

UPPER JURASSIC AMMONITES FROM MEXICO

BY RALPH W. IMLAY

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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	Upper Oxfordian	Upper Oxfordian
(Mesoxfordian) or Divesan		Lower Oxfordian	Middle Oxfordian	<i>cordatus</i> <i>lamberti</i> <i>athleta</i>
(Eoxfordian) or Callovian		Callovian	Lower Oxfordian	<i>anceps</i> <i>calloviensis</i>
Bathonian		Bathonian	Bathonian	<i>bullatus</i>

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.

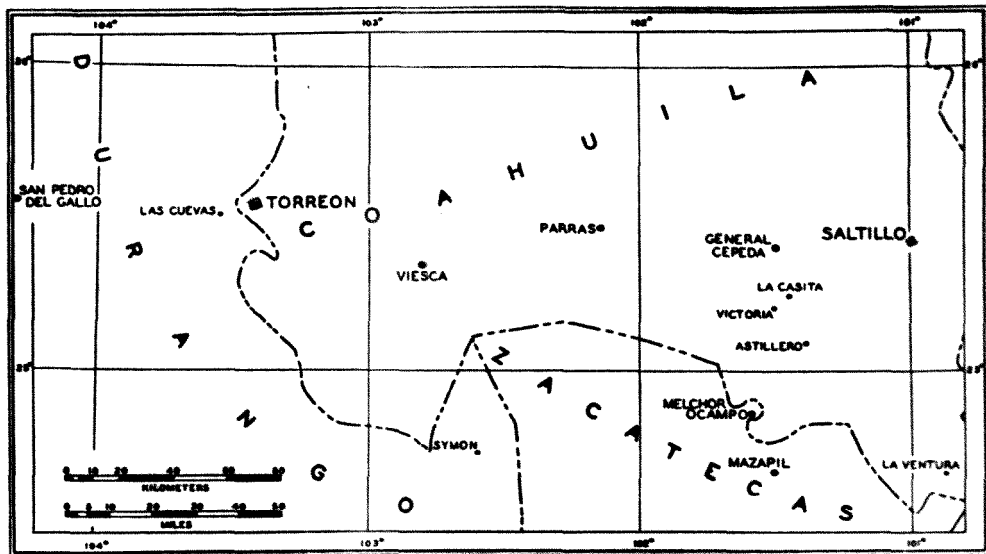


FIGURE 1.—Index map of fossil localities in north-central Mexico

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

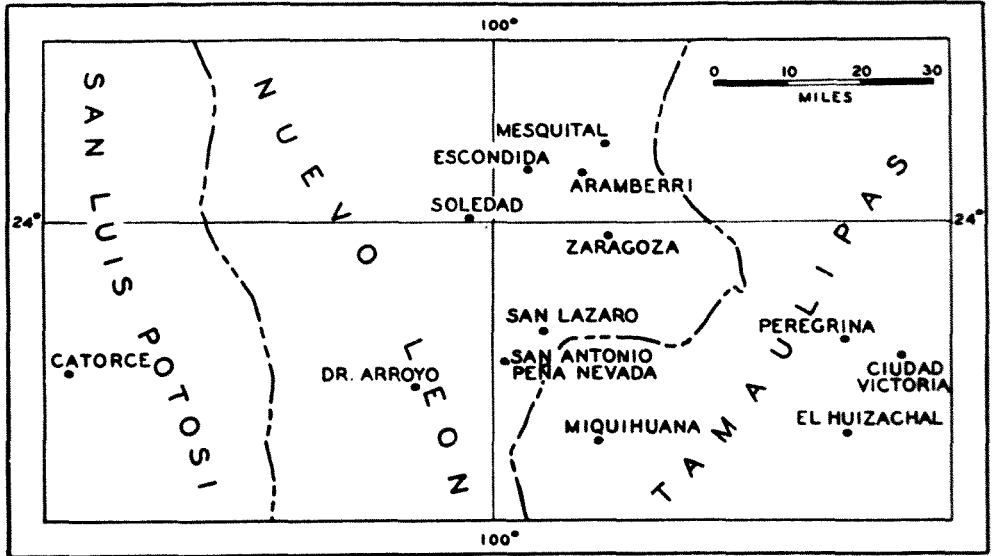


FIGURE 2.—Index map of fossil localities in eastern Mexico

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).

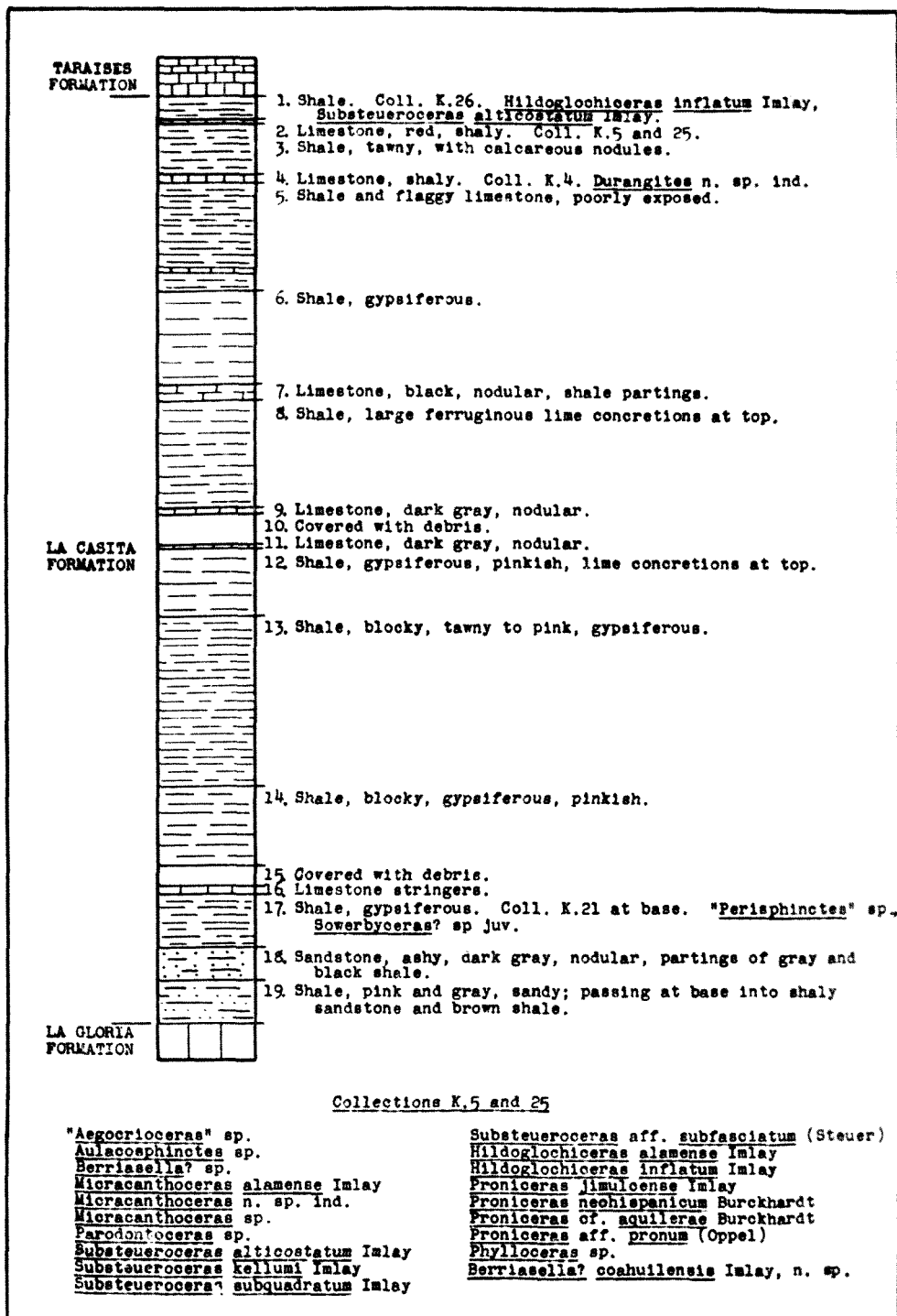


FIGURE 3.—Stratigraphic section in Cañón Alamo, Sierra de Jimulco, Coahuila

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. alticostatatum* 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 alticostatatum* 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).

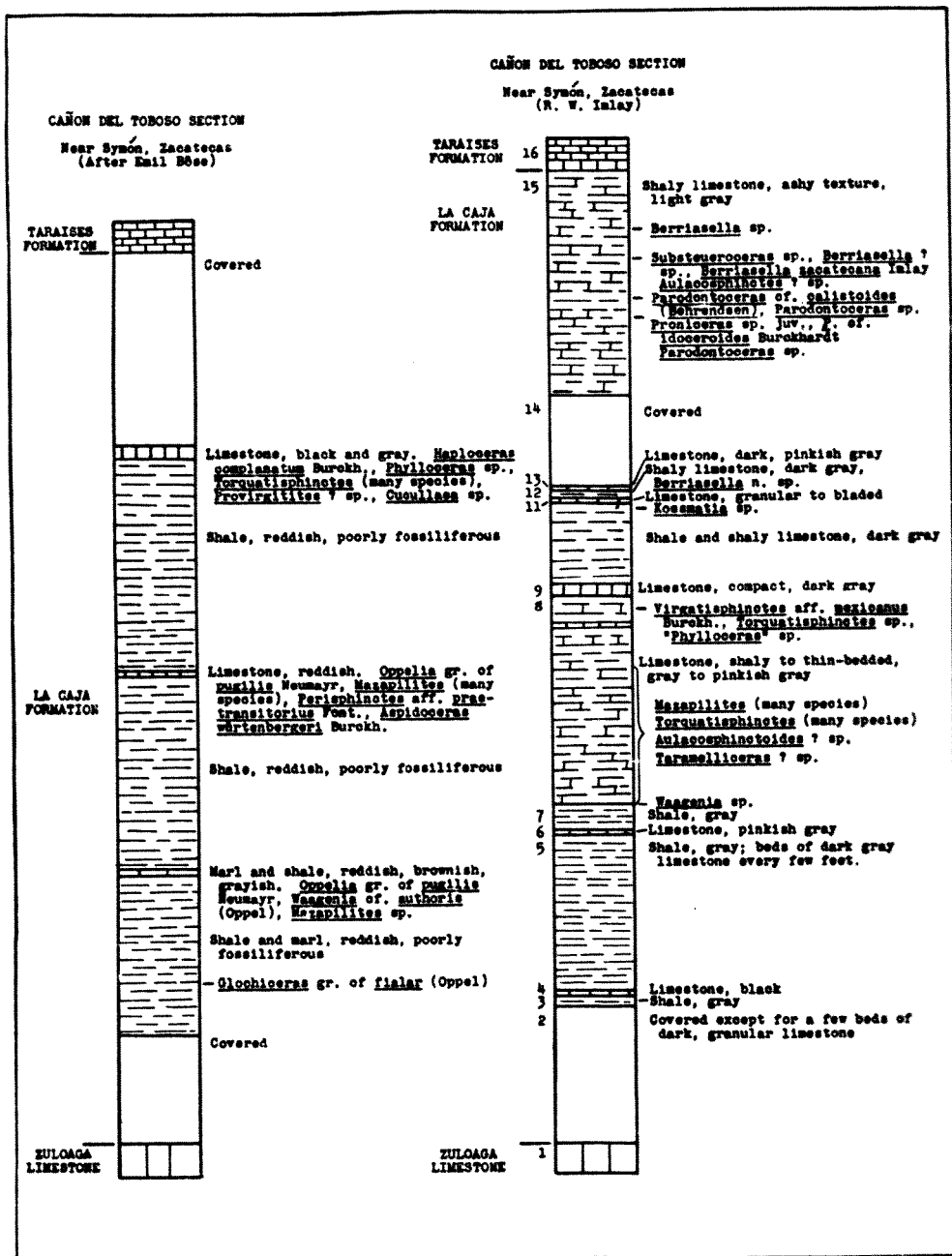


FIGURE 4.—Stratigraphic section on north side of Cañón del Toboso, Sierra del Chivo Near Symón, Durango.

2. Puerto Blanco in the Sierra de Santa Rosa is a divide between Cañón de las Bocas and Santa Rosa Valley, about 4 miles southeast of Mazapil. Fossils listed by Burekhart (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 Sombretillo.—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 Sombretillo. 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-

