidal; outer whorl wedge-shape in section, much higher than wide, embracing preceding whorl four-fifths, thickest at edge of umbilicus; flanks feebly convex, sloping gently to acutely sharpened venter which does not bear lateral carinae. Umbilicus narrow; wall moderately high, nearly vertical, separated from flanks by a feeble carina. Anterior third of outer whorl represents incomplete body chamber.

Shell ornamented by a spiral groove, by broadly triangular, flared flank ribs, and by bundles of coarse striae on the venter. The spiral groove is narrow, is situated slightly below the middle of the flanks, is distinct at the posterior end of outer whorl and indistinct at the anterior end. The flanks below the spiral groove are marked by broad, irregularly spaced ribs of two sizes which begin at edge of umbilical wall and incline slightly forward. The larger ribs are separated by one or rarely two smaller ribs. The flanks above the spiral groove are marked by strong, broad, widely spaced ribs which are concave forward. Most of them are the continuations of the larger ribs below the spiral groove. On the venter of the posterior half of the outer whorl, these flank ribs become small and sharp and are separated by two

to six short ribs equally sharp and inclined forward. On the venter of the anterior half of the outer whorl the flank ribs disappear, and concomitantly the short ribs on the venter develop into bundles of coarse striae. The ornamentation of the shell becomes much finer anteriorly, and at the extreme anterior end the entire flanks are marked by faint striae.

Greatest diameter of holotype 95 mm.; width of umbilicus 12 mm.; height of last whorl 51 mm.; thickness of last whorl 21 mm.

REMARKS: *Ochetoceras sanlazarens* Imlay differs from *O. neohispanicum* Burckhardt (1912, p. 46, pl. X, figs. 1-3, 7) by its stronger, more distantly spaced ribs. Among foreign species *O. canaliferum* (Oppel) (1863, p. 195, pl. LII, figs. 4 a, b) is similar but has a slightly higher and thinner whorl section, fewer flank ribs, and at a comparable size has much finer ribbing. *O. zio* (Oppel) (1863, p. 196, pl. LII, figs. 7 a-c) has closer-spaced main ribs ventral to the spiral groove. Also, the fine ribs between the main ribs are larger than in *O. sanlazarens* Imlay and bifurcate instead of forming striae. *O. palissyanum* (Fontannes) (1879, p. 48, pl. V, fig. 6) has a wider umbilicus, a wider groove, and finer ornamentation on the flanks.

TYPE: Holotype 19531, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Idoceras* zone). San Lazaro Canyon, Nuevo León.

Genus *Glochiceras* Hyatt 1900

Glochiceras diaboli Imlay, n. sp.

(Plate 6, figures 8-10)

DESCRIPTION: The species is represented definitely by six specimens of which the holotype is the largest. A fragment of an outer whorl of a large ammonite (Pl. 4, fig. 10) probably also belongs to the species.

Shell discoid, flattened; whorls subrectangular in section, slightly higher than wide, embracing about two-fifths, with greatest thickness at the middle of the flanks; venter regularly convex on inner whorls, slightly flattened on outer whorl; flanks slightly convex, rounding rather abruptly into venter on outer whorls, passing gradually into umbilical wall. Umbilicus fairly large, moderate in depth; wall steeply inclined.

The ornamentation consists of spiral furrow, fine falciform striae, and falciform folds. The spiral furrow is situated a little below the middle of the flanks, begins at a diameter of about 17 mm., and is never very pronounced. The striae start at the suture and curve forward on the lower part of the flanks to the spiral furrow where they describe a sharp fold which is convex forward.

On the flanks above the spiral furrow, the striae describe a broad curve which is convex backward, and on the venter form a deep fold which is convex forward. The falciform folds begin at a diameter of about 10 mm., are fairly regularly spaced, occur only above the spiral furrow, and are curved like striae which cover them. Anteriorly they become broader, stronger, and more widely spaced. They are strongest on the upper part of the flanks but diminish rapidly in strength and are scarcely visible on the venter. The largest specimens bear faint spiral markings on the venter. The suture line is unknown.

Greatest diameter of holotype 36 mm.; width of umbilicus 9.3 mm.; height of last whorl 15.4 mm.; thickness of last whorl 12 mm.

REMARKS: This species is distinguished from *G. fialar* (Oppel), as figured by Burckhardt (1906b, p. 77, pl. 19, figs. 1-19, pl. 20, figs. 1-6, 12, 14, 15) by more

vigorous ornamentation on the flanks, weaker ornamentation on the venter, less pronounced spiral furrow, broader venter, and subrectangular whorl section.

TYPE: Holotype 18998; paratypes 18999, 19000, Museum of Paleontology, University of Michigan.

OCCURRENCE: Concretionary, ashy, phosphatic shale on east flank of San Lazaro-Peña Nevada Anticline along strike north of Diablo Canyon, Nuevo León.

Glochiceras fialar Burckhardt (not Oppel)

REMARKS: There is a reasonable doubt as to whether the Mexican forms described by Burckhardt (1906, p. 77, pl. XIX, figs. 1-19; pl. XX, figs. 1-6, 12, 14, 15) are the same as *G. fialar* (Oppel), and the matter will probably have to be settled by European students as the published figures of the type are inadequate. Burckhardt has pointed out the considerable variation in shape and ornamentation of the Mexican forms. This variation is well shown by about 200 specimens in the University of Michigan collections. Much of the variation in shape is due to post-humous deformation, and some of the apparent difference in ornamentation is due to the condition of preservation. Certain specimens could be described as varieties, but this seems inadvisable as all the forms are connected by many transitions and the species is limited to a fairly narrow horizon. If varieties were found in other horizons, there would be some use in giving them special names. The species probably is the most common and widely distributed of any in the Upper Jurassic of Mexico.

SPECIMENS: 19524, 18957, 18992, 18980, 18974, 19542, 19001, 18967, Museum of Paleontology, University of Michigan.

OCCURRENCE: Many localities in north-central Mexico, especially in the Sierras Sombretillo, Zuloaga, de la Caja, Santa Rosa, de la Ventura, de Parras, and Catorce. Also found at San Pedro del Gallo, Durango (Locality 11 of Burckhardt); and 7 miles (11.2 km.) from La Escondida on road to Soledad, Nueva León.

Glochiceras augustiumbilicatum Imlay, n. sp.

(Plate 7, figures 4-6)

DESCRIPTION: Form small, discoidal; outer whorl elongate-ovate in section, much higher than wide, embracing about two-thirds; flanks nearly flat; venter evenly rounded. Umbilicus narrow; wall low, vertical, rounded rather abruptly into flanks. The outer whorl appears to represent a nearly complete body chamber.

Shell ornamented with fine, falciform striae which begin at the line of involution, curve forward on the lower part of the flank, form a pronounced forwardly inclined sinus in the spiral groove, describe a curve convex to the rear on the upper part of the flanks, and then recurve to form a forwardly inclined sinus on the venter. The striae become a little stronger ventrally, and on the venter develop into broad but extremely low ribs. Some of the striae are slightly reinforced on passing the spiral groove. The spiral groove is situated slightly below the middle of the flanks and on the anterior three-fourths of the outer whorl. The upper part of the flanks and the venter bear many faint, spiral markings. On the left side of the type is a short groove directly above the edge of the umbilicus. The short groove is probably due to an injury as a similar groove is not present on the right side. The suture line is unknown.

Greatest diameter of holotype 39 mm.; width of umbilicus 6.5 mm.; height of last whorl 19.5 mm.; thickness of last whorl 11 mm.

REMARKS: This species is characterized by its narrow umbilicus and flattened form. In these respects it resembles *Haploceras mexicanum* Burckhardt (1906b, p. 89, pl. 23, figs. 9-15) which, however, enlarges more rapidly and has different ornamentation. *Glochiceras fialar* (Oppel) and *G. diaboli* Imlay, n. sp. are more evolute, have more inflated whorl-sections, and stronger ornamentation.

TYPE: Holotype 18581, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Idoceras* beds): *Burckhardt's* locality 11, about $1\frac{1}{3}$ miles ($2\frac{1}{4}$ km.) northeast of San Pedro del Gallo, Durango.

Genus *Hildoglochiceras* Spath 1924

Hildoglochiceras grossicostatum Imlay, n. sp.

(Plate 2, figures 5-11; Plate 3, figures 1-7, 9-11)

DESCRIPTION: The species is represented by about 100 specimens of which the majority are internal molds of immature forms.

Shell small, discoidal; whorls ovate in section, higher than wide, thickest near or slightly below middle of flanks, embracing about three-fourths; flanks gently convex, becoming broader and flatter during growth, rounding evenly into venter, sloping toward umbilicus at a low angle; venter evenly rounded on immature forms, becoming narrower during growth and developing a keel. Umbilicus fairly narrow, moderate in depth; wall extremely low and nearly vertical, separated from flanks by a faint carina. Aperture unknown.

The innermost whorls are smooth. The outer whorls are marked by a prominent, narrowly rounded keel, by strongly sickle-like ribs and striae, and by a moderately developed spiral groove. The relative strength of these various features and the stage of development at which they appear vary somewhat in different individuals, but the order of development is always the same, i.e. keel, ribs, and then spiral groove. A faint sharpening of the venter is visible at a diameter of about 4 mm. and develops anteriorly into a true keel at a diameter of about 10 mm. On the outer whorl the keel is high, strong, rounded, and slightly uneven. Sickle-like striae are barely visible at a diameter of about 7 mm., at which size they curve forward from the line of involution to the lower third of the flanks, then backward to the upper third of the flanks, then forward again to the sharpened venter where they meet striae from the opposite flanks at a sharp angle. At this diameter the striae are only slightly stronger on the upper part of the flanks than on the lower part. During development the striae on the flanks persist as the stems of sickles, but their points of maximum forward inflection become higher and on the outer whorls are slightly below the middle of the flanks. At diameters varying from 10 to 14 mm. some of the striae on the upper part of the flanks become grouped in bundles which develop into high, sharp, falcoid ribs, between which are the terminations of other striae. The ribs approach the keel at a sharp angle, some merge with the keel, and others barely flatten out before reaching it.

The spiral groove appears at a diameter of about 14 mm. or a little later and is bounded dorsally by a faint ridge or swelling which persists into the adult whorls. The maximum inflection of the striae takes place in the lower part of the groove. On the outer whorls the groove is fairly broad but shallow.

The suture line can be traced fairly accurately on only one form (Paratype 20028) at a diameter of 12.3 mm. Probably due to immaturity of the form, its suture line is much simpler than those of the Indian forms that have been figured (Uhlig, 1903, p. 20, fig. 4; pl. 3, fig. 5; Uhlig, 1910, pl. LVIII, figs. 4d, 5d; Spath, 1928, pl. XIX.

figs. 5, 6; pl. XIII, fig. 17; Spath, 1931, pl. XCIX, fig. 6). The external lobe is shorter than the first lateral and is divided by a broad secondary saddle. The first lateral lobe is fairly broad and is deeper than the second lateral. The saddles are bifid. The external and first lateral saddles are broad, the first lateral saddle is a little higher than the external saddle, and its two parts are unequal, the inner being higher than the outer. An interesting peculiarity of the suture line is its asymmetry. The median saddle of the external lobe lies to the right of the mid-line of the venter.

Dimensions in mm. of several specimens are as follows:

Specimen	Greatest diameter	Whorl height	Whorl thickness	Umbilical width
holotype 20020	...	18.0	12.0	..
paratype 20026	23.5	11.7	7.0	3.7
paratype 20022	24.5	13.0	8.0	3.5
paratype 20024	24.0	11.5	8.0	3.7
paratype 20027	18.7	9.8	7.0	3.4
paratype 20021	20.0	10.8	..	3.1
paratype 20025	15.5	7.5	6.0	3.0
paratype 20028	16.3	7.6	5.3	3.0

REMARKS: *Hildoglochiceras grossicostatum* Imlay is characterized by its coarse ribbing, pronounced keel, and small umbilicus. *H. propinquum* (Waagen) (1875, p. 45, pl. XI, figs. 4a, b; Spath, 1931, pl. LXXXVI, figs. 1a, b) and *H. dieneri* (Uhlig) (1903, p. 19, pl. VII, figs. 9a, b) resemble the Mexican form but are less involute and are less coarsely ornamented. *H. colei* Spath (1931, pl. XCIX, fig. 6; pl. LXVIII, fig. 8, pl. LXXXI, figs. 4a, b, pl. LXXXII, fig. 4) approaches the Mexican form even more but is a little less involute, the spiral groove is probably less developed, and the ribs appear to approach the venter at a less sharp angle.

TYPE: Holotype 20020; paratypes 20021, 20022, 20023, 20024, 20025, 20026, 20027, 20028, 20029, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Durangites* beds), (1) Locality 34 in the Sierra de Parras, Coahuila. (2) Locality K 2 in Cañón Alamo, Sierra de Jimulco, Coahuila.

Hildoglochiceras ecarinatum Imlay, n. sp.

(Plate 5, figures 1-4)

DESCRIPTION: This species is represented by two immature forms. Shell small, discoidal; whorls ovate in section, higher than wide, thickest slightly above middle of flanks, embracing about three-fourths; flanks gently convex, rounding evenly into venter, sloping toward umbilicus at a low angle; venter narrowly rounded but not sharpened. Umbilicus fairly narrow, moderate in depth; wall extremely low and nearly vertical, separated from flanks by a faint carina. Aperture unknown.

The ornamentation consists of striae on the lower two-thirds of the flanks, of ribs on the upper parts of the flanks and the venter, and of a faint spiral groove which is bounded dorsally by a faint spiral ridge. The striae and ribs form sickles as in *H. grossicostatum* Imlay. The striae begin at the line of involution, incline slightly forward on the umbilical wall, curve slightly backward on the lower fourth of the flanks, are strongly inflected forward just above the middle of the flanks along a zone marking a faint spiral ridge, and are then inflected backward on the upper part of the flanks where they pass into ribs. The ribs arise at the place

of maximum backward inflection and then curve strongly forward to the venter where they form a narrow arch with the ribs from the opposite side. The ribs are strongest on the venter, but there is no evidence of a keel or of ventral tubercles. The ventral ribbing is strongest to the right of the mid-line, which may indicate a slight degree of asymmetry of the shell. At the extreme anterior end of the holotype is an intercalary rib which is restricted to the venter. Faint striae are visible on and between some ribs. The spiral ridge near the middle of the flanks is faint at the posterior end of both types. It becomes broader anteriorly and on the anterior third of the shell is bounded ventrally by a faint spiral groove.

The few traceable parts of the suture line do not differ appreciably from the suture line of *H. grossicostatum* Imlay.

Greatest diameter of holotype 20.5 mm.; height of whorl 10.1 mm.; thickness of whorl 7.7 mm.; width of umbilicus 4 mm.

REMARKS: This species is clearly distinguished from all other species of *Hildoglochiceras* by lacking a ventral keel. Otherwise it is similar to *H. grossicostatum* Imlay with which it is associated.

TYPE: Holotype 17709; paratype 19800, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Durangites* beds). Locality 34 in the Sierra de Parras, Coahuila.

Hildoglochiceras inflatum Imlay, n. sp.

(Plate 4, figures 1-5)

DESCRIPTION: The species is represented by nine specimens. The holotype has been slightly crushed laterally. Shell discoidal, small; whorls ovate in section, a little higher than wide, thickest at middle of flanks, embracing more than three-fourths of preceding whorls; flanks gently convex, below spiral groove inclined toward umbilicus; venter moderately broad, sharpened. Umbilicus fairly narrow and deep, wall vertical at base, rounding evenly into flanks. All specimens are sutured to the end.

The shell is ornamented with faint striae which are strongest at the spiral groove. They are visible at the edge of the umbilicus and disappear on the venter. They describe a curve which is convex backward below the spiral groove, convex forward at the groove, then convex backward on the upper part of the flanks. The venter is merely sharpened on the types and a faint sharpening is visible at a diameter of about 16 mm. The spiral groove is situated at the middle of the flanks and is broad and deep. The depth of the groove varies somewhat on different specimens and even on the two sides of the same specimen.

Dimensions in mm. are as follows:

Specimen	Maximum diameter	Whorl height	Whorl thickness	Umbilical width
holotype 20094	34	16.5	13	7
paratype 15908	32	16	10?	5
paratype 20002	27	12.5	9.5	4.3
paratype 19379	33.2	15.7	11.	6.5

REMARKS: This species differs from *H. alamense* Imlay by having a broader whorl section, a merely sharpened venter, a more pronounced spiral groove, stronger striae at a comparable size, and an evenly rounded umbilical wall. As the body chamber is unknown, it is impossible to say whether a keel develops on the adult forms.

Among the Indian species of *Hildoglochiceras*, *H. ? planum* (Waagen) (1875, p. 56, pl. XI, figs. 3a, b) is distinguished from *H. inflatum* Imlay by a wider umbilicus

and less inflation. *H. subdieneri* Spath (1931, pl. LXXXVI, figs. 3a, b) is more like the Mexican species but has a wider umbilicus.

TYPE: Holotype 20094; paratypes 20002, 19379, 15908, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Substeueroceras* beds). Collections K1, 25, and 26 in Cañón Alamo, Sierra de Jimulco, Coahuila.

Hildoglochiceras alamense Imlay, n. sp.

(Plate 4, figures 6-9, 11, 12)

DESCRIPTION: The species is represented by 11 specimens of which three are smaller than the exposed inner whorl of the holotype. In addition four tiny, immature forms may belong to the species.

Form discoidal, fairly large. Whorls elliptical in section, much higher than wide, enlarging slowly, embracing most of preceding whorls; flanks flattened and wide; venter narrow; rounded on inner whorls, keeled on outer whorls. Umbilicus narrow, shallow; wall low, vertical, rounding abruptly into flanks.

The spiral groove is situated at the middle of the flanks. On the holotype it is broad and shallow but owing to poor preservation is somewhat indistinct. On smaller specimens it is faintly present at a diameter of about 25 mm. The flank ribbing is fine at all stages. The smaller specimens bear nearly microscopic striae which follow the course characteristic of the genus and are strongest on the edges of the venter. The exposed inner whorl of the holotype is so corroded that the striae are preserved only in a few places on the upper part of the flanks. On the outer whorl of the holotype, probably the body chamber, the striae are much stronger, are somewhat variably spaced, and are strongest on the upper parts of the flanks next to the venter. They describe a curve convex forward at the spiral groove and a curve convex backward on the upper part of the flanks, but end abruptly on the venter before reaching the keel. The venter is faintly sharpened at a diameter of about 14 mm. and gradually develops into a low rounded keel anteriorly. The diameter at which a keel appears varies somewhat in different specimens, but on paratype 16936 it is already present at a diameter of 22 mm. Concomitant with the development of the keel the shell on both sides of the median line becomes flattened but does not develop lateral grooves.

The inner whorl of the holotype at a diameter of 53 mm. has a whorl height of 27 mm., a whorl thickness of 14 mm.(?), and an umbilical width of 9 mm.

REMARKS: This species is characterized by its fine ribbing, narrow umbilicus, and flattened flanks. Of the Indian species, it most closely resembles *H. subdieneri* Spath (1931, pl. LXXXVI, figs. 3a, b) which, however, has a wider umbilicus and a merely sharpened venter.

TYPE: Holotype 20001; paratypes 16936, 16937, 20095, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Substeueroceras* beds). Collections K1, 5, and 26 in Cañón Alamo, Sierra de Jimulco, Coahuila.

Genus *Nebrodites* Burckhardt 1910

Nebrodites burckhardti Imlay, n. sp.

(Plate 2, figure 12)

DESCRIPTION: Form fairly large, discoidal, flattened; whorl section subrectangular, much higher than wide; greatest thickness on lower third of flanks; whorls em-

bracing about one-fifth; flanks flattened; venter narrow, flattened on outer whorl. Umbilicus fairly wide, shallow; wall low, vertical on inner whorls, becoming steeply inclined on outer whorl.

The inner whorls, shown in the umbilicus, bear strong, wide ribs which start from the line of involution and cross the flanks nearly radially but incline slightly forward. Most of the ribs bifurcate at or a little below the middle of the flanks. On the penultimate whorl intercalary ribs appear on the upper part of the flanks, and the branching points of the ribs tend to become indistinct. About seven or eight faint constrictions per whorl.

On the outer whorl, which is part of the body chamber, the ribs are strong and broad on the flanks but weakened appreciably along the venter. Their cross-section tends to be triangular rather than rounded. They originate at the line of involution and pass radially onto the flanks where they curve forward slightly, especially near the venter. Most ribs bifurcate below the middle of the flanks, but commonly the bifurcation point is indistinct. Simple ribs and intercalary ribs likewise are present. The ribbing becomes markedly coarser anteriorly on the outer whorl.

Greatest diameter of holotype 120 mm.; height of whorl 31 mm.; thickness of whorl (estimated) 18 mm.; width of umbilicus 58 mm.

REMARKS: *Nebrodites burckhardti* Imlay compared with *N. rota* Burckhardt (1912, p. 96, pl. 22, figs. 1, 9-11) is less involute, has a higher whorl section, and finer ribbing. The frequency of rib bifurcation is similar to *N. crassicosatus* Burckhardt (1912, p. 93, Pl. 21, figs. 1-3, 6) which, however, is more involute, has a rounder whorl section, and rounder, less prominent ribs on the outer whorl.

TYPE: Holotype 19156, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Idoceras* beds). Burckhardt's locality 5, about 2¾ miles (4½ km.) north of San Pedro del Gallo, Durango.

Genus *Simoceras* Zittel 1870

Simoceras sp.

(Plate 6, figure 2)

DESCRIPTION: One internal mold probably represents the inner whorls of this genus. Form flattened, discoidal, evolute; flanks gently convex, rounding into umbilical wall and venter; umbilicus wide and shallow.

The ribs are straight and strong. They start from the line of involution, swell up considerably on the umbilical edge, and give rise to spirally elongated spines at the edge of the venter. On the small part of the venter that is preserved the ribs are wide and weak.

SPECIMEN: 18407, Museum of Paleontology, University of Michigan.

OCCURRENCE: In gray to reddish gray, thin-bedded limestone, transitional from Jurassic to Cretaceous (mapped by Burckhardt as Lower Cretaceous), near center of Cerro del Panteón about 1000 feet west of village and 150 feet northwest of graveyard, San Pedro del Gallo, Durango.

Genus *Waagenia* Neumayr 1878

Waagenia parrasensis Imlay, n. sp.

(Plate 3, figures 8, 12)

DESCRIPTION: The species is represented by one specimen which is mostly covered with iridescent shell. The anterior third of the outer whorl represents the incom-

plete body chamber. The shell is somewhat compressed and broken but must have been fairly flat. Whorls barely embracing to outer row of tubercles; section apparently much higher than wide and becoming relatively higher during growth; flanks rounded on inner whorls, flattened on outer whorls; venter narrow, with moderately deep groove bordered by two tuberculate ridges. Umbilicus fairly wide and shallow; wall rounded and low on inner whorls, becoming moderately high and vertical on outer whorl, rounding rather abruptly into flanks on outer whorl.

The ornamentation of the four inner whorls consists of straight, radially trending ribs which begin at the line of involution and become stronger ventrally. The two outer whorls are marked by three rows of tubercles on each side, by broad, flexuous, indistinct, irregular ribs, and by striae. The ventral tubercles, visible only on the outer whorl, are conical and are separated by slightly narrower interspaces. At the anterior end of the outer whorl there are about seven tubercles per inch. The lateral tubercles, situated high on the flanks, begin at a diameter of about 18 mm. and become very strong anteriorly. They are conical or slightly elongated at right angles to the ribbing. On the penultimate whorl, spines about 8 mm. in length are preserved along the umbilical wall. The umbilical tubercles appear about half a whorl later than the lateral tubercles at a diameter of about 26 mm. and do not become so strong anteriorly. They are slightly elongated parallel to the ribbing. On the two outer whorls the umbilical and lateral tubercles are connected by broad, low, slightly flexuous ribs which are generally strongest near the tubercles and weakest in the middle of the flanks. Some ribs begin at umbilical tubercles and fade out on the upper part of the flanks between lateral tubercles; others begin faintly low on the flanks and may or may not pass ventrally into lateral tubercles. In addition, the anterior half of the outer whorl is marked by numerous faint striae which mostly overlie or are the continuations of ribs.

Greatest diameter of holotype 135 mm.; height of whorl 51 mm.; width of umbilicus 53 mm.; estimated thickness of whorl 24 mm.

REMARKS: *Waagenia parrasensis* Imlay is similar to *W. hybonata* (Oppel) (1863, p. 254, pl. LXXI, figs. 1-3) in regard to coarse tuberculation and high, vertical umbilical wall. In contrast the Mexican form appears to be more compressed and to have closer-spaced ventral tubercles. *Waagenia beckeri* (Neumayr) (1873, p. 202, pl. XXXVIII, figs. 3, 4) has a less vertical umbilical wall, coarser costation, finer tuberculation, a deeper ventral groove, and a thicker whorl section.

TYPE: Holotype 17623, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation. Locality 43 in the Sierra de Parras, Coahuila.

Genus *Aspidoceras* Zittel 1868

Aspidoceras casitense Imlay, n. sp.

(Plate 5, figure 7; Plate 6, figure 11)

DESCRIPTION: Form large, inflated; whorls depressed in section, much wider than high, enlarge slowly, embrace about one-third; flanks narrow and gently convex; venter broadly rounded. Umbilicus wide and deep; wall high and vertical, rounding evenly into flanks. Specimen sutured to anterior end.

The flanks bear two rows of tubercles. The inner row occurs at the edge of the umbilicus and consists of fairly large, round tubercles. The outer row, situated on the upper part of the flanks, consists of much larger tubercles. The outer row of tubercles as preserved in the umbilical opening are produced in spines about a quarter of an inch long, which indicate that the outer whorl bore spines at least

one inch long. The tubercles are irregularly spaced and become wider spaced anteriorly. The tubercles of the two rows are generally opposed and connected by broad low folds which continue faintly across the venter. In addition, the shell is marked with fine radial striations. The thickness of the shell as preserved in the umbilicus and along the line of involution is about 3.5 mm.

Diameter of holotype about 40 mm. from anterior end 105 mm.; height of whorl 38 mm.; thickness of whorl 57 mm.; width of umbilicus 31 mm. Dimensions of whorl one-half volution earlier, given in the same order, are 60, 25, 38, and 20 mm. respectively.

REMARKS: *Aspidoceras casitense* Imlay is characterized by its evolute form and depressed whorl section. *A. aff. bispinosum* Burckhardt (not Quenstedt) (Burckhardt, 1912, p. 69, pl. XVI, figs. 1-6) has a higher whorl section and is more involute. *A. subwynnei* Spath (1931, p. 640, pl. CXXII, figs. 5a, b) is like *A. casitense* Imlay in cross-section and arrangement of tubercles but is more involute and has coarser tuberculation. *A. aff. hoplisum* (Oppel) in Spath (1931, p. 634, pl. CXVIII, figs. 1a, b) is more involute than the Mexican form, and *A. iphicerum* (Oppel) (1863, p. 218, pl. 60, fig. 2a, b) has a higher whorl section. *A. haupti* Krantz (1928, p. 12, pl. IV, figs. 2 a-b) is slightly more involute, has wider-spaced tubercles, and a smoother venter.

TYPE: Holotype 16983, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Torquatisphinctes* beds). Locality 57 in the Sierra de Parras, Coahuila.

Genus *Pseudopeltoceras* Spath 1928

Pseudopeltoceras? sp.

(Plate 6, figure 1)

DESCRIPTION: One crushed specimen represents parts of two outer whorls of a large form. The smaller whorl (not figured) bears numerous primary and secondary ribs and small tubercles only on the umbilical edge. On the outer whorl the primary ribs are strong, bituberculate and broadly connected across the venter, the secondary ribs have disappeared, and the ventral tubercles are much stronger than the umbilical.

SPECIMEN: 19401, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Gloria formation. Kellum's collection A-16, in Cañón Maravillas, about 2¼ miles southwest of Las Cuevas Ranch, Durango.

Genus *Subgrossouvria* Spath 1924

Subgrossouvria? sp.

(Plate 5, figure 8)

DESCRIPTION: The genus is questionably represented by two specimens. One is a fragment of an outer whorl; the other is a large ammonite with a diameter of about 350 mm. whose inner whorls are not preserved. At a diameter of 220 mm. the whorl bears strong distantly spaced primary ribs on the lower two-thirds of the flanks and numerous faint secondary ribs on the venter. Half a whorl anteriorly at a diameter of about 280 mm. the ridge-like primary ribs extend to the venter which is apparently smooth. At the anterior end of the shell the primary ribs form high, sharp ridges which are about 35 mm. from crest to crest and about 20 mm. in depth.

SPECIMENS: 19308, 15948, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Gloria formation. Kellum's collection A-16 in Cañón Maravillas, about 2¼ miles southwest of Las Cuevas Ranch, Durango.

Genus *Indosphinctes* Spath 1930

Indosphinctes? sp.

(Plate 7, figures 1, 7; Plate 8, figures 1, 2; Text figure 7)

DESCRIPTION: Eight fragments are referred provisionally to *Indosphinctes* on the basis of the fine, perisphinctoid sculpture of the inner whorls and the degree of involution. The development of fairly coarse primary ribs on the outer whorls might suggest a position nearer *Orionoides*.

Specimen 15960 (Pl. 7, fig. 7) shows an immature form fairly well. Its dimensions are as follows: greatest diameter 106 mm., whorl height 45 mm., whorl thickness 32 (?) mm., umbilical width 33 mm. Outer whorl elliptical in section, higher than wide, and embracing slightly more than one-half. Umbilicus fairly narrow and deep; wall oblique and rather high. The ribs are fine and closely spaced. They begin at the line of involution, trend radially on the umbilical wall, curve forward at the edge of the umbilicus, and incline forward slightly on the flanks. Most ribs branch above the middle of the flanks in bundles of twos or threes. On the outer whorl the primary ribs become stronger on the lower part of the flanks, and the branching points of the secondary ribs become indistinct. The inner whorls bear deep constrictions; the outer whorl has five weak constrictions.

Some specimens of larger septate whorls (Pl. 8, figs. 1, 2) may represent different species. The whorl section is slightly higher than wide and embraces about two-fifths. The primary ribs are strong, especially on the edge of the umbilicus, but not distinctly tuberculate. The upper third of the flanks and venter bear numerous secondary ribs of which some are indistinctly connected with the primary ribs.

SPECIMENS: 15960, 19306, 19400, 19307, 15950, 19309, 15961, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Gloria formation. Kellum's collection A-16 in Cañón Maravillas, about 2¼ miles southwest of Las Cuevas Ranch, Durango.

Genus *Torquatisphinctes* Spath 1923

Torquatisphinctes? aff. *bangei* (Burckhardt)

(Plate 9, figure 2)

1919. *Perisphinctes* (*Aulacosphinctes*) *Bangei* BURCKHARDT, Inst. Geol. Mex., Bol., núm. 33, p. 30; 1921, pl. IX, figs. 5-9.

REMARKS: One slightly compressed specimen from the Sierra de Parras probably belongs to this species. The ribs of the inner whorls are a little closer spaced, and the outer whorl bears a few short intercalary ribs which are not present on the type of *T. bangei* (Burckhardt). The ribbing of the inner whorls compares with that of *T. alterneplicatus* (Waagen) (1875, p. 199, pl. L, fig. 2), but the Indian form is distinguished by a different rib curve and a greater number of simple ribs.

SPECIMEN: 16981, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Torquatisphinctes* beds). Locality 57 in the Sierra de Parras, Coahuila.

Torquatisphinctes? sp. ind.

(Plate 9, figure 1)

DESCRIPTION: The outer whorl of the specimen figured has been crushed laterally, but the inner whorls appear to be undeformed. The ribbing of the inner whorls is even finer and closer spaced than on the specimen just described, but the ribbing of the outer whorls is much coarser. Besides, the coiling is more rapid, the point of rib bifurcation is lower, and there are many single ribs at all stages. Most of the ribs bifurcate at or slightly below the middle of the flanks, but some bifurcate on the lower third of the flanks. The ribs begin low on the umbilical wall, incline backward to the edge of the umbilicus, then incline forward on the flanks in a slightly flexuous manner. The coarse ribbing on the outer whorl contrasts markedly with the fine ribbing on the inner whorl and distinguishes the species from all other described Mexican species. There are four or five constrictions per whorl.

REMARKS: This species might be placed in *Lithococeras* except for the projected ribbing of its outer whorl and its rather evolute form.

SPECIMEN: 19572, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Torquatisphinctes* and *Mazapilites* beds). Locality 46 in the Sierra de Parras, Coahuila.

Genus *Subdichotomoceras* Spath 1925*Subdichotomoceras?* sp.

(Plate 10, figure 13; Text figure 7)

DESCRIPTION: Whorls embracing about one-third, depressed in section, much wider than high; flanks rounded, venter broadly rounded. Umbilicus wide, funnel shaped; wall steeply inclined, rounding evenly into flanks.

Shell ornamented with strong, high, fairly widely spaced ribs, which start near the line of involution and trend nearly radially across the flanks and venter. Bifurcation occurs on the upper part of the flanks, and the ribs are highest at the points of bifurcation. The latter are barely visible in the internal whorls. There are a few single ribs. Height of outer whorl 25 mm.; thickness 35 mm.

SPECIMEN: 16979, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Torquatisphinctes* beds). Locality 57 in the Sierra de Parras, Coahuila.

Genus *Aulacosphinctoides* Spath 1923*Aulacosphinctoides?* (*Subdichotomoceras?*) sp.

(Plate 10, figures 1-6)

DESCRIPTION: Several small specimens from the Sierra de Parras are obviously the internal whorls, or immature forms, of large perisphinctids. The largest specimen (Pl. 10, figs. 1-3) may be described as follows:

Whorls enlarging slowly, embracing a little less than one-half; inner whorls much wider than high, anterior end of outer whorl slightly wider than high; flanks rounded, venter broadly rounded. Umbilicus fairly wide; wall low and steeply inclined.

Shell ornamented with high, narrow, rather widely spaced ribs which begin low on the umbilical wall and trend nearly radially on the lower part of the flanks. Most ribs bifurcate near or slightly below the middle of the flanks, and the secondary ribs are slightly recurved backward. Two simple ribs and one trifurcating rib are

present on the outer whorl. The ribs are highest at the points of bifurcation. The inner whorls are marked by deep, narrow constrictions. On the outer whorl the ribs along the mid-ventral line are faintly thinned. Greatest diameter 60 mm.; height of whorl 20.5 mm.; thickness of whorl 23.5 mm.; umbilical width 26.5 mm.

The smaller figured specimen (Pl. 10, figs. 4-6) possibly represents the inner whorls of a form as just described. Its flanks are narrowly rounded, and its venter is nearly flat. The whorl section is much wider than high.

REMARKS: Forms such as described here might represent the internal whorls of any of several of the perisphinctoid forms described by Burckhardt (1919, 1921), especially such a form as "*Perisphinctes*" *alexiei* Burckhardt (1919, p. 20; 1921, pl. IX, figs. 1-4) or "*Perisphinctes (Aulacosphinctes)*" *diversecostatus* Burckhardt (1919, p. 34; 1921, pl. XII, figs. 1, 2, 4, 5).

SPECIMENS: 16977, 16978, 16980, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Torquatisphinctes* beds). Locality 57 in the Sierra de Parras, Coahuila.

Aulacosphinctoides? aff. *diversecostatus* (Burckhardt)

(Plate 10, figure 7)

1919. *Perisphinctes (Aulacosphinctes) diversecostatus* BURCKHARDT, Inst. Geol. Mex., Bol., núm. 33, p. 34; 1921, pl. 12, figs. 1, 2, 4, 5.

REMARKS: The figured specimen has been considerably mashed but illustrates how much the appearance varies with the preservation. Thus the internal whorls and a part of the outer whorl bear sharp high ribs which contrast greatly with the low, worn ribs at the anterior end of the specimen. Much of the bluntness of the ribs on the perisphinctoid forms from Sierrita del Chivo near Symón, Durango, is due to their preservation as internal molds, whereas the original shell in many species probably bore high, sharp ribs.

SPECIMEN: 17622, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation. Locality 43 in the Sierra de Parras, Coahuila.

Genus *Subplanites* Spath 1925

Subplanites? sp.

(Plate 9, figures 13-15; Text figure 7)

DESCRIPTION: Several specimens probably belong to this genus. A small specimen (Pl. 9, figs. 14, 15) shows several internal whorls and may be described as follows: Whorls subquadrate in section, wider than high, embracing about one-half; flanks slightly convex, fairly broad, rounding rapidly into venter; venter broadly rounded. Umbilicus fairly wide and deep; wall vertical and fairly high, rounding rapidly into flanks.

The ribs are fairly low, narrowly rounded, and well separated. They begin near the middle of the umbilical wall, curve backward to the edge of the umbilicus, incline forward on the flanks, and arch forward slightly on the venter. Simple ribs are about a third as common as forked ribs. Bifurcation generally takes place on the upper third of the flanks, but some of the ribs bifurcate near the middle of the flanks, and one of the branches in turn bifurcates on the upper third. Constrictions are generally bounded by ribs which bifurcate at the edge of the umbilicus, and one of the branches commonly bifurcates again higher up. The points of bifurcation are

generally slightly swollen. There are five pronounced constrictions on the outer whorl. The mid-ventral line is marked by a distinct thinning of the ribs.

At a diameter of 51 mm. the whorl height is 18.5 mm., the whorl thickness is 22 mm., and the umbilical width is 20 mm.

A large specimen (Pl. 9, fig. 13; Text figure 7) from the same locality might represent the adult form of the specimen described above. Its whorl section is about as high as wide; its umbilical wall is vertical. The ribs are high, narrowly rounded, and bi- or trifurcate at or slightly above the middle of the flanks. They curve backward on the umbilical wall but incline forward on the flanks. There is one pronounced constriction. Only a small part of the venter is preserved, but there is no indication of a mid-ventral thinning.

SPECIMENS: 19546, 19557, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Idoceras* beds). Burckhardt's locality 4, San Pedro del Gallo, Durango.

Genus *Idoceras* Burckhardt 1906

Idoceras viverosi Burckhardt

(Plate 13, figures 1-3)

1906. *Idoceras viverosi* BURCKHARDT, Inst. Geol. Mex., Bol., núm. 23, p. 61, Pl. 15, figs. 4-7.

REMARKS: In the University of Michigan collections from San Lazaro Canyon, Nuevo León, are four specimens of this species. The largest is a little smaller than the holotype and is crushed laterally. The specimen figured shows the internal whorls better than the holotype. On the three inner whorls the ribs are high and narrow, and the whorl section is wider than high. On the outer whorl the ribs become wide, and the whorl section much higher than wide.

Dimensions in mm. are as follows:

Specimen	Greatest diameter	Whorl height	Whorl thickness	Umbilical width
holotype (unknown)	76	30	22	30
hypotype 19517	47	19	14	16.5

OCCURRENCE: (*Idoceras* beds). (1) Holotype from Cañón de San Matias, near Casa Sotelo, Sierra de Santa Rosa, Zacatecas; (2) hypotype from San Lazaro Canyon, Nuevo León.

Idoceras involutum Imlay n. sp.

(Plate 12, figures 3, 4)

DESCRIPTION: Form discoidal, moderate in size for genus; whorl section subquadrate, higher than wide, thickest on lower fourth of flanks; whorls embracing three-fourths; flanks slightly convex, sloping gently toward venter; venter moderately broad and evenly rounded. Umbilicus fairly narrow and deep; wall fairly high for genus, steeply inclined, rounding evenly into flanks.

The inner whorls, shown in the umbilical opening, bear strong, closely set ribs which are separated by slightly wider interspaces on the three inner whorls but on the fourth whorl are about the same width as the interspaces. The ribs begin low on the umbilical wall and incline forward slightly on the flanks.

On the outer whorl are about 28 primary ribs which begin low on the umbilical wall, pass radially onto the flanks where they incline forward and become flexuous, and then incline forward rather strongly on the venter. These primary ribs are

broad and low and some become rather indistinct near the middle of the flanks. Most of them bifurcate or trifurcate on the upper third of the flanks. A few ribs bifurcate near the middle of the flanks, and one or both branches bifurcate on the upper third. In addition, many short intercalary ribs occur on the upper part of the flanks. The secondary ribs are much more pronounced but narrower than the primary ribs. Inconspicuous radial striae occur at intervals. Faint constrictions are on all the whorls. The ribs are much weakened along the midventral line, and in general there is an alternation of ribs on the opposite sides of the venter. The venter of the outer whorl bears about 95 ribs.

Greatest diameter of holotype 96 mm.; width of umbilicus 27.5 mm.; height of last whorl 39 mm.; thickness of last whorl 26 mm.

REMARKS: *I. involutum* Imlay may be recognized by its degree of involution and its few, broad primary ribs. *I. subdedalum* Burckhardt (1906b, p. 63, pl. 13, figs. 5-8) has a narrower venter and more numerous, sharper primary ribs. *I. aff. dedalum* (Gemmellaro) sp. Burckhardt (1912, p. 125, pl. 33, figs. 1-6) has a narrower venter, a higher whorl section, and nearby effaced ribs on the flanks of the body whorls.

TYPE: Holotype 19496, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Idoceras* beds). San Lazaro Canyon, Nuevo León.

Idoceras striatum Imlay, n. sp.

(Plate 13, figures 4-8; Text figure 7)

DESCRIPTION: Form flattened, discoid; whorl section compressed-ovate, higher than wide at all stages but becoming more depressed during growth; whorls embracing slightly more than one-half; flanks flattened; venter gently convex, tending to become flattened at anterior end of holotype. Umbilicus fairly narrow, moderate in depth; wall steeply inclined, on outer whorl rounding rather abruptly into flanks. On holotype the incomplete body chamber is represented by most of the outer whorl.

The ribs of the inner whorls, as shown in the umbilical opening, are close set and moderately strong. They begin at the line of involution and curve forward slightly on the flanks, a few bifurcating low on the flanks. On the outer whorl the ribs begin at the line of involution, curve backward on the umbilical wall, recurve abruptly at the base of the flanks and incline forward strongly, become slightly flexuous and less inclined on upper part of flanks, and then incline forward a little stronger on the venter. On the posterior half of the outer whorl the ribs bifurcate near or somewhat below the middle of the flanks, and one on both branches bifurcates again on the upper third of the flanks. Other ribs bifurcate only on the upper third of the flanks, and a few remain simple throughout their course. The flank ribbing is moderately strong at the posterior end of the outer whorl but becomes weaker anteriorly and on the anterior half is replaced by striae which tend to be grouped in bundles. On the venter the ribs remain strong and are replaced by striae only immediately anterior to constrictions. On the posterior three-fourths of the outer whorl the venter is marked by a narrow smooth band, but on the anterior fourth the ribs cross the venter with only slight diminution in strength. The outer whorl of the holotype bears eight constrictions which are weak on the right side and fairly pronounced on the left side.

The suture line is characteristic of the group of *Idoceras durangense*. The siphonal lobe is a little shorter than the first lateral lobe. The latter has a wide trunk and is subsymmetrically divided by three main branches. The second lateral lobe is short and wide. There are three oblique auxiliary lobes. External saddle wide and bifid. First lateral saddle higher and narrower than external, asymmetrically subdivided.

Greatest diameter of holotype 77 mm.; height of whorl 30 mm.; thickness of whorl 20.5 mm.; width of umbilicus 23.5 mm.

TYPE: Holotype 19492, Museum of Paleontology, University of Michigan.

REMARKS: *Idoceras striatum* Imlay may be recognized by its striate body chamber and the common bifurcation of ribs low on the flanks. *Idoceras johnsoni* Burckhardt (1912, p. 114, pl. 25, figs. 6, 10-12) is slightly less involute, has coarser ribbing, and bifurcation occurs only on the upper part of the flanks. A fragment of a large specimen collected near La Escondida, Nuevo León, has a steeper umbilical wall than the holotype but may be distorted.

OCCURRENCE: La Casita formation (*Idoceras* beds). (1) Holotype from San Lazaro Canyon, Nuevo León; (2) Questionably 7 miles (11.2 km.) from La Escondida about 100 yards south of road to Soledad, Nuevo León.

Idoceras sanlazarense Imlay, n. sp.

(Plate 11, figures 3-6)

DESCRIPTION: Form flattened, discoid; whorl section compressed ovate in early stages, a little convergent in later stages, and becoming higher during growth; whorls embracing about one-half; flanks nearly flattened, rounding evenly into venter; venter gently convex, becoming narrower during growth. Umbilicus fairly deep, moderate in width, tending to become slightly wider during growth; wall fairly high, nearly vertical on inner whorl steeply inclined on outer whorls, rounding rather abruptly into flanks. The incomplete body chamber is represented by the anterior half of the outer whorl of the holotype 19519 and by the outer whorl of paratype 19497 (Pl. 11, figs. 4-6).

On the inner whorls up to a diameter of about 25 mm. the ribs are wide, strong, rounded, and separated by wider interspaces. They begin at the line of involution, trend nearly radially across the flanks, and arch forward on the venter which they cross with only slight diminution in strength. Bifurcation is common on the upper part of the flanks.

On the outer whorls the ribs are wide, strong, rounded, and as wide or wider than the interspaces. They begin at the line of involution, incline forward slightly on the flanks, and become a little flexuous on the body whorl. They arch forward on the venter to form chevrons but undergo only slight diminution in strength except on the body chamber where a narrow, smooth band is developed. Almost all ribs bifurcate, or trifurcate, on the upper third of the flanks. Some bifurcate as low as the middle of the flanks and in turn one or both branches bifurcate again on the upper third. Bifurcation rarely takes place as low as the base of the flanks. The upper part of the flanks bear some intercalary ribs. At all stages the secondary ribs are narrower but more pronounced than the primary ribs. This relationship is most pronounced on the body chamber where the primary ribs become broad and faint and the secondary ribs somewhat stronger. Fine, radial striae occur at irregular intervals on the outer whorls and are most common on the body whorl. About six or seven weak constrictions per whorl. Paratype 19498 at a diameter of 63 mm. has 42 primary ribs.

Dimensions in mm. are as follows:

Specimen	Greatest diameter	Umbilical width	Whorl height	Whorl thickness
holotype 19519	78	27	29	17.5
paratype 19498	63	20	24.5	17.5
paratype 19520	51.5	18	19.5	14.5

REMARKS: *Idoceras sanlazarensense* Imlay closely resembles *I. santarosanium* Burckhardt (1906b, p. 58, Pl. 14, figs. 6, 7) but is more involute and has a higher, steeper umbilical wall.

TYPE: Holotype 19519; paratype nos. 19497, 19498, 19520, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Idoceras* beds). San Lazaro Canyon, Nuevo León.

Idoceras tamaulipanum Imlay, n. sp.

(Plate 12, figures 1, 2)

DESCRIPTION: Form discoidal, fairly large; whorl section ovate, higher than wide, thickest at edge of umbilicus; whorls embracing a little more than one-half; flanks flattened below, slightly convergent above and rounding evenly into a moderately wide venter. Umbilicus moderate in width and depth; wall fairly low, vertical on inner whorls, almost vertical on outer whorl, rounding abruptly into flanks.

The inner whorls, shown in the umbilical opening, bear straight, high, narrowly rounded ribs, which begin at the line of involution, pass radially onto the flanks and then incline forward. The interspaces are slightly wider than the ribs.

On the outer whorl the ribs are straight, pronounced, fairly wide and separated by interspaces of similar width. They begin at the line of involution, incline forward on the flanks, and bend forward conspicuously on the venter. Their strength increases from the umbilicus to the venter where some ribs are nearly effaced and others connect with the ribs of the opposite flanks. Bifurcation occurs on the upper third of the flanks. The bifurcating ribs are commonly separated by one or two simple ribs. There are a few short intercalary ribs. Radial striae are present at irregular intervals. Constrictions are narrow and inconspicuous.

At a diameter of 86 mm. the holotype has an umbilical width of 28 mm., a whorl height of 33 mm., and whorl thickness of 21 mm.

REMARKS: *Idoceras tamaulipanum* Imlay is distinguished by its straight, strong, frequently unforked ribs and by its vertical umbilical wall. None of the described Mexican species resembles it closely.

TYPE: Holotype 19494, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Idoceras* beds). San Lazaro Canyon, Nuevo León.

Idoceras densicostatum Imlay, n. sp.

(Plate 8, figures 3-5)

DESCRIPTION: Form discoidal, small; whorl section ovate, higher than wide, thickest at edge of umbilicus; whorls embracing about three-fifths; flanks slightly convex, sloping gently toward venter; venter moderate in width, evenly rounded. Umbilicus fairly narrow and deep; wall moderate in height, steeply inclined, rounding rather abruptly into flanks.

On the outer whorl of the holotype the ribs are fine, sharp, and close set but separated by much wider interspaces. They begin at the umbilical wall, pass nearly radially onto the flanks, then incline forward to the venter where they bound a broad, nearly smooth, midventral area. Bifurcation occurs commonly on the upper third of the flanks, but some ribs bifurcate as low as the middle of the flanks, and a few bifurcate at the edge of the umbilicus. Many of the bifurcation points are indistinct. In addition there are a few simple ribs, which extend from the umbilicus to the venter without bifurcating, and many short intercalary ribs on the edge of the venter.

Toward the anterior end of the shell the ribs become more pronounced on the venter and on the lower part of the flanks than on the middle of the flanks, and the secondary ribs become broader than the primary ribs. Radial striae occur at irregular intervals. Constrictions are faint except for one near the anterior end of the holotype. The venter of the outer whorl bears about 110 ribs.

The ornamentation of the inner whorls, shown on two small specimens, is essentially like that of the holotype except that the ribs are of about the same strength throughout their course and are only slightly reduced on the venter.

Greater diameter of holotype 50 mm.; width of umbilicus 14.5 mm.; height of last whorl 21 mm.; thickness of last whorl 14 mm.

REMARKS: *Idoceras densicostatum* Imlay may be distinguished easily from other Mexican forms by its fine, dense costation. *I. zacatecanum* Burckhardt (1906b, p. 42, Pl. 9, figs. 1-4) approaches most closely but has coarser ribbing and is more evolute.

TYPE: Holotype 19518; paratype 19488, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Idoceras* beds) 7 miles (11.2 km.) from La Escondida about 100 yards south of road to Soledad, Nuevo León.

Genus *Virgatisphinctes* Uhlig 1910

Virgatisphinctes sp. juv.

(Plate 6, figures 3-5)

DESCRIPTION: One small immature form is worth recording because of its occurrence with *Substeuerocheras* in the highest Jurassic beds.

Outer whorl subovate in section at posterior end, becoming subquadrate at anterior end, a little higher than wide, embracing about one-fourth; flanks flattened and nearly parallel, rounding evenly into venter and abruptly into umbilical wall; venter fairly broad and somewhat flattened. Umbilicus fairly narrow and deep, wall steeply inclined.

The shell is ornamented with ribs and striae. The primary ribs begin at the line of involution, curve backward strongly on the umbilical wall, recurve at the edge of the umbilical wall and incline forward on the flanks, being slightly inflected forward in the lower part, and then cross the venter transversely. On the lower part of the flanks the primary ribs are strong, narrowly rounded, widely spaced, and covered and separated by nearly microscopic striae. Near the middle of the flanks the primary ribs pass into bundles of two or three slightly smaller ribs which cross the venter without diminution in strength. These bundles of ribs are separated by one to three intercalary ribs which originate on the upper third of the flanks as continuations of some of the striae. On the venter all ribs are of equal strength.

Greatest diameter of figured specimen about 31.5 mm.; whorl height, 15.5 mm.; whorl thickness, 14.5 mm.; umbilical width, 10 mm.

SPECIMEN: 20096, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Substeuerocheras* beds). Collection K1 in Cañón Alamo, Sierra de Jimulco, Coahuila.

Genus *Involuticeras* Salfeld 1913

Involuticeras sp. ind. juv.

(Plate 6, figures 6, 7)

DESCRIPTION: One immature form of this genus is worth recording because it is much coarser ribbed than the species described by Burckhardt (1906b, p. 98-100, Pl.

XVII, figs. 1-4; Pl. XVIII, figs. 1-3) from Mazapil, although possibly close to *I. praecursor* (Burckhardt).

Whorl section subquadrate in section, higher than wide; flanks flattened but converging slightly ventrally; venter arched. Umbilicus narrow, wall slightly overhanging.

The ribs are flexuous, become strongest ventrally, are variously branched or simple, and are not weakened on venter. They begin on the umbilical wall and curve backward to the lower fourth of flanks, then curve forward to the upper part of the flanks, where they recurve slightly and cross the venter transversely. Di- and bi-dichotomy occur at various heights from the lower third to the upper third of the flanks. Many secondary ribs are loosely connected with the primary ribs, and there are a number of intercalary ribs. Anteriorly the ribs become fainter on the lower part of the flanks but remain strong on the venter.

SPECIMEN: 19528, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Caja formation, about 100 feet from base (*Glochiceras fialar* beds). About 2 miles south-southeast of Melchor Ocampo just south of crest of Sierra Zuloaga, Zacatecas.

Genus *Aulacosphinctes* Uhlig 1910

Aulacosphinctes sp.

(Plate 15, figures 10, 11)

DESCRIPTION: Two specimens from the Sierra de Jimulco are the sole representatives of this genus in a large faunal assemblage dominated by *Substeuerocheras*. The larger specimen has been compressed laterally.

Form discoidal; whorls barely embracing; inner whorls wider than high; outer whorl probably nearly as wide as high before compression; flanks convex, becoming flatter on outer whorl. Umbilicus wide; wall fairly high and nearly vertical on outer whorl, rounding evenly into flanks.

The inner whorls, which are poorly preserved, bear fine ribs of which the majority are simple and the remainder bifurcate above the middle of the flanks. The ribs terminate ventrally in radially elongate tubercles which bound a narrow, smooth midventral area.

On the outer whorl of the larger specimen the ribs are fairly low, flexuous, incline forward on the flanks, are greatly reduced in strength along the midventral line, and are separated by much wider interspaces. Some of the ribs are slightly swollen at the edge of the umbilicus, and most of them are swollen at the edge of the ventral depression. The ribs begin at the line of involution, curve backward slightly to the edge of the umbilicus, then curve forward to the middle of the flanks where they recurve slightly and cross the venter transversely. Simple ribs outnumber the forked ribs. Bifurcation occurs below or at the middle of the flanks. Some of the interspaces on the outer whorl are a little wider and deeper than the rest and might be considered constrictions.

REMARKS: Because of its poor preservation, this species cannot be positively identified with any of the Mexican species (Burckhardt, 1912, p. 138, 139, Pl. XXXV, figs. 1-3, 7, 9; 1919, p. 50-53; 1921, Pl. XVII, Pl. XVIII, fig. 1), but its general appearance is like *A. torresianus* Burckhardt (1919, p. 52; 1921, Pl. XVII, figs. 4-6).

SPECIMENS: 20004 and 20045, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Substeuerocheras* beds): Locality K 5 in Cañón Alamo, Sierra de Jimulco, Coahuila.

Genus *Micracanthoceras* Spath 1925*Micracanthoceras acanthellum* Imlay, n. sp.

(Plate 16, figures 8-11)

DESCRIPTION: The species is represented by four specimens. Shell discoidal; whorls ovate in section, wider than high in early stages, becoming as high as wide in later stages, embracing about one-fourth; flanks gently convex; venter fairly broad, somewhat flattened. Umbilicus fairly wide; wall moderate in height, vertical at base, rounding evenly into flanks.

The inner whorls bear fine flexuous ribs of which the majority are simple. Bifurcation occurs below or at the middle of the flanks, and the points of bifurcation are commonly strongly tuberculate. Most of the simple ribs are likewise swollen or weakly tuberculate near the middle of the flanks. Ventrally all ribs terminate in tubercles of varying prominence which border a nearly smooth midventral area.

On the outer whorl of the holotype the ribs are low, rounded, and slightly flexuous. They begin low on the umbilical wall and trend radially, or slightly backward, to the edge of the umbilicus. They are nearly straight or slightly inflected forward near the middle of the flanks, and all have a slight forward curvature at the margin of the venter. Simple ribs are less common than forked ribs and are disposed irregularly. Bifurcation occurs near the middle of the flanks, and the points of bifurcation are swollen. Some of the simple ribs bear slight swelling near the middle of the flanks. Ventrally all ribs terminate in radially elongate swellings of varying prominence which bound a narrow, smooth midventral area or are continued weakly across the venter. Tuberculation becomes relatively weaker with growth. Near the anterior end of the holotype there appears to be a weak constriction.

At a diameter of 46 mm. the holotype has a whorl height of 16.5 mm., a whorl thickness of 16.5 mm., and an umbilical width of 18.5 mm. Maximum diameter of holotype, 50 mm.

REMARKS: This species is distinguished from the associated Mexican species by its flexuous ribs and weaker tuberculation. It is possibly close to the Argentine *Hoplites microcanthus* of Burckhardt (1903, p. 58, Pl. X, figs. 12-16), but its ribs appear to be closer spaced and more flexuous. *M. aff. microcanthum* (Oppel) in Spath (1931, p. 543, Pl. XCII, figs. 3a, b) has a more depressed whorl section and straighter ribs.

TYPE: Holotype 19580; paratypes 19604, 19602, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation, collected by Mexican helpers supposedly at Burckhardt's locality 11 but probably near the northeastern part of Cerro de la Cruz, San Pedro del Gallo, Durango.

Micracanthoceras aquajitense Imlay, n. sp.

(Plate 14, figures 5-7)

1912. *Hoplites* sp. ind. BURCKHARDT, Inst. Geol. Mex., Bol., núm. 29, p. 142, Pl. XXXVI, figs. 4-6.

DESCRIPTION: Burckhardt's description may be translated as follows:

"Shell composed of whorls which embrace about one-half and do not increase very rapidly. Flanks convex, passing insensibly into a low but abrupt umbilical wall. Venter wide, somewhat flattened. Transverse section wider than high, depressed. The umbilicus is narrow and of little depth.

"From the suture [line of involution] pass thin but projecting principal ribs, which are directed obliquely forward and are completely straight. The majority of these

ribs subdivide into two, or more rarely into three, branches at the middle of the flanks and generally, but not always, at the point of division, they form a more or less pronounced median tubercle. The ribs pass over the venter without interruption, but they are, however, attenuated at their median part. At irregular intervals along the ventral depression some ribs bear a large ventral tubercle, and sometimes two ribs, issuing from distinct principal ribs, are reunited in a single ventral tubercle."

Three specimens in the University of Michigan collections belong to this species. The largest, selected as the holotype, has parts of two whorls beyond that shown in Burekhardt's original figure. On these outer two whorls the ribs become much stronger and wider spaced anteriorly, and the tubercles become relatively weaker. The most anterior part of the outer whorl of the holotype (Pl. 14, figs. 6, 7) is not figured because of poor preservation.

REMARKS: This species, although imperfectly known, may be distinguished from *M. microcanthum* (Oppel) (Zittel, 1868, p. 93, Pl. XVII, figs. 1-5) by the finer ornamentation of its inner whorls.

TYPE: Holotype 19588; paratypes 19589, 19598, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation. (1) Collected by Mexican helper supposedly at Burekhardt's locality 11 but probably near the northeastern part of Cerro de la Cruz. (2) Burekhardt's locality 24, San Pedro del Gallo, Durango.

Micracanthoceras n. sp. aff. *koellikeri* (Oppel)

(Plate 17, figures 2-4)

DESCRIPTION: The species is represented by two specimens of which one shows parts of two whorls. Whorls wider than high, outer whorl more depressed than the inner; flanks convex; venter broadly convex, slightly flattened along midline; umbilical wall vertical at base, rounding evenly into flanks.

The inner whorl has high, widely spaced, radially inclined ribs which bear pronounced tubercles near the middle of the flanks. The outer whorl has high, narrow, flexuous ribs of which about half bifurcate near the middle of the flanks. The ribs begin at the line of involution, curve backward to the umbilical edge, then curve forward on the lower part of the flanks, and recurve backward on the upper part of the flanks. In the case of forked ribs the anterior branch appears as a continuation of the primary rib, and the posterior branch is deflected slightly backward near its base. The bifurcation points, as well as the ventral terminations of the ribs, bear more or less prominent, radially elongate tubercles. The simple ribs bear less prominent tubercles, or swellings, near the middle of the flanks. At one place a weak secondary rib is given off from a primary at the umbilical edge and does not become tuberculate. The ventral groove is narrow and faintly marked in several places by rib continuations.

Dimensions of figured specimen at anterior end: whorl height 13 mm.; whorl thickness 10.5 mm.

REMARKS: This species is distinguished from the associated Mexican species described here by its widely spaced, prominent ribs and pronounced tubercles. *M. koellikeri* (Oppel) (Zittel, 1868, p. 95, Pl. 18, figs. 1, 2; Krantz, 1928, p. 28, Pl. III, figs. 1a, b) appears to have a more compressed whorl section, weaker ribbing, and weaker tuberculation. The Argentine form figured by Steuer (1897, p. 31; Pl. 8, figs. 5, 6) is more evolute but has similar ribbing. *Corongoceras lotenoense* Spath (1925, p. 144; Haupt, 1907, p. 201, Pl. 9, fig. 7) at first glance appears similar but has a differently ornamented venter, a higher whorl section, and a slightly different rib curve.

SPECIMENS: 19590, 19592, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation, collected by Mexican helper supposedly at Burckhardt's locality 11, but probably from northeast part of Cerro de la Cruz, San Pedro del Gallo, Durango.

Micracanthoceras cf. microcanthum (Oppel)

(Plate 7, figures 2, 3)

1912. *Hoplites microcanthus* BURCKHARDT, Inst. Geol. Mex., Bol., núm. 29, p. 141, Pl. XXXVI, figs. 1-3, 9.

REMARKS: One immature specimen shows the inner whorls excellently. Compared with *M. aguajitense* Imlay the ribs are higher, thinner, inclined more strongly forward, wider spaced, and bifurcate more commonly; the tubercles are less prominent; and the whorl section is more depressed.

SPECIMEN: 19597, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation, collected by Mexican helper supposedly at Burckhardt's locality 11 but probably from northeast part of Cerro de la Cruz, San Pedro del Gallo, Durango.

Micracanthoceras alamense Imlay, n. sp.

(Plate 9, figures 3-12)

DESCRIPTION: The species is represented by six specimens which show $3\frac{1}{2}$ inner whorls. Whorls subovate in section, wider than high, embracing about one-third; flanks gently convex, becoming less convex on outer whorl of largest specimens; venter fairly broad, somewhat flattened. Umbilicus moderate in width; wall moderate in height, vertical at base, rounding evenly into flanks.

The ribs are high, narrow, and nearly straight or inflected slightly forward near the middle of the flanks. They begin at the line of involution and trend radially or slightly backward to the edge of the umbilicus and are directed a little forward on the flanks. Simple ribs are about one-third as common as forked ribs and are disposed irregularly. Bifurcation commonly occurs near the middle of the flanks and rarely as low as the umbilical edge. The bifurcation points are swollen or weakly tuberculate. Some of the simple ribs are likewise swollen near the middle of the flanks. Ventrally all ribs pass into radially elongate swellings of varying prominence which are partially interrupted along the midventral line. The internal mold, however, bears a distinct ventral groove.

Dimensions in mm. are as follows:

Specimen	Diameter	Whorl height	Whorl thickness	Umbilical width
paratype 20049	16.0	6.5	7.0	5.5
holotype 20047	9.3	9.7	8.8
paratype 15902	27.5	11.0	11.0	9.0

REMARKS: This species is similar to *Micracanthoceras aguajitense* Imlay but is distinguished by a more rapid rate of coiling, weaker tuberculation, a less distinct ventral depression, fewer simple ribs, and a relatively higher whorl section.

TYPE: Holotype 20047; paratypes 20048, 20049, 15902, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Substeueroceras* beds). Kellum's collections 5 and 25 in Cañón Alamo, Sierra de Jimulco, Coahuila.

Micracanthoceras n. sp. ind.

(Plate 17, figures 1, 5)

DESCRIPTION: One small form is characterized by extremely high, thin ribs of which most are simple. About every third or fourth rib bifurcates at or below the middle of the flanks and gives rise to a prominent, thin spine at the point of furcation. Some of the simple ribs are likewise somewhat swollen near the middle of the flanks. Some of the ribs are inflected forward slightly on the flanks but recurve slightly on the venter. Ventrally the ribs are produced in radially elongate spines of considerable prominence which terminate abruptly at an extremely narrow midventral depression across which the ribs extend faintly.

SPECIMEN: 20044, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Substeueroceras* beds). Kellum's collection 5 in Cañón Alamo, Sierra de Jimulco, Coahuila.

Genus *Kossmatia* Uhlig 1910*Kossmatia* sp.

(Plate 1, figures 5, 6)

DESCRIPTION: One fragment is worth recording because of its importance as a stratigraphic marker in the Sierrita del Chivo section. It does not appear to belong to any described Mexican species.

The whorl section is higher than wide, the venter is flattened, and the flanks are slightly convex. The ribs are high, strong, and rather widely spaced. They trend nearly radially on the lower part of the flanks, become highest at the middle of the flanks where they bifurcate. The secondary branches curve forward on the flanks and form pronounced chevrons on the venter. There are examples of simple and intercalary ribs.

SPECIMEN: 19422, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Caja formation (*Kossmatia* beds). Bed 10 (collection 7) of Imlay's section on the north side of Cañón del Toboso, Sierrita del Chivo, near Symón, Durango.

Genus *Durangites* Burckhardt 1910*Durangites astillerensis* Imlay, n. sp.

(Plate 10, figures 10-12)

DESCRIPTION: Shell small, discoidal; whorls ovate in section, wider than high in early stages, becoming as high as wide in late stages; outer whorl embracing about one-fourth; flanks convex; venter nearly evenly rounded, slightly flattened along midventral line. Umbilicus fairly wide and shallow; wall nearly vertical at base, inclined above and rounding evenly into flanks. Long lateral lappets are preserved at the anterior end of the holotype.

The inner whorls bear high, narrow ribs which start at the line of involution, incline forward slightly on the flanks, and become stronger ventrally. A few ribs bifurcate below the middle of the flanks.

On the penultimate whorl the ribs become much higher anteriorly but remain rather narrow. About every third or fourth rib bifurcates near the middle of the flanks, and the points of bifurcation bear prominent tubercles. The simple ribs are more or less

swollen near the middle of the flanks but are never so strongly tuberculate as the forked ribs.

On the outer whorl the ornamentation changes considerably. The posterior part bears high, narrow, tuberculate ribs as on the penultimate whorl. The ribs are nearly radial on the umbilical wall but incline forward strongly on the flanks and cross the venter transversely. In addition to prominent lateral tubercles, the ribs terminate ventrally in ventral tubercles of varying prominence which bound a narrow ventral furrow. Commonly the posterior rib of a pair of secondaries bears the most prominent ventral tubercle, but there are exceptions. In one place a lateral tubercle gives rise to three secondaries, and in another place two simple ribs terminate in a common ventral tubercle. The ventral furrow is crossed by the ribs which are only partly reduced in strength where the shell is preserved, but on the internal mold the ribs distinctly terminate at the ventral furrow.

The anterior part of the outer whorl is represented by an internal mold, and the ribs do not appear so prominent as on the posterior part. However, it seems likely that the ribbing on the shell would be as vigorous as on the posterior part, although less strongly tuberculate. On the anterior part the ribs trend radially on the umbilical wall, incline forward on the lower part of the flanks, then recurve on the upper part, and cross the venter with a slight arching toward the rear. Simple ribs are as numerous as forked ribs but exhibit no regular arrangement. The bifurcation points become less strongly tuberculate anteriorly and on the anterior half are merely swollen. At the anterior end of the holotype the ribs cross the venter with scarcely any diminution in strength, and the ventral tubercles have disappeared. As this part is preserved as an internal mold, the original shell probably bore only the faintest imprint of a ventral depression.

Greatest diameter of holotype 33 mm.; height of whorl 10.7 mm.; thickness of whorl 10.7 mm.; umbilical width 14.5 mm.

REMARKS: Among the various Mexican species, the present species most approaches *Durangites vulgaris* Burckhardt (1912, p. 149, Pl. XXXVII; Pl. XXXVIII, figs. 1-4) in proportions but may be distinguished by its coarser ornamentation and its greater number of simple ribs. *D. acanthicus* Burckhardt (1912, p. 146, Pl. XXXVI, figs. 7, 8, 10, 11, 15) has a slightly higher whorl section, a narrower umbilicus, flatter flanks, and less flexuous ribs. *D. incertus* Burckhardt (1912, p. 147, pl. XXXVI, figs. 12-14, 16, 17) is much like the present species in general appearance but has a higher whorl section, a narrower umbilicus, and less flexuous ribs.

TYPE: Holotype 17707; paratype 20008, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Durangites* beds). Locality 34 in the Sierra de Parras, Coahuila.

Durangites cf. *acanthicus* Burckhardt

(Plate 17, figures 6, 7)

REMARKS: The specimen figured is much larger than the type of *D. acanthicus* Burckhardt (1912, p. 146, pl. XXXVI, figs. 7, 8, 10, 11, 15), but its form and ornamentation are similar. Especially noteworthy is the persistence of prominent ventral tubercles to a late stage of development.

SPECIMEN: 20009, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Durangites* beds). Locality 34 in the Sierra de Parras, Coahuila.

Durangites rarifurcatus Imlay, n. sp.

(Plate 17, figures 8, 9)

DESCRIPTION: Two specimens from Cañón Alamo almost certainly represent the same species but because of their difference in size only the larger specimen is definitely assigned to the species.

Form discoidal, compressed; whorls ovate in section, a little higher than wide, embracing slightly; flanks gently convex; venter moderate in width. Umbilicus fairly wide and shallow; wall oblique on innermost whorls, becoming vertical on outer whorls, rounding evenly into flanks at all stages.

A small specimen consists of inner whorls (Pl. 17, fig. 9). Up to a diameter of about 30 mm. the ribs are narrow, fairly close spaced, moderate in height, trend radially across the flanks, and nearly all are simple. Bifurcation rarely occurs low on the flanks, or at the edge of the venter. A few ribs bear lateral tubercles or swellings, and most ribs are more or less strongly swollen on the edges of the venter. The ribs are only slightly reduced in strength along the midventral line. At a diameter greater than about 30 mm. the ribs become fairly wide spaced, much stronger, and more frequently bifurcate although simple ribs predominate.

On the holotype the inner whorls are not well exposed but appear to be like those described above. On the two outer whorls the ribs are wide spaced, strong, and mostly simple. Bifurcation occurs at or above the middle of the flanks, and some of the posterior secondary ribs are poorly united with the primary ribs. There are no lateral tubercles on the outer whorls and only suggestions of ventral swellings.

The holotype is so compressed that its proper dimensions cannot be measured. Specimen 20090 at a diameter of 28 mm. has a whorl height of 10 mm. and an umbilical width of 12 mm.

REMARKS: This species may be distinguished by its large number of simple ribs, its wide umbilicus, and the contrast in rib spacing between the inner and the outer whorls.

TYPE: Holotype 20088, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Durangites* beds). Collection K2 in Cañón Alamo, Sierra de Jimulco, Coahuila.

Durangites n. sp. ind.

(Plate 17, figures 10-12)

DESCRIPTION: Two specimens of *Durangites* represent the entire collection from locality 4 in Cañón Alamo. The specimens possibly belong to the same species and are certainly distinct from any described species. The larger specimen is the largest known representative of the genus.

The smaller specimen (Pl. 17, figs. 10, 11) has a subquadrate whorl section which is a little higher than wide. The flanks and venter are nearly flattened. The umbilicus is fairly wide and shallow. The ribs are strong, high, and widely spaced. Most of them are simple, but some bifurcate at or above the middle of the flanks. The bifurcation points are feebly tuberculate. Several short intercalary ribs are present. Every fourth or fifth rib passes into a pronounced ventral tubercle. The other ribs are merely swollen on the venter. All ribs undergo considerable diminution in strength along the midventral line. This specimen may be distinguished from *Durangites* aff. *rarifurcatus* Imlay (Pl. 17, fig. 9) by coarser ribs, more frequent bifurcation, and stronger ventral tuberculation. *Durangites incertus* Burckhardt

(1912, p. 147, pl. XXXVI, figs. 12-14, 16, 17) has a rounder whorl section, more frequent rib bifurcation, and weaker ventral tubercles.

The larger specimen (Pl. 17, fig. 12) has parts of two outer whorls which probably were a little higher than wide before compression. The complete specimen is not figured. The ribs are high, narrowly rounded at top, broad at base, and separated by wide interspaces. One half of the ribs bifurcate high on the flanks, and most of the simple ribs alternate with short intercalary ribs. No trace of lateral or ventral tubercles is apparent, and only a slight reduction in rib strength occurs along the midventral line.

SPECIMENS: 20105, 20104, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Durangites* beds). Collection K4 in Cañón Alamo, Sierra de Jimulco, Coahuila.

Genus *Substeueroceras* Spath 1923

Substeueroceras subquadratum Imlay, n. sp.

(Plate 15, figures 8, 12-15)

DESCRIPTION: The species is represented by nine immature forms. Shell discoidal, compressed; whorls subquadrate in section, higher than wide, embracing about one-third; flanks on outer whorls flattened, subparallel, rounding abruptly into umbilical wall and fairly abruptly into venter; flanks on inner whorls (Pl. 15, fig. 8) slightly convex and rounding evenly into umbilical wall and venter; venter on outer whorl somewhat flattened, on inner whorl gently convex. Umbilicus fairly narrow and shallow; wall fairly low, oblique on inner whorls, vertical on outer whorls.

The ribs are high, narrow, flexuous, moderately spaced on the inner whorls, becoming rather widely spaced on largest whorl known (Pl. 15, fig. 12). They begin at the line of involution, curve backward on the umbilical wall, incline forward on the flanks, and arch forward slightly on the venter. They are inflected forward near the middle of the flanks and, as in many species of *Substeueroceras*, the inflection becomes accentuated with growth. The mold is marked by a distinct ventral furrow, but the shell shows only a faint thinning of the ribs along the midventral line. The ribbing is characterized at all stages by numerous simple or intercalary ribs which in some specimens are as common as forked ribs. Bifurcation occurs in a zone near the middle of the flanks, although more commonly below than above the middle. No trifurcating ribs have been observed.

Dimensions in mm. are as follows:

Specimen	Diameter	Whorl height	Whorl thickness	Umbilical width
15905.....	41.0	18.5	14.0	11.5
20053.....	34.5	15.0	12.5	11.0
20050.....	19.0	18.5	7.5	5.0

REMARKS: This species may be distinguished from *S. allicostatum* Imlay by its more compressed whorl section, closer-spaced ribbing on its inner whorls, and by its greater number of simple ribs. *S. kellumi* Imlay has finer, closer-spaced ribbing, and fewer simple ribs. The immature form of *S. intercostatum* (Steuer) (1897, p. 46, pl. XXII, figs. 4-5) shows some resemblances but is more involute and has a distinct ventral furrow. *S. incertum* (Steuer) (1897, p. 37, pl. XII, figs. 1-4) has a different whorl section and coarser ribbing. *S. sp. ind.* in Burekhardt (1912, p. 171, pl. XLI, fig. 2) has fewer simple ribs and a different manner of furcation.

TYPE: Holotype 15905, paratypes 20050, 20053, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Substeueroceras* beds). Kellum's collections 1, 5, and 25 in Cañón Alamo, Sierra de Jimulco, Coahuila.

Substeueroceras n. sp. aff. *subfasciatum* (Steuer)

(Plate 15, figure 9)

DESCRIPTION: The species is represented by 18 specimens of which most are small and retain considerable shell material. Shell discoidal, compressed; whorl section ovate on inner whorls, subquadrate on outer whorls, higher than wide, thickest on lower fourth of flanks, embracing about two-fifths; flanks flattened and subparallel below, slightly convex above and converging slightly toward the venter; venter fairly narrow, somewhat flattened. Umbilicus fairly narrow and shallow; wall low and vertical, rounding evenly into flanks.

On the internal mold the ribs are low, rounded, and terminate ventrally at a narrow, smooth ventral furrow. On the shell the ribs are high, thin, fairly widely spaced, and are only slightly reduced in strength along the midventral line. They curve backward on the umbilical wall, curve forward on the lower part of the flanks, recurve backward just above the middle of the flanks, and then curve forward again on the upper part of the flanks and the venter. The ribs are inclined only slightly forward on the inner whorls but anteriorly become more strongly inclined. On the inner whorls most ribs bifurcate near the middle of the flanks, but there are a few simple ribs and rarely an intercalary rib. Anteriorly bifurcation occurs variably below or above the middle of the flanks, and simple and intercalary ribs become a little more common. On the outer whorls many of the bifurcation points are indistinct, and consequently some of the branch ribs are more or less faintly connected. On the largest specimen some of the ribs are trichotomous.

The largest specimens are too poorly preserved to be reproduced, but are several times the size of the specimen figured.

REMARKS: The Mexican species just described probably is new but because of the lack of mature forms it seems advisable at present to merely draw comparisons with similar species. *S. subfasciatum* (Steuer) (1897, p. 47, pl. XIX, figs. 1-3; Gerth, 1925, p. 84, pl. VI, fig. 5, 5a) has similar ribbing but appears to be more evolute and more robust. *S. kellumi* Imlay has denser ribbing on the inner whorls. *S. durangense* (Burckhardt) (1912, p. 168, pl. XL, figs. 5, 7-10) has wider-spaced, more flexuous ribs which are only slightly reduced in strength on the venter.

SPECIMEN: 20033, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Substeueroceras* beds): Kellum's collection 5, Cañón Alamo section, Sierra de Jimulco, Coahuila.

Substeueroceras kellumi Imlay, n. sp.

(Plate 14, figures 1-4)

DESCRIPTION: The species is represented by 14 specimens of which the holotype is the largest. Shell discoidal, compressed; whorl section ovate on inner whorls, subquadrate on outer whorls, higher than wide, thickest on lower fourth of flanks on inner whorls, thickest near middle of flanks on outer whorl of holotype; whorls embracing about two-fifths; flanks flattened and subparallel below, converging slightly above; venter moderate in width on inner whorls, becoming slightly broader on outer whorls, flattened along midline, rounding evenly into flanks. Umbilicus fairly

narrow; wall moderate in height, vertical or slightly overhanging, rounding rather abruptly into flanks. The anterior half of the outer whorl of the holotype probably represents part of the body chamber.

The ribs are flexuous and inclined forward. They curve backward on the umbilical wall, are inflected forward considerably near the middle of the flanks, then recurve slightly and arch forward on the upper part of the flanks and the venter. On the inner whorls to a diameter of about 25 mm. the ribs are thin, fairly high, densely spaced, and commonly bifurcate at or a little above the middle of the flanks. There are a few simple and intercalary ribs. At a greater diameter the ribbing rapidly becomes wider spaced, higher, and broader. Simple ribs become rather common, and trichotomous ribs occur. The outer whorl of the holotype has many tri- and bi-dichotomous ribs. At all stages the ribs on the shell are only slightly reduced in strength along the midventral line although the mold bears a narrow, smooth ventral furrow. At the extreme anterior end of the holotype the flank ribs become broad and somewhat indistinct.

Dimensions in mm. are as follows:

Specimen	Diameter	Whorl height	Whorl thickness	Umbilical width
holotype 15900	114	54(?)	36(?)	27
paratype 20036	31	14.5	11.5	8
paratype 20037	26	13.0	8.5	6.5

REMARKS: This species greatly resembles *Substeuerocheras lamellicostatum* (Burckhardt) (1912, p. 167, pl. XL, figs. 1-4, 6) but has wider-spaced ribbing on the outer whorls, fewer intercalary ribs, and probably a slower rate of coiling. It is distinguished from the forms described in this report as *S. aff. subsfasciatum* (Steuer) by much closer-spaced ribs on the inner whorls and by thicker, rounder ribs on the outer whorls. *S. koeneni* (Steuer) (1897, p. 45, pl. XVII, figs. 1-5) is much like *S. kellumi* Imlay but, judging from published figures, appears to have finer, more flexuous ribbing on its outer whorls, a more pronounced ventral groove on its inner whorls, and is a little more involute. *S. steueri* (Gerth) (1925, p. 86, pl. V, figs. 4, 4a) has a more robust form and closer-spaced ribbing on its outer whorls.

TYPE: Holotype 15900, paratypes 20036, 20037, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Substeuerocheras* beds). Kellum's collections 1, 5, and 25 in Cañón Alamo, Sierra de Jimulco, Coahuila.

Substeuerocheras alticostatum Imlay, n. sp.

(Plate 15, figures 1-7)

DESCRIPTION: The species is represented by about 24 specimens and probably includes several large fragments of outer whorls which have very coarse ribbing.

Shell discoidal; inner whorls ovate in section, wider than high; outer whorls becoming subquadrate in section, higher than wide, embracing about two-fifths; flanks of outer whorls nearly flattened below, rounding above into moderately broad venter which is somewhat flattened along its median line. Umbilicus fairly narrow and deep; wall fairly high, vertical at base, rounding rather abruptly into flanks.

The innermost whorls (Pl. 15, figs. 5, 6) bear high, narrow, widely spaced ribs which curve backward on the umbilical wall, incline forward on the flanks, and cross the venter transversely. They undergo only faint diminution in strength along

the midventral line. Most ribs bifurcate near the middle of the flanks but there are four or five simple ribs per whorl.

The ornamentation of the outer whorls is like that of the inner. The ribs remain high, narrow, and widely spaced. In addition they are more or less inflected forward near the middle of the flanks and arch forward slightly on the venter. Simple ribs and intercalary ribs are rare. Bifurcation occurs commonly a little above the middle of the flanks. All the ribs are simple on the umbilical edge, and no examples of tri- or bi-dichotomy have been observed. A ventral furrow is present on the internal mold, but on the shell the ribs are only slightly reduced in strength.

The anterior end of the outer whorl of the holotype is slightly drawn away from the inner whorls. At a diameter of 35 mm., the whorl height is 17 mm., the whorl thickness 15 mm., and the umbilical width 10 mm.

REMARKS: This species is easily distinguished from the Mexican species described herein by its coarse and widely spaced ribs. *S. santarosatum* (Burckhardt) (1906b, p. 129, pl. XXXV, figs. 1-4) has a wider, shallower umbilicus, and a greater number of simple ribs. *S. disputabile* (Castillo and Aguilera) (1895, p. 14, pl. XIV, fig. 1) has a greater resemblance but is distinguished by the mode of rib-branching on its outer whorl.

TYPE: Holotype 15906, paratypes 20056, 20055, 20086, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Substeueroceras* beds). Kellum's collections 1, 5, 25, and 26 in Cañón Alamo, Sierra de Jimulco, Coahuila.

Genus *Berriasella* Uhlig 1910

Berriasella zacatecana Imlay, n. sp.

(Plate 18, figures 4, 7-10)

DESCRIPTION: Shell discoidal, flattened; outer whorl subquadrate in section, higher than wide, thickest at lower third of flanks, embracing slightly less than two-fifths; flanks nearly flat, converging slightly toward venter; venter fairly broad, flattened. Umbilicus fairly wide and shallow; wall moderately high, nearly vertical, rounding evenly into flanks. Body chamber represented by one-third of the outer whorl of holotype.

The inner whorls bear pronounced, moderately spaced ribs which start low on the umbilical wall, incline forward slightly on the flanks, and bifurcate just ventral of the line of involution of the succeeding whorl. On the outer whorl the ribs are flexuous, strong, and terminate ventrally in tubercles which bound a fairly broad, smooth, midventral area. They begin near the middle of the umbilical wall, curve backward to the edge of the umbilicus, are inflected forward considerably on the middle of the flanks, recurve backward on the upper parts of the flanks, and curve forward again at the ventro-lateral margins. They are strongest on the lower parts of the flanks and are highest at the points of bifurcation. Most ribs bifurcate at or near the middle of the flanks, but some bifurcate on the upper third or the lower third. There are a few simple ribs. Constrictions are not present, although some interspaces are wider than others. The suture line is poorly preserved.

Near the anterior end of the holotype (Pl. 18, figs. 4, 7, 8), the whorl height is 23 mm., the whorl thickness 17.5 mm., and the umbilical width is 20 mm.

REMARKS: This species greatly resembles *Berriasella calisto* (d'Orbigny) (1842-

1851, p. 551, pl. 213, figs. 1, 2; Burckhardt, 1919, p. 56, 1921, pl. 19, figs. 1, 2) but has a wider whorl section and coarser, more distantly spaced ribs. *Berriasella oppeli* Kilian (1889, p. 662; Zittel, 1868, p. 107, pl. 20, figs. 1-4) has less flexuous ribs and bifurcation occurs higher on the flanks.

TYPE: Holotype 19295, paratype 19293, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Caja formation (*Substeueroceras* beds). Bed 15, collection 3, of Inlay's section on the north side of Cañón del Toboso, Sierrita del Chivo, near Symón, Durango.

Berriasella? sp.

(Plate 5, figures 5, 6, 9)

REMARKS: Under this heading are included immature forms of several distinct species which are close to *Berriasella* and are associated with *Substeueroceras* in the Cañón Alamo section of the Sierra de Jimulco.

The form shown on Plate 5, figures 5 and 6 (20042), shows coarse, widely spaced, nearly regularly biplicate ribbing which is only slightly interrupted on the venter. The ribs are somewhat swollen at the furcation points and on the venter. The inner whorls are much wider than high; the outer whorl is only slightly wider than high. The combination of forwardly inclined secondary ribs, of increasing whorl height with growth, and swellings at the ribs' furcation points, perhaps indicates a position nearer *Aulacosphinctes* than *Berriasella* or *Micracanthoceras*.

The form shown on Plate 5, figure 9 (20041) probably belongs to *Berriasella*. The whorl section is as wide as high. The outer whorl embraces about two-fifths of the preceding whorl. The ribs are nearly regularly biplicate, and the secondaries incline strongly forward. The ribs pass ventrally into swellings but are only slightly reduced in strength along the midventral line, although the internal mold bears a distinct groove.

Another form, shown on Plate 10, figures 8 and 9 (20039), has very distinctive ornamentation on its outer whorl. Its ribs are irregularly spaced on the umbilical edge; some arise close together, others arise in pairs. All ribs bifurcate a little above the middle of the flanks, and the secondaries arch forward on the venter which they cross without diminution in strength. The outer layer of shell is lacking except at the anterior end of the specimen, but this fragment shows that the ribs are high and thin. The bifurcation points are slightly swollen, but rib swellings are not indicated on the venter.

SPECIMEN: 15907, 20039, 20041, 20042, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Substeueroceras* beds). (1) Specimen 15907 from Kellum's collection 25 in Cañón Alamo. (2) Other forms from Kellum's collection 5 in Cañón Alamo, Sierra de Jimulco, Coahuila.

Berriasella? coahuilensis Inlay, n. sp.

(Plate 16, figures 1-7)

DESCRIPTION: The species is represented by four specimens which retain part of the shell material. The largest specimen is sutured to near the anterior end.

Shell medium in size, discoidal; whorl section of outer whorls subrectangular, higher than wide, becoming relatively higher and narrower during development; whorl sec-

tion of inner whorls subovate, slightly higher than wide; greatest thickness of whorl section near middle of flanks except at anterior end of types where it occurs near the umbilical edge; outer whorls embracing nearly three-fourths; flanks convex on inner whorls, becoming broader and flatter during development, nearly flattened on anterior end of outer whorl; venter truncated, moderate in width, becoming slightly convex at anterior end of shell. Umbilicus fairly narrow and deep; wall low and vertical on inner whorls, moderately high and slightly overhanging on outer whorls.

The innermost known whorls (Pl. 16, fig. 1) possess mainly simple ribs which start on the umbilical wall and pass nearly radially across the flanks but curve forward somewhat near the venter which they cross transversely with slight diminution in strength. They possess prominent, rounded tubercles at the edge of the venter, and some are faintly swollen near the middle of the flanks. Bifurcation occurs rarely and only on the lower parts of the flanks. Several of the wider interspaces possibly represent constrictions.

On the outer whorls the ribs begin low on the umbilical wall, curve backward slightly to the edge of the umbilicus, incline forward on the flanks in a flexuous manner, and are weakly arched forward on the venter. The ribs are low, rounded, and about as broad as the interspaces. They increase gradually in strength ventrally and undergo only slight diminution along the midventral line. On the posterior ends of the outer whorls of the large specimens most of the ribs are simple, but there are examples of bi- and trichotomy on the lower half of the flanks. On the anterior end of the outer whorl simple ribs are about one-fourth as common as forked ribs, and bifurcation occurs at various heights from the edge of the umbilicus to the upper third of the flanks. In the case of bifurcation near the umbilical edge, one or both branches bifurcate again higher up. Generally the bifurcation points are indistinct. Short intercalary ribs occur rarely.

Dimensions in mm. are as follows:

Specimen	Diameter	Whorl height	Whorl thickness	Umbilical width
holotype 15901	63	32	20(?)	13
paratype 20032	53	27	18(?)	12

REMARKS: The affinities of this species are probably nearer to the berriasellids than to the neocomitids as indicated by the absence of umbilical tubercles, the forward arching of the ribs on the venter, and the rib curve. It bears considerable resemblance to the Californian forms described by Stanton (1895, p. 79-80, pl. XVII, figs. 1, 2; pl. XVIII, fig. 5; pl. XVIII, figs. 3, 4) as *Hoplites storrsi* and *H. angulatus* but is readily distinguished by its greater involution and by many details of ornamentation. Resemblances also exist with some species described by Gerth from the *Substeuerocheras* beds of Argentina. *Thurmannites duraznensis* Gerth (1925, p. 97, pl. IV, figs. 1, 1a) is less involute than the Mexican species and has finer, wider-spaced ribbing. *Thurmannites? discoidalis* Gerth (1925, p. 98, pl. V, figs. 3, 3a) is difficult to compare because of the difference in size but is more evolute, more compressed, and has a smooth midventral area.

TYPE: Holotype 15901, paratypes 20032, 20031, 20030, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Substeuerocheras* beds). Kellum's collection 25 in Cañón Alamo, Sierra de Jimulco, Coahuila.

Genus *Proniceras* Burekhardt 1919*Proniceras jimulcense* Inlay, n. sp.

(Plate 18, figures 1-3)

DESCRIPTION: Form discoidal, flattened; outer whorl ovate in section, higher than wide, embracing preceding whorl slightly more than one-half; flanks nearly flat below, slightly convex above; venter arched. Umbilicus fairly wide, moderate in depth; wall moderately high, steeply inclined, rounding rather abruptly into flanks at anterior end of outer whorl, rounding evenly at posterior end.

The inner whorls bear strong, wide, irregularly spaced ribs which start at the line of involution and incline slightly forward on the flanks. Most of the ribs are simple, but some bifurcate low on the flanks. Umbilical tubercles appear at a diameter of about 44 mm. and become gradually stronger anteriorly.

On the outer whorl the ribs begin faintly near the line of involution, incline slightly backward to the umbilical shoulder, and terminate in stout, radially elongated tubercles. From the tubercles pass bundles of two or three ribs which bifurcate just above the tubercles, or near the middle of the flanks. The ribs are low, broad, and somewhat indistinct on the lower parts of the flanks, but become stronger above and cross the venter without diminution in strength. They incline forward considerably on the lower part of the flanks and strongly on the venter. Constrictions are narrow, fairly shallow, and most conspicuous on the inner whorls.

The extreme anterior end of the holotype has been crushed, but the remainder of the shell seems nearly undeformed except for slight depression. Remnants of shell attached to the left side and venter of the outer whorl indicate the former presence of a nearly complete whorl beyond the present outer whorl. The shell remnants show that the tubercles become larger and blunter anteriorly and that the ribs are replaced by striae which in turn are replaced by smooth shell.

At a diameter of 77 mm. the whorl height is 28 mm., the whorl thickness 22 mm., and the umbilical width 28 mm.

REMARKS: This species is very close to *P. subpronum* Burekhardt (1919, p. 48; 1921, pl. XVI, figs. 9-15, 20-22, 26, 28-30, 32, 34, 35) but is more involute, has a narrower umbilicus, a higher whorl section, stouter tubercles, broader ribs which are more inclined forward, shallower constrictions, and on the outer whorls the ribs become obscure on the lower part of the flanks.

TYPE: Holotype 15899, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Substucerocceras* beds). Kellum's collection 25 in Cañón Alamo, Sierra de Jimulco, Coahuila.

Proniceras scorpionum Inlay, n. sp.

(Plate 18, figures 5, 6)

DESCRIPTION: Form discoidal, flattened; whorls enlarging slowly, ovate in section, higher than wide, thickest near middle of flanks, embracing about one-fourth; flanks nearly flat; venter slightly sharpened at posterior end of outer whorl, narrowly rounded at anterior end. Umbilicus fairly wide, shallow; wall extremely low, rounded.

On the inner whorls the ribs are strong, straight, and inclined slightly forward. Most ribs are simple, but some bifurcate near the middle of the flanks. The outer whorl, preserved mainly as an internal mold, bears fine, slightly flexuous ribs which are moderately spaced. The ribs originate at the line of involution and incline obliquely forward to the middle of the flanks where they give rise to two or three

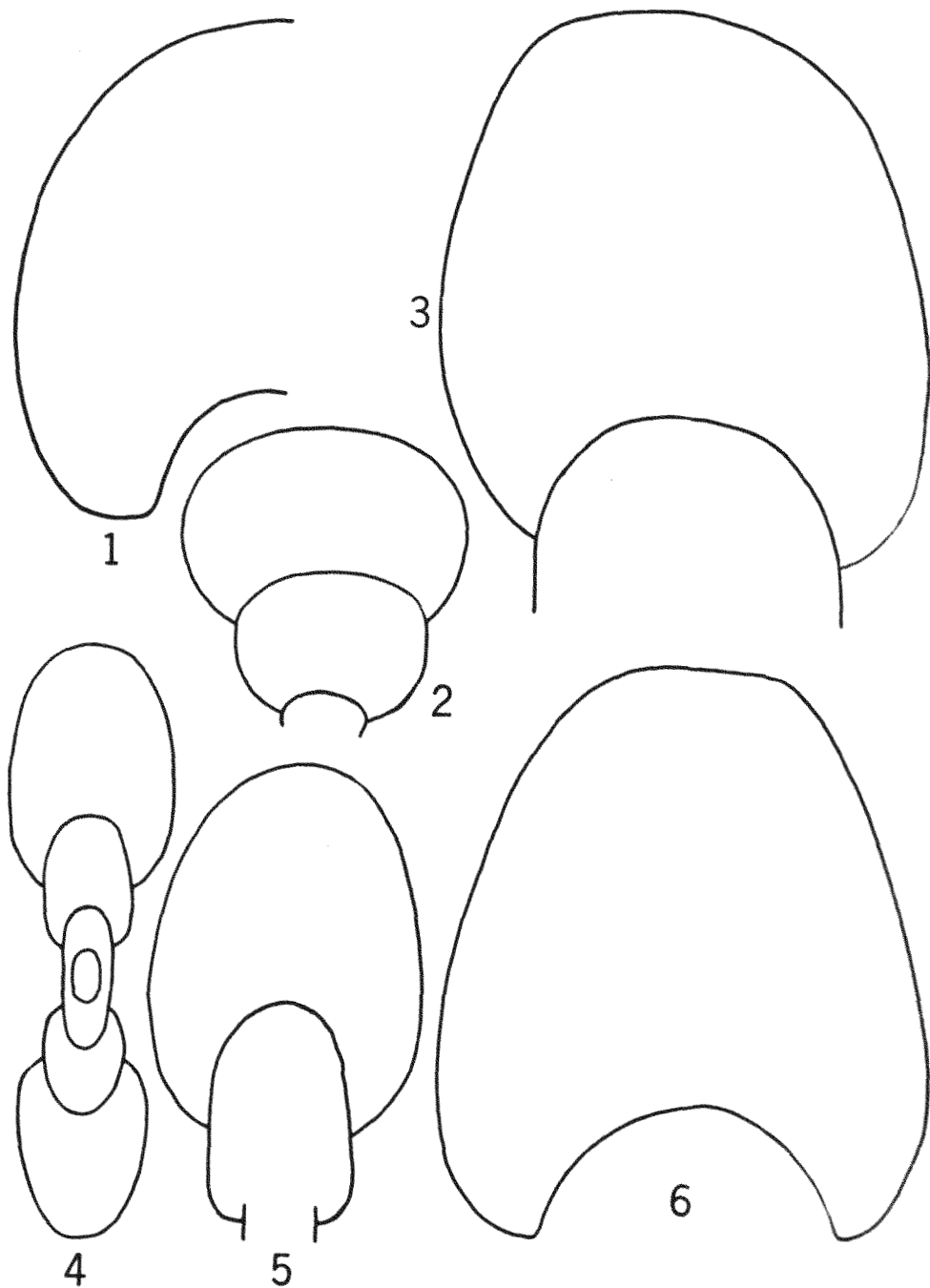


FIGURE 7.—Whorl sections of ammonites

(1) *Subplanites?* sp. (U. M. 19546); (2) *Subdichotomoceras?* sp. (U. M. 16979); (3) *Indosphinctes?* sp. (U. M. 19307); (4) *Idoceras striatum* Imlay (U. M. 19492); (5) *Indosphinctes?* sp. (U. M. 15960) at anterior end; (6) *Indosphinctes?* sp. (U. M. 19400) at posterior end.

slightly weaker secondary ribs which incline forward less strongly. One of the trifurcating ribs is generally loosely connected with the primary rib. There are a few intercalary ribs. The ribs form chevrons on the posterior part of the outer whorl but on the anterior part are merely weakly curved forward. Each whorl has four or five fairly strong constrictions.

Greatest diameter of holotype 34 mm.; height of whorl, 10 mm.; thickness of whorl, 8.5 mm.; width of umbilicus, 16 mm.

REMARKS: This species greatly resembles *P. idocerooides* Burckhardt (1919, p. 42; 1921, pl. XV, figs. 2-4) but has wider-spaced ribs, stronger constrictions, and on the outer whorl its primary ribs branch consistently near the middle of the flanks.

TYPE: Holotype 19408; paratype 19406, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Caja formation (*Substeuroceras* beds). Fossils from black limestone nodules in lower part of 25-foot unit of whitish gray, platy limestone at top of Jurassic section, Cañón del Escorpión about 3 miles northeast of Melchor Ocampo, Zacatecas.

Proniceras aff. *pronum* (Oppel)

(Plate 1, figures 8, 9)

DESCRIPTION: One fragment shows considerable resemblance to *Proniceras pronum* (Oppel) as figured by Djanelidze (1922, p. 70, pl. II, figs. 3a, b). The section is spheroidal and is as wide as high. The umbilical tubercles are strong, elongated radially, and are widely spaced. Each tubercle gives rise to three or four ribs which incline forward. In addition there are one or two intercalary ribs between successive rib bundles. The ribs are weakened a little on the venter and form broad chevrons.

SPECIMEN: 19184, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Substeuroceras* beds). Kellum's collection 5 in Cañón Alamo, Sierra de Jimulco, Coahuila.

Proniceras sp.

(Plate 1, figure 7; Plate 7, figure 8)

REMARKS: Several fragmentary specimens from Sierrita del Chivo are mentioned because of their stratigraphic significance. One immature form (Pl. 7, fig. 8) possibly belongs to *Proniceras subpronum* Burckhardt (1919, p. 48; 1921, pl. XVI, figs. 9-15, 20-22, 26, 28-30, 32, 34, 35). Another specimen (Pl. 1, fig. 7) is considerably weathered but resembles *P. idocerooides* Burckhardt (1919, p. 42; 1921, pl. XV, figs. 2-4).

SPECIMENS: 19428, 19430. Museum of Paleontology, University of Michigan.

OCCURRENCE: La Caja formation (*Proniceras* beds); Bed 15 (Collection 5) of Imlay's section on the north wall of Cañón Toboso, Sierrita del Chivo, near Symón, Durango.

Genus *Aegocrioceras* Spath 1924

"Aegocrioceras" sp.

(Plate 11, figures 1, 2)

DESCRIPTION: One fragment is provisionally placed under *Aegocrioceras* although probably belonging to a new genus. Spiral probably open; whorl ovate in section, higher than wide, thickest near middle, enlarging slowly; flanks gently convex, rounding rather abruptly into flattened dorsum, rounding gently into venter. All ribs are simple. They are high on the flanks, strongest at the edge of the venter, slightly reduced in strength along the midventral line, and nearly vanish on the dorsum. They trend backward slightly on the dorsum, forward slightly on the flanks.

and cross the venter nearly transversely, or arched a little forward. Most of them are nearly straight on the flanks, but some are inflected forward near the middle. The interspaces are wide but variable and have flat bottoms.

SPECIMEN: 20038, Museum of Paleontology, University of Michigan.

OCCURRENCE: La Casita formation (*Substeueroceras* beds). Collection K5 in Cañón Alamo, Sierra de Jimulco, Coahuila.

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EXPLANATION OF PLATES

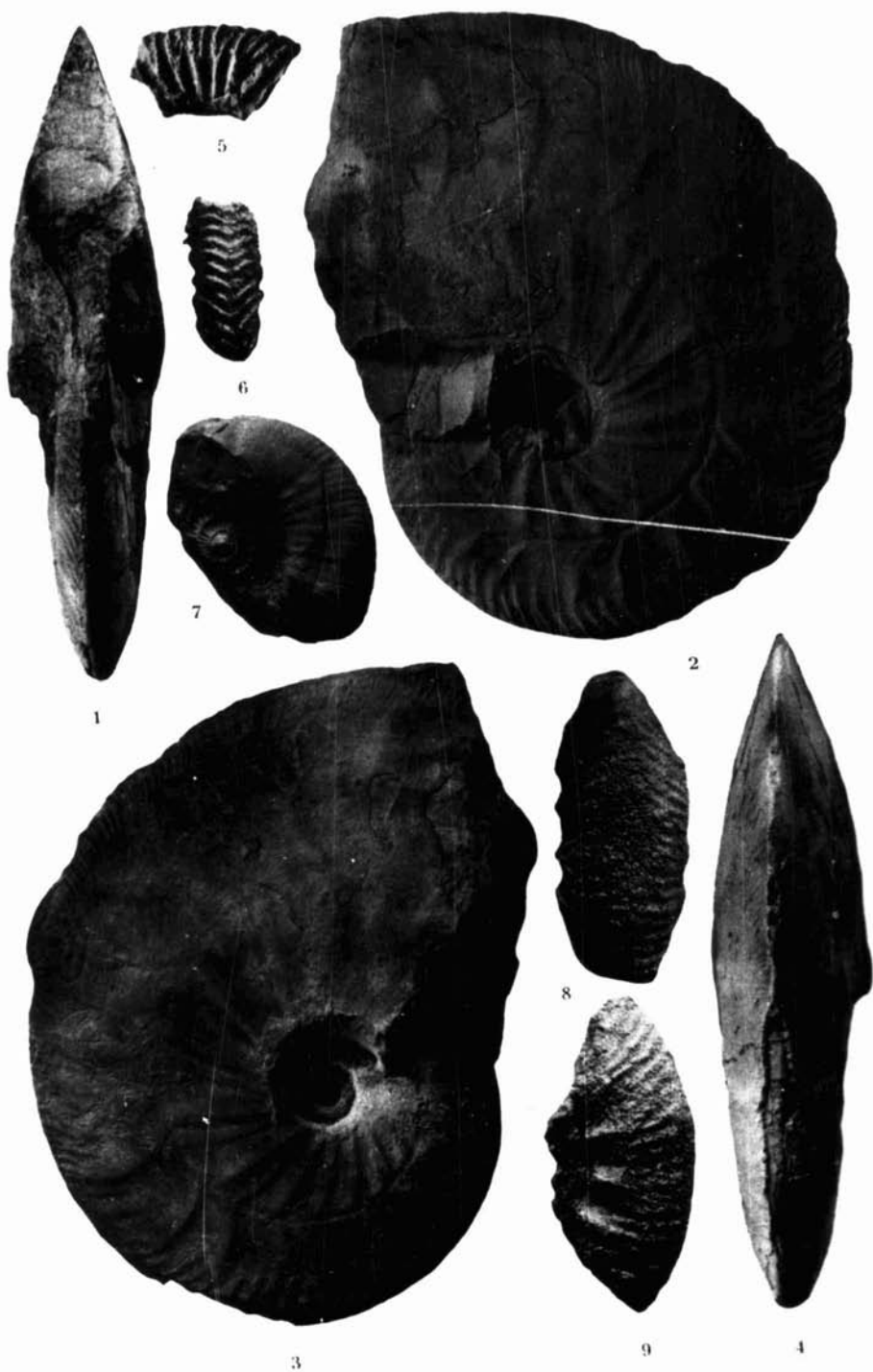
PLATE 1

UPPER JURASSIC AMMONITES FROM MEXICO

Figure

- (1-4) *Ochetoceras sanlazarense* Imlay, n. sp.; Apertural, lateral, and ventral views of holotype; U. M. 19531 (p. 24).
(5, 6) *Kossmatia* sp.; Lateral and ventral views; U. M. 19422 (p. 46).
(7) *Proniceras* cf. *idoceroides* Burckhardt; U. M. 19428 (p. 57).
(8, 9) *Proniceras* aff. *pronum* (Oppel); Ventral and lateral views; U. M. 19184 (p. 57).

All figures natural size.



UPPER JURASSIC AMMONITES FROM MEXICO

PLATE 2

UPPER JURASSIC AMMONITES FROM MEXICO

Figure

- (1-4) "*Phylloceras*" sp.; (1-3) Ventral, lateral, and apertural views; (4) Suture line from posterior end of outer whorl of holotype; U. M. 19289 (p. 24).
- (5-11) *Hildoglochiceras grossicostatum* Imlay, n. sp.; (5, 6) Ventral and lateral views of paratype; U. M. 20021; (7, 8) Ventral and lateral views of paratype; U. M. 20024; (9-11) Lateral, ventral, and apertural views of paratype; U. M. 20025 (p. 27).
- (12) *Nebrodites burckhardti* Imlay, n. sp.; Holotype U. M. 19156 (p. 30).

All figures natural size unless otherwise indicated.



UPPER JURASSIC AMMONITES FROM MEXICO

PLATE 3

UPPER JURASSIC AMMONITES FROM MEXICO

Figure

- (1-7, 9-11) *Hildoglochiceras grossicostatum* Imlay, n. sp.; (1, 6) Lateral and ventral views of paratype U. M. 20026; (2) Clay squeeze of paratype U. M. 20023; (3, 4) Ventral and lateral views of holotype U. M. 20020; (5, 7) Suture line at diameter of 12.3 mm. and lateral view of paratype U. M. 20028; (9) Paratype U. M. 20027; (10, 11) Ventral and lateral views of paratype 20022 (p. 27).
- (8, 12) *Waagenia parrasensis* Imlay, n. sp.; Lateral lobe at diameter of about 37 mm. and lateral view of holotype U. M. 17623 (p. 31).
- All figures natural size unless otherwise indicated.



UPPER JURASSIC AMMONITES FROM MEXICO

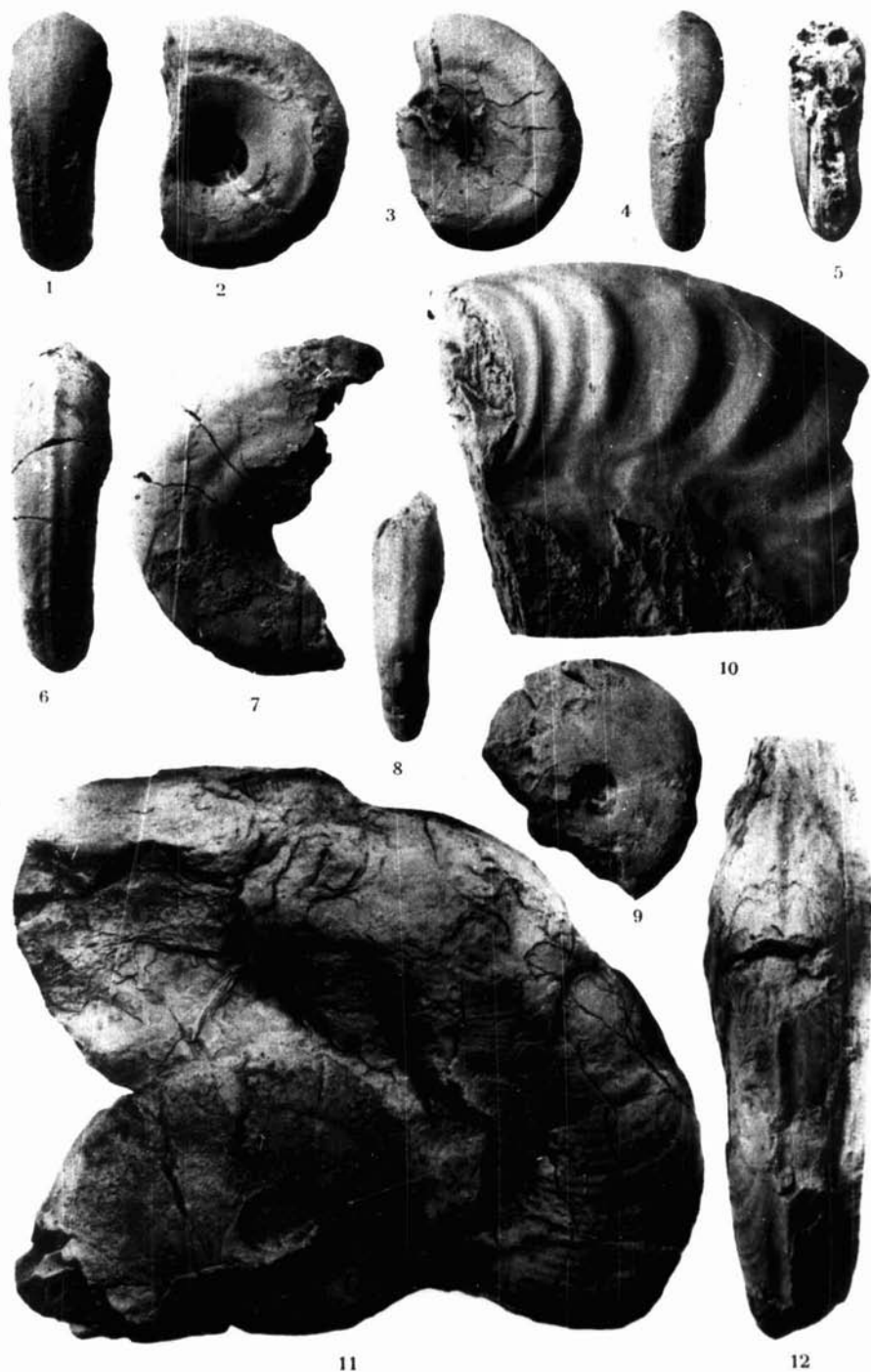
PLATE 4

UPPER JURASSIC AMMONITES FROM MEXICO

Figure

- (1-5) *Hildoglochiceras inflatum* Imlay, n. sp.; (1, 2) Ventral and lateral views of holotype U. M. 20094; (3-5) Lateral, ventral, and apertural views of paratype U. M. 15908 (p. 29).
- (6-9, 11, 12) *Hildoglochiceras alamense* Imlay, n. sp.; (6, 7) Ventral and lateral views of paratype U. M. 20095; (8, 9) Ventral and lateral views of paratype U. M. 16936; (11, 12) Lateral and ventral views of holotype U. M. 20001 (p. 30).
- (10) *Glochiceras* aff. *diaboli* Imlay, n. sp.; Fragment of an outer whorl of a large ammonite; U. M. 20115 (p. 25).

All figures natural size.



UPPER JURASSIC AMMONITES FROM MEXICO

PLATE 5

UPPER JURASSIC AMMONITES FROM MEXICO

Figure

- (1-4) *Hildoglochiceras ecarinatum* Imlay, n. sp.; Ventral, apertural, and lateral views of holotype; U. M. 17709 (p. 28).
- (5, 6) *Berriasella?* sp.; Lateral and ventral views of specimen U. M. 20042 (p. 53).
- (7) *Aspidoceras casitense* Imlay, n. sp.; Lateral view of holotype U. M. 16983 (p. 32). Apertural view on Pl. 6, fig. 11.
- (8) *Subgrossouvria?* sp.; U. M. 19308 (p. 33).
- (9) *Berriasella?* sp.; U. M. 20041 (p. 53).

All figures natural size unless otherwise indicated.



UPPER JURASSIC AMMONITES FROM MEXICO

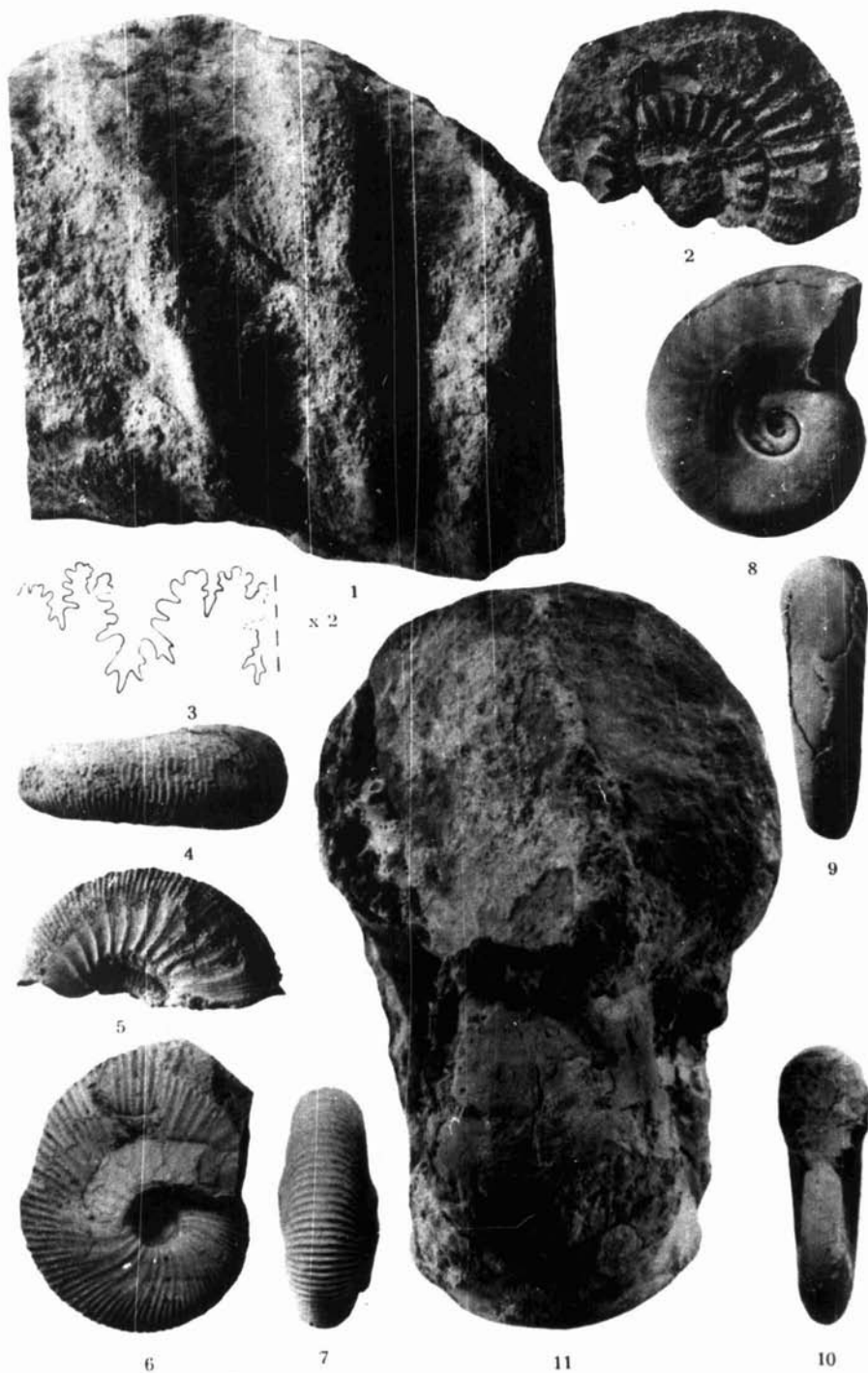
PLATE 6

UPPER JURASSIC AMMONITES FROM MEXICO

Figure

- (1) *Pseudopeltoceras?* sp.; U. M. 19401 (p. 33).
- (2) *Simoceras* sp.; U. M. 18407 (p. 31).
- (3-5) *Virgatosphinctes* sp.; Suture line, ventral, and lateral views of specimen U. M. 20096 (p. 41).
- (6, 7) *Involuticeras* sp. ind. juv.; Lateral and ventral specimen U. M. 19528 (p. 41).
- (8-10) *Glochiceras diaboli* Imlay, n. sp.; Lateral, ventral, and apertural views of holotype U. M. 18998 (p. 25).
- (11) *Aspidoceras casitense* Imlay, n. sp.; Apertural view of holotype U. M. 16983 (p. 32). Lateral view on Pl. 5, fig. 7.

All figures natural size unless otherwise indicated.



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PLATE 7

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Figure

- (1, 7) *Indosphinctes?* sp.; (1) Lateral view of specimen U. M. 19306; (7) Lateral view of specimen U. M. 15960 (p. 34).
(2, 3) *Micracanthoceras* cf. *microcanthum* (Oppel); Ventral and lateral views of specimen U. M. 19597 (p. 45).
(4-6) *Glochiceras angustiumblicatum* Imlay, n. sp.; Ventral, apertural, and lateral views of holotype U. M. 18581 (p. 26).
(8) *Proniceras* cf. *subpronum* Burckhardt; U. M. 19430 (p. 57).

All figures natural size.



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PLATE 8

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Figure

(1, 2) *Indosphinctes?* sp.; (1) U. M. 19307; (2) U. M. 19400 (p. 34).

(3-5) *Idoceras densicostatum* Imlay, n. sp.; Apertural, ventral, and lateral views of holotype U. M. 19518 (p. 40).

All figures natural size.



1



3



4



5



2

PLATE 9

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Figure

- (1) *Torquatisphinctes?* sp. ind.; U. M. 19572 (p. 35).
(2) *Torquatisphinctes?* aff. *bangei* (Burckhardt); U. M. 16981 (p. 34).
(3-12) *Micracanthoceras alamense* Imlay, n. sp.; (3, 4) Lateral and ventral views of holotype U. M. 20047; (5-7) Paratype U. M. 20048; (8-10) Apertural, ventral, and lateral views of paratype U. M. 20049; (11-12) Ventral and lateral views of paratype U. M. 15902 (p. 45).
(13-15) *Subplanites?* sp.; (13) U. M. 19546; (14, 15) Lateral and ventral views of specimen U. M. 19557 (p. 36).

All figures natural size.



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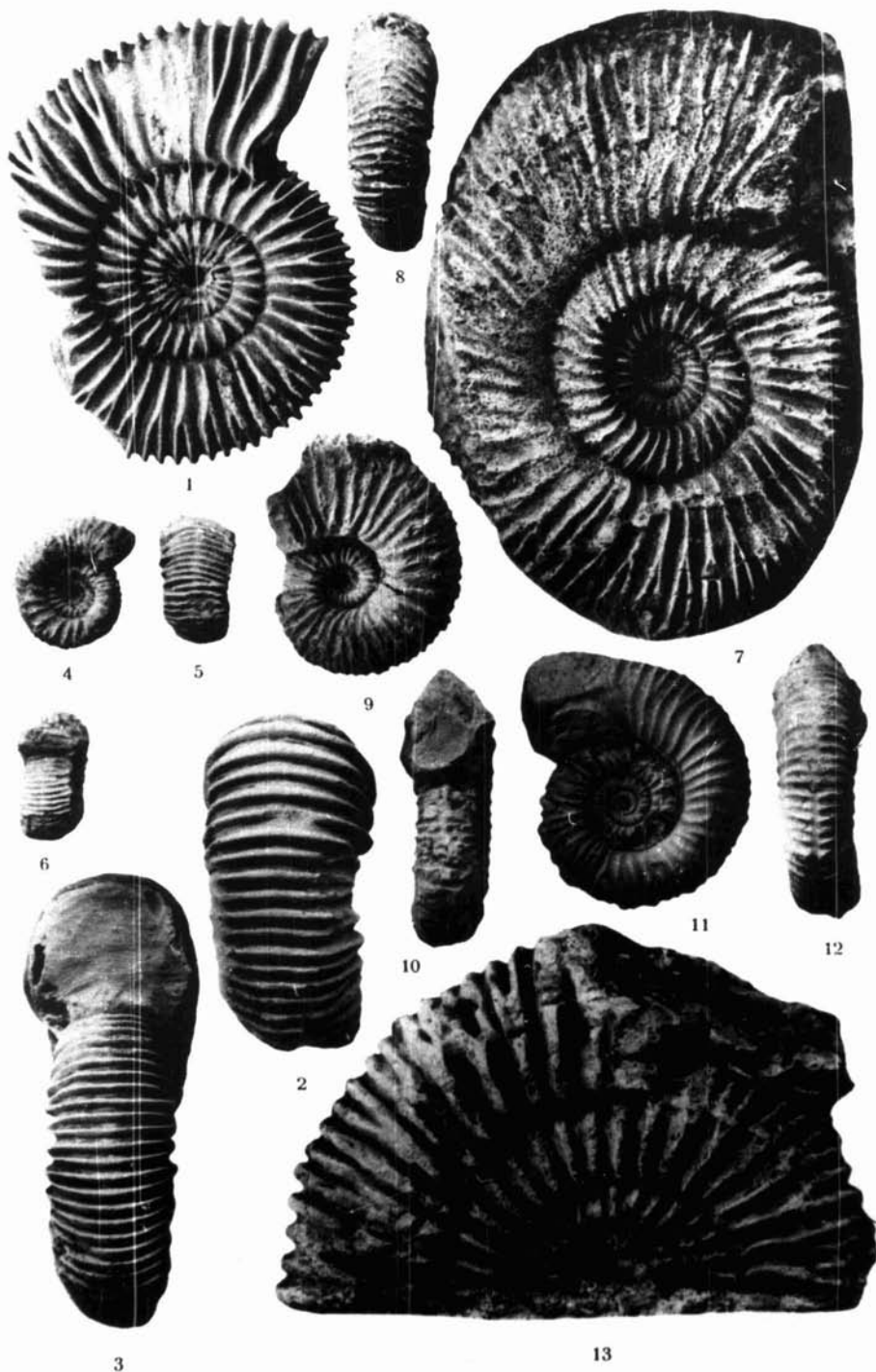
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PLATE 10

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Figure

- (1-6) *Aulacosphinctoides?* (*Subdichotomoceras?*) sp.; (1-3) Lateral, ventral, and apertural views of specimen U. M. 16977; (4-6) Same views of specimen U. M. 16980 (p. 35).
- (7) *Aulacosphinctoides?* aff. *diversecostatus* (Burckhardt); U. M. 17622 (p. 36).
- (8, 9) *Berriasella?* sp.; U. M. 20039 (p. 53).
- (10-12) *Durangites astillerensis* Imlay, n. sp.; Apertural, lateral, and ventral views of holotype U. M. 17707 (p. 46).
- (13) *Subdichotomoceras?* sp.; U. M. 16979 (p. 35).



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PLATE 11

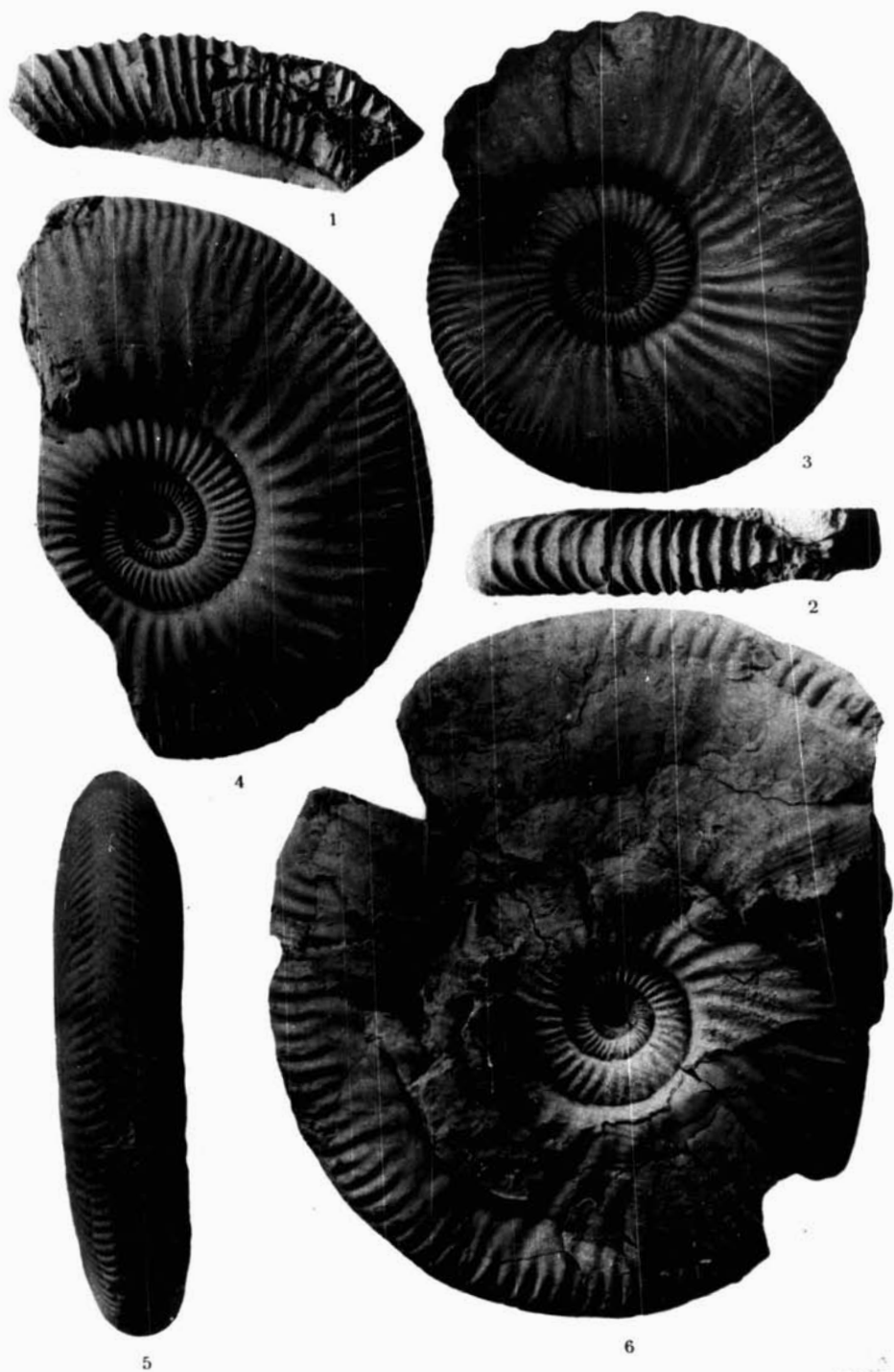
UPPER JURASSIC AMMONITES FROM MEXICO

Figure

(1, 2) "*Aegocrioceras*" sp.; Lateral and ventral views of specimen U. M. 20038 (p. 57).

(3-6) *Idoceras sanlazarense* Imlay, n. sp.; (3) Paratype U. M. 19498; (4, 5) Lateral and ventral views of holotype U. M. 19519; (6) paratype U. M. 19497 (p. 39).

All figures natural size.



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PLATE 12

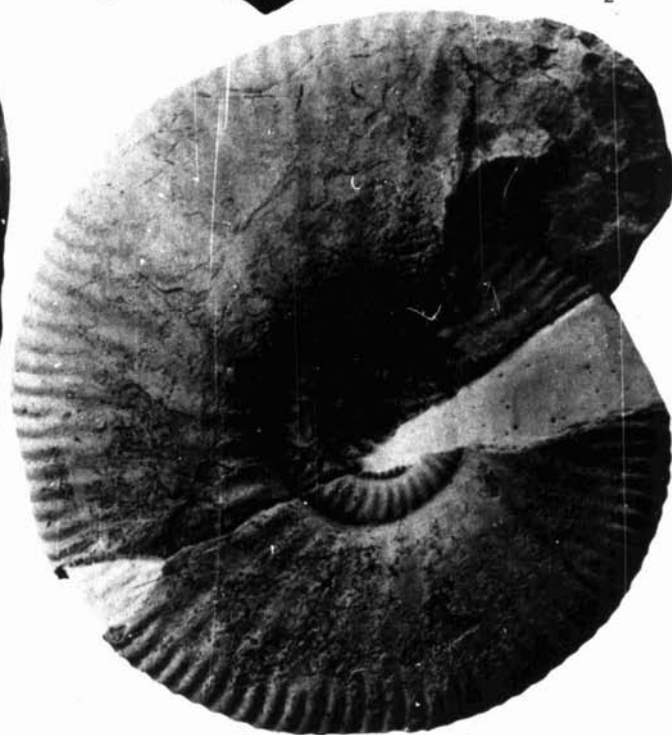
UPPER JURASSIC AMMONITES FROM MEXICO

Figure

(1, 2) *Idoceras tamaulipanum* Imlay, n. sp.; Lateral and ventral views of holotype U. M. 19494 (p. 40).

(3, 4) *Idoceras involutum* Imlay, n. sp.; Ventral and lateral views of holotype U. M. 19496 (p. 37).

All figures natural size.



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PLATE 13

UPPER JURASSIC AMMONITES FROM MEXICO

Figure

(1-3) *Idoceras viverosi* Burckhardt; Lateral, ventral, and apertural views of hypotype U. M. 19517 (p. 37).

(4-8) *Idoceras striatum* Imlay, n. sp.; Lateral, apertural, and ventral views and suture line of holotype U. M. 19492 (p. 38).

All figures natural size unless otherwise indicated.



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PLATE 14

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Figure

- (1-4) *Substeueroceras kellumi* Imlay, n. sp.; (1, 2) Lateral and ventral views of holotype U. M. 15900; (3) Paratype U. M. 20037; (4) Paratype U. M. 20036 (p. 50).
- (5-7) *Micracanthoceras aguajitense* Imlay, n. sp.; (5) Paratype U. M. 19598; (6, 7) Holotype U. M. 19588 (p. 43).

All figures natural size.



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PLATE 15

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Figure

- (1-7) *Substeuroceras alticostatum* Imlay, n. sp.; (1-4) Lateral, ventral, and apertural views of holotype U. M. 15906; (5, 6) Ventral and lateral views of paratype U. M. 20056; (7) Paratype U. M. 20055 (p. 51).
- (8, 12-15) *Substeuroceras subquadratum* Imlay, n. sp.; (8) Paratype U. M. 20050; (12, 13) Lateral and ventral views of holotype U. M. 15905; (14, 15) Ventral and lateral views of paratype U. M. 20053 (p. 49).
- (9) *Substeuroceras* n. sp. aff. *subfasciatum* (Steuer); U. M. 20033 (p. 50).
- (10, 11) *Aulacosphinctes* sp.; (10) U. M. 20045; (11) U. M. 20004 (p. 42).

All figures natural size.



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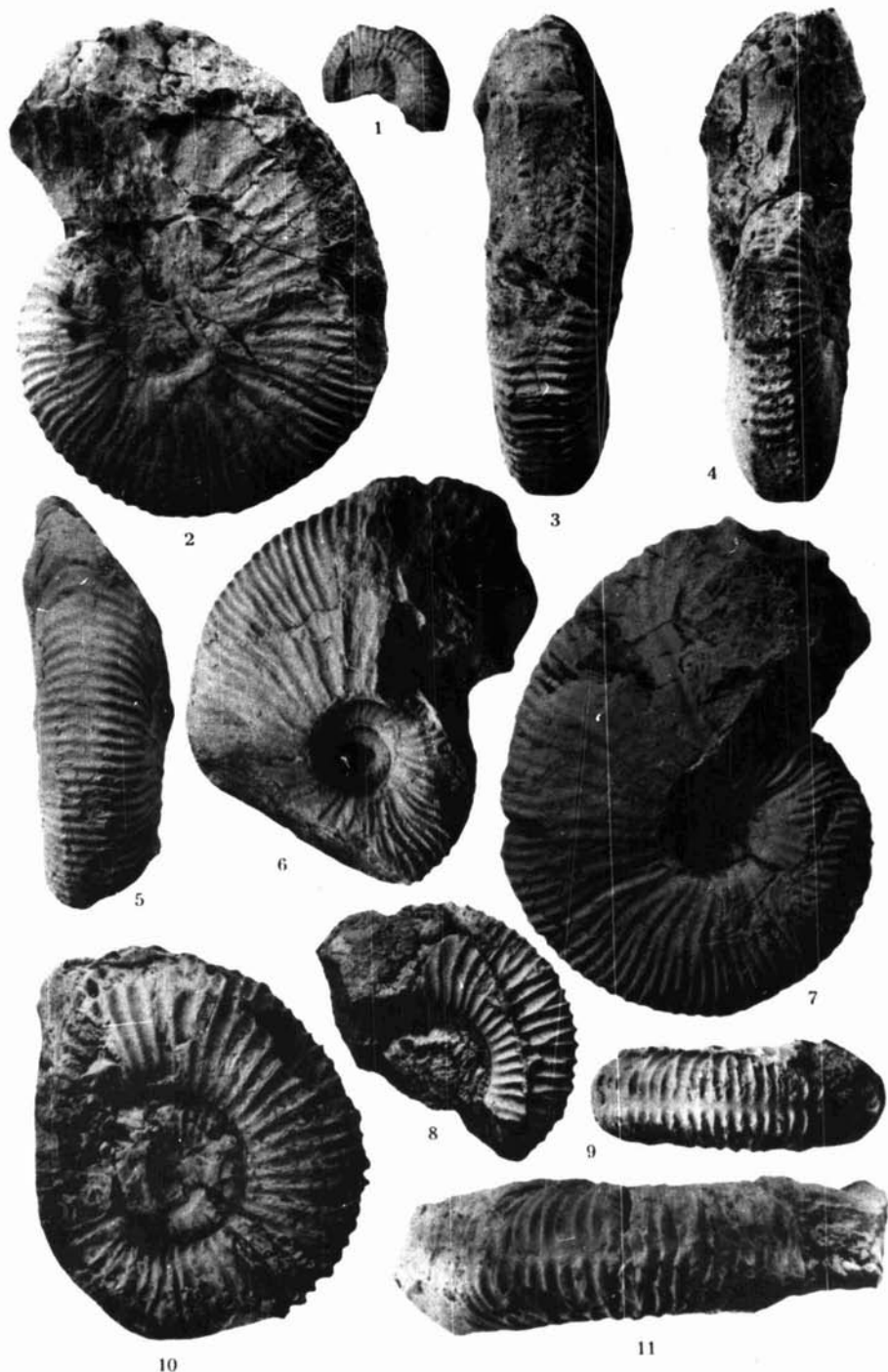
PLATE 16

UPPER JURASSIC AMMONITES FROM MEXICO

Figure

- (1-7) *Berriasella? coahuilensis* Imlay, n. sp.; (1) Lateral view of paratype U. M. 20031; (2-5) Lateral, ventral, and apertural views of holotype U. M. 15901; (5, 6) Ventral and lateral views of paratype U. M. 20032 (p. 53).
- (8-11) *Micracanthoceras acanthellum* Imlay, n. sp.; Lateral and ventral views of paratype U. M. 19604; (10, 11) Lateral and ventral views of holotype U. M. 19580 (p. 43).

All figures natural size.



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PLATE 17

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Figure

- (1, 5) *Micracanthoceras* n. sp. ind.; Lateral and ventral views of specimen U. M. 20044 (p. 46).
(2-4) *Micracanthoceras* n. sp. aff. *koellikeri* (Oppel); Lateral and ventral views of specimen U. M. 19590 (p. 44).
(6, 7) *Durangites* cf. *acanthicus* Burckhardt; Lateral and ventral views of specimen U. M. 20009 (p. 47).
(8) *Durangites rarifurcatus* Imlay, n. sp.; Holotype U. M. 20088 (p. 48).
(9) *Durangites* aff. *rarifurcatus* Imlay, n. sp.; U. M. 20090 (p. 48).
(10-12) *Durangites* n. sp. ind.; (10, 11) Lateral and ventral views of specimen U. M. 20104; (12) U. M. 20105 (p. 48).

All figures natural size.



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1924

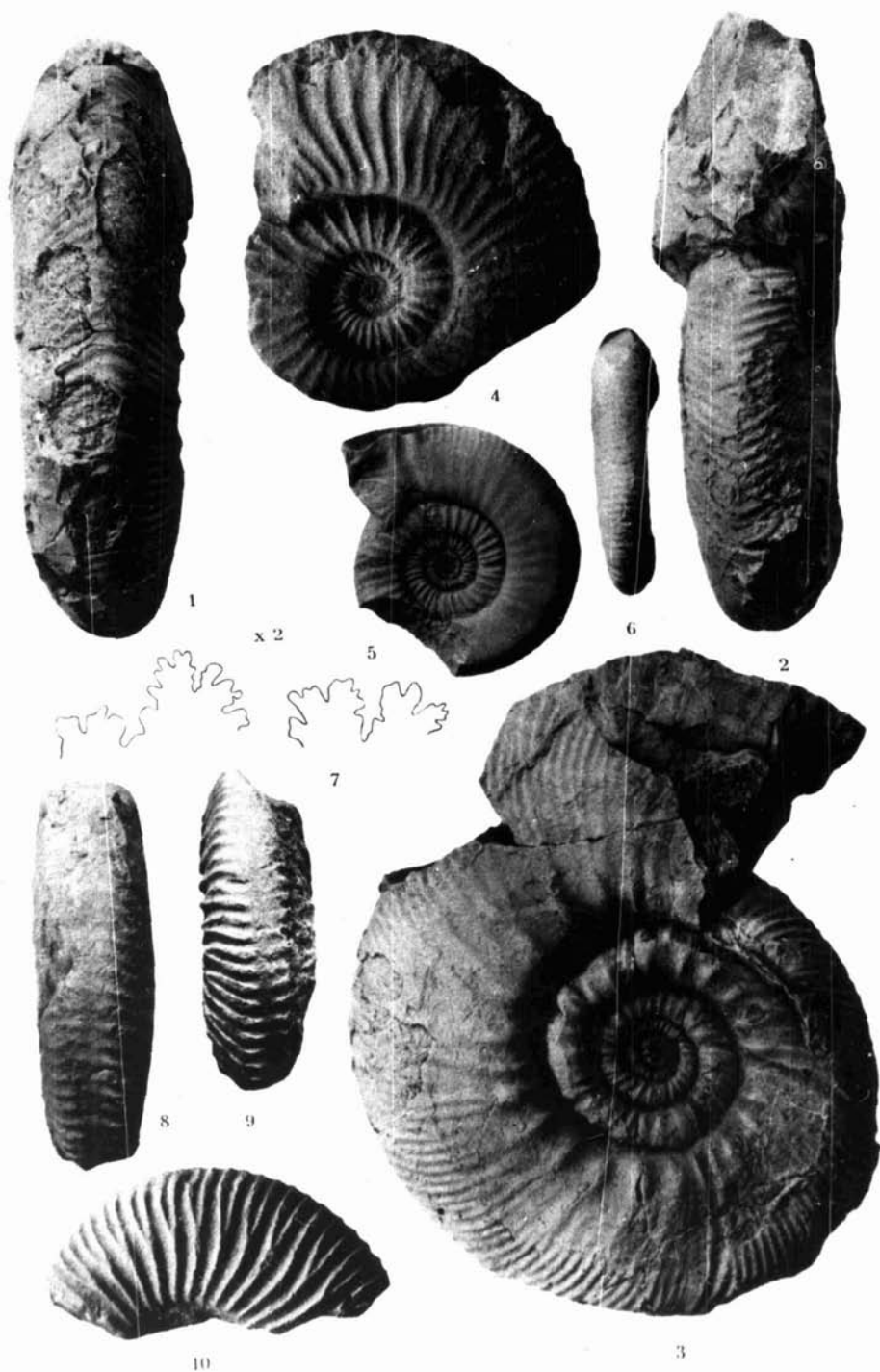
PLATE 18

UPPER JURASSIC AMMONITES FROM MEXICO

Figure

- (1-3) *Proniceras jimulcense* Imlay, n. sp.; Ventral, apertural, and lateral views of holotype U. M. 15899 (p. 55).
- (4, 7-10) *Berriasella zacatecana* Imlay, n. sp.; (4, 7, 8) Lateral and ventral views and suture line of holotype U. M. 19295; (9, 10) Ventral and lateral views of paratype U. M. 19293 (p. 52).
- (5, 6) *Proniceras scorpionum* Imlay, n. sp.; Lateral and ventral views of holotype U. M. 19408 (p. 55).

All figures natural size unless otherwise indicated.



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