Ammonite zones of northern Chihuahua

Keith Young, 1969, pp. 97-101

in:

The Border Region (Chihuahua, Mexico, & USA), Cordoba, D. A.; Wengerd, S. A.; Shomaker, J. W.; [eds.], New Mexico Geological Society 20th Annual Fall Field Conference Guidebook, 228 p.

This page is intentionally left blank to maintain order of facing pages.

AMMONITE ZONES OF NORTHERN CHIHUAHUA

by
KEITH YOUNG
Department of Geology, University of Texas at Austin

ABSTRACT

Although the most persistent ammonite zones of northern Chihuahua represent the late Aptian and the Albian, even these stages have an incomplete ammonite zonation. Non-ammonite-bearing rudistid facies are also present in parts of the Albian and Aptian in most areas.

Generally the pre-Upper Aptian rocks are either of the continental facies, or they are not exposed. Consequently, Jurassic ammonites are known from only one northern Chihuahua locality, vicinity of Placer de Guadalupe, and Neocomian ammonites from only two northern Chihuahua localities, vicinity of Placer de Guadalupe and vicinity of Samayaluca.

Lower Cenomanian zones are persistent and wide-spread, but have not been thoroughly studied. Post-Lower Cenomanian zones are known only from that area along the Rio Bravo adjacent to Texas.

The following stages are represented by ammonite zones in Northern Chihuahua: Kimmeridgian and Tithonian (Jurassic), and Hauterivian, Aptian, Albian, Cenomanian, Turonian, and Senonian (Cretaceous)).

RESUMEN

Aun cuando las zonas de amonitas más persistentes del norte de Chihuahua representan el Aptiano tardio y el Albiano, éstos estados aim tienen una zonation incompleta. Las facies de rudistas sin amonitas también están presentes en partes del Albiano y Aptiano, en la mayor parte del area.

Generalmente las rocas del Aptiano Superior son facies continentales o no están expuestas. Consecuentemente, las amonitas jurasicas se conocen solamente en una localidad del norte de Chihuahua, ésto es, en la vecindad de Placer de Guadalupe; las amonitas neocomianas se conocen en dos localidades en el norte de Chihuahua, que son Placer de Guadalupe y Samalayuca.

Las zonas del Cenomaniano Inferior son persistentes y están ampliamente distribuidas, pero no han sido estudiadas a fondo. Las zonas del post-Cenomaniano Inferior se conocen solamente en el area adyacente a Texas, a lo largo del Rio Bravo.

Los siguientes estados están representados por zonas de amonitas en el norte de Chihuahua Kimeridgiano y Titoniano (Jurásico), Hauteriviano, Aptiano, Albiano, Cenomaniano, Turoniano y Senoniano (Cretácico).

INTRODUCTION

Ammonites of northern Chihuahua have not been studied in great detail. Scott (1940) described late Aptian and early Albian ammonites from the southern Quitman Mountains, Trans-Pecos Texas. These ammonites occur also in adjacent Chihuahua, and many of them occur even farther into Chihuahua. Since the ammonites described by Scott belong to a cosmopolitan fauna, many of them, or closely related forms, are known from other parts of the world (Casey, 1961) . Stoyanow (1949) described ammonites of late Aptian and Lower Cenomanian ages from southern Arizona. Unknowingly, Scott (1940) and Stoyanow (1949) described some of the same species under different names (Casey, 1961). The Late Aptian-Early Albian ammonites are a very interesting group, and I have been working on those of northern Mexico, Texas, New Mexico, and Arizona, off and on, for a number of years. It will be at least another five years before I feel confident to publish a thorough study. The incompleteness of these studies accounts for the extensive use of aff. and cf. in the present paper.

Rose's (1910) monograph on the Cerro de Muleros fauna constitutes the only work on Upper Albian ammonites in northern Chihuahua, and is the earliest paper on northern Chihuahua ammonites. The ammonites described by Bose are mostly lower Upper Albian; additional localities for some of these ammonites in northern Chihuahua have been listed recently by Young (1966b, 1968).

Powell (1963a, 1963b) has described Cenomanian and Turonian ammonites from northeastern Chihuahua, but he did not collect south and west of the Sobaco syncline just west of Cuchillo Parado. The age of Upper Cretaceous shales, such as those east of Aldama (Diaz, 1956) is not known. Young (1966a) has studied the occurrence of lower Cenomanian ammonites from the Sierra Lágrima (see also Haenggi, 1966) .

Wolleben (1967) has described Santonian and Campanian ammonites from the Ojinaga area and adjacent Texas. These ammonites had not been described previously, except for the ammonites Hyatt (1903) described from the "San Carlos Beds." San Carlos Formation is no longer applied to the beds from which Hyatt described "San Carlos" ammonites, and these beds are now referred to the Ojinaga Formation.

It should be pointed out that as early as 1918 and 1919

W. T. Keller had a group of Swiss geologists in northern Chihuahua, working for "El Aguila" (La Compania de Méxicana de Shell). Keller collected Campanian fossils in the vicinity of Ojinaga and La Mula, and Jurassic fossils at San Sostenes. These fossils were taken to Tampico and were eventually deposited in the University of Texas collections as the "El Aguila" part of the W. S. Adkins collection. These fossils had also been seen by Burkhardt (1933) and still accompany a label bearing the name of the collector, the date, and the locality.

REMARKS ON AMMONITE ZONATION

The ammonite zones of Tables 1 and 2 are incomplete. There are three reasons for incomplete ammonite zonation: (1) collection failure, (2) wrong environment, e. g., ammonites are not found in non-marine rocks, nor are they found in rudistid-bearing strata, and (3) lacunae. The first two examples appear to be mainly responsible for the absence of many ammonite zones in northern Chihuahua.

JURASSIC ZONES

I have listed only two Jurassic zones from northern Chihuahua. W. S. Adkins and R. E. King collected the fossils, and Imlay (1943) described them. However, there may be more than two zones, as indicated by the age comparisons of Imlay (1943, p. 529) .

The absence of Upper Kimmeridgian and Lower Tithonian zones in the Placer de Guadalupe area is probably the result of collection failure in rocks that do not abound with fossils. Upper Tithonian and Lower Neocomian (Berriasian and Valanginian zones) are likwise probably absent by collection failure in this vicinity; they could be cut out by complex structure, or these slightly fossiliferous beds may not as yet have yielded fossils. No one has found a Jurassic-Cretaceous unconformity in this area, but I must admit that not many have tried. Fossils of the Kossmatia rancheriaensis Imlay zone also occur in the Jurassic Malone Formation of the Malone Mountains; the specimen that I have identified is a Kossmatia kingi Imlay. Otherwise, the Jurassic is not known north or northeast of the vicinity of Placer de Guadalupe, unless the Jurassic at Sierra de Ojo Caliente, stop 4 of trip A-13, 20th International Geological Congress (Diaz, 1956, p. 312, Fig. 4) has been correctly dated.

CRETACEOUS ZONES

The collection in the summer of 1968 by D. S. Webb of a good specimen of Leopoldia victoriensis Imlay (1938) from the sandstones along the highway south of Samalayuca has changed the age of these rocks, formerly reported as Jurassic by William E. Humphrey (Diaz, 1956, p. 28) on field identification only. These rocks are lower Hauterivian. The same rocks with the same fossils occur at Placer de Guadalupe where Bridges (1962, 1965, pp. 74-76) reported them as Jurassic because I made misidentifications similar to Humphrey's. An isolated specimen, in different lithology, of Leopoldia sp. cf. leopoldinus (d'Orbigny), collected by DeFord from near the picachos in the vicinity of Placer de Guadalupe, likewise is lower Hauterivian. Two Lower Cretaceous ammonites (presumably pre-Aptian) are rumored to have come from near Cuchillo Parado, but these seem to be misplaced. No pre-Aptian ammonites from northern Chihuahua, other than those mentioned above, are known to the writer.

Jurassic and Cretaceous fossils are reported at Sierra de Ojo Caliente (Diaz, 1956, p. 26, 31, 32). I have seen no identifiable fossils from this locality.

The absence of upper Hauterivian, Barremian, and most of the Lower Aptian ammonites from northern Chihuahua can usually be attributed to the occurrence of the wrong facies. In many localities the Navarette evaporite section is overlain by continental deposits, as on the west flank of the Sierra de la Aldea, east of Cuchillo Parado. At this locality, above the evaporites, pulmonate land snails have been collected by Young, Powell, Diaz, and DeFord. In the southern Quitman Mountains, dinosaur bones were collected by Donald Campbell (1968) and Bill Jones (1968) from the Las Vigas formation. How much of the Las Vigas Formation is terrestrial is debatable, but the Las Vigas and Navarette formations certainly represent environments inhospitable to ammonites.

The first ammonites above the lower Hauterivian represent the latest Lower Aptian. These are Cheloniceras sp., one specimen from the Sierra del Presidio; Cheloniceras adkinsi Scott, from the southern Quitman Mountains, which may not be a Cheloniceras; and a specimen of Cheloniceras from just above the redbed sequence on the east flank of Sierra Cuervo, north of Aldama. Only in these three areas have probable late Lower Aptian fossils been collected.

Upper Aptian fossils are well known in northern Chihuahua and adjacent Trans-Pecos Texas (Table 1).

The zone of Dufrenoyia justinae (Hill) is not as widespread as heretofore assumed, since myself and others have misidentified Hypacanthoplites bakeri Scott as D. justinae on more than one occasion. In addition, the Dufrenovia justinae zone may represent other zones too, but the geological sections have not been collected in detail, and none have received the type of study necessary to produce exact collections.

Overlying the zone of Dufrenoyia justinae in the southern Quitman Mountains of Trans-Pecos Texas, the Sierra del Presidio, and the Bisbee district of southeastern Arizona is the zone of *Kazanskyella trinitense* (Scott). Finer collecting may also produce a more detailed zonation at this level. This fauna has not been collected to the south of these areas, probably because it is replaced by the late Aptian-lower Albian rudistid complex. Gillerman (1958, pp. 47-50) collected a fauna of approximately the same age from the Carbonate Hill Limestone in the central Peloncillo Mountains. Some of his specimens seem to be closely related to *Kazanskyella* n. sp. from the Bexar Shale in the Spahn well in Gonzales County, south Texas. I also have a good specimen of Kazanskyella *trinitense* (Scott) from the Sierra de Sabinas-Lampazos, northwest of Sabinas Hidalgo, Nuevo Leon.

The Lower Albian zone of Hypacanthoplites bakeri Scott

is widespread. In addition to the localities mentioned (Table 1), H. bakeri Scott was collected by R. E. King and W. S. Adkins at Cerro Chino, north of Coyame, and by Haenggi, Young, Gries, and Heiken, on the east flank of the Sierra Lágrima, opposite Rancho la Bomba.

The zone of Quitmanites ceratitosus (Scott) seems to lie between the zone of Douvilleiceras and the zone of Hypacanthoplites bakeri. Collecting has not been in sufficient detail to verify this additional zone, especially since Scott's (1940, pp. 981-984) Locality MI would seem to range through at least three zones.

The zone of Douvilleiceras mammilatum s.I. is wide-ranging throughout much of the world at the base of the middle Albian. The zone of D. mamilatum s.l. probably includes the zone of *"Sonneratia" whitneyi* Scott. Therefore I have used two zones, "S." whitneyi above and *Douvilleiceras* quitmanensis below. "Sonneratia" whitneyi is not a *Sonneratia,* and may turn out to be a special offshoot of *Hypacanthoplites* with flexuous ribs. Its occurrence with Hypacanthoplites n.sp. is apparently another example of endemic species of relict genera behind the Texas-Mexico barrier reef system (Young, 1966a, 1969) . In this zone endemic species of *Hypacanthoplites* range into rocks younger than those represented for the genus in other parts of the world.

Except for a clay-marl facies at Banco Lucero (Webb, D. S., 1969, personal communication) apparently extending into the region from the southwest, the remainder of the Middle Albian in northern Chihuahua is represented by reef facies (Finlay Limestone, etc.) . Webb has collected, from the pinchout of the clay-marl facies, a couple of small ammonites that appear to be related to Tegoceras, but they are poorly preserved and more specimens are needed before a zone can be set up.

The next overlying ammonite zone is the zone of Manu*aniceras* powelli Young, which represents the base of the Upper Albian. Fossils of this zone have been found only at the north end of the Sierra del Presidio (Rancherias, collected by Diaz and others in 1945) and in the southern Quitman Mountains (collected by T. W. Stanton, and later by Bill Jones). The fossils collected by Diaz and others and T. W. Stanton are in the United States National Museum. The fossils collected by Bill Jones are in the collections at The University of Texas. South of these areas rudistid facies of this age appear to be more complete, and ammonites have not been recovered.

The zones of Adkinsites bravoensis (Bose) and Boeseites romeri (Haas) are widespread from the vicinity of Placer de Guadalupe to the north into Texas and to the east into Nuevo Leon (Young, 1966b, 1968). In northern Chihuahua they occur in the Benevides Formation. The occurrence of the overlying zone of Pervinquieria equi-

TABLE 1.

PRE-FINLAY AMMONITE ZONES OF NORTHERN CHIHUAHUA (CRETACEOUS AND JURASSIC)

CUCHILLO FORMATION	
Zone of *"Sonneratia" whitneyi* Scott (Middle Albian)	
"Sonneratia" whitneyi Scott	TQ
Hypacanthoplites n. sp.	T
Zone of *Douvilleiceras quitmanense* Scott (Middle Albian)	
Douvilleiceras quitmanense Scott	QV
(= *Trinitoceras rex* Scott)	
(= *Douvilleiceras offarcinatum* Scott non White)	
Douvilleiceras spathi Scott	Q
D. reesidei (Scott)	Q
D. cuchillense Scott	Q
D. (?) *dunlapi* (Scott)	T
D. spp. cf. *mammillatum* (Schlotheim) s. 1.	T
Zone of *Quitmanites ceratitosus* Scott (Lower Albian)	
Quitmanites ceratitosus Scott	QP
Quitmanites evolutus (Scott)	Q
Quitmanites n. sp. aff. *evolutus* (Scott)	T
Zone of *Hypacanthoplites mayfieldensis* Scott (Lower Albian)	
Hypacanthoplites mayfieldensis Scott	QPT
(= *Dufrenoyia robusta* Scott)	
(= *Hypacanthoplites cragini* Scott)	
Hypacanthoplites rugosus Scott	T
Hypacanthoplites bakeri Scott	QFPV
Zone of *Kazanskyella trinitensis* (Scott) (Upper Aptian-*Clansayes*)	
Kazanskyella trinitensis (Scott)	QPAB
(= *K. spathi* Stoyanow)	
Kazanskyella minima (Scott)	QPA
(= *K. arizonica* Stoyanow)	
Kazanskyella cuchillensis (Scott)	Q
Kazanskyella n. sp.	B
Hypacanthoplites immunitus (Stoyanow)	PA
H. sp. aff. *immunitus* (Stoyanow)	P
Zone of *Dufrenoyia justinae* (Hill) (Upper Aptian)	
Dufrenoyia justinae (Hill)	PQT
(= *Dufrenoyia texana* Burckhardt)	
(= *Hoplites roemeri* Cragin)	
(= *Dufrenoyia burckhardt* Scott)	
Zone of *Cheloniceras* sp. (Lower Aptian)	
Cheloniceras sp. cf. *fossae* Humphrey	P
LAS VIGAS FORMATION (with great latitude—may be equivalent to Navarette Formation also).	
Zone of *Leopoldia victoriensis* Imlay (Hauterivian, probably Lower)	
Leopoldia victoriensis Imlay	S
Neocomites sp. aff. *neocomiensis* (d'Orbigny)	GS
Neocomites sp. cf. *neocomiensis* (d'Orbigny)	M
Leopoldia sp. cf. *leopoldinus* (d'Orbigny)	G
Kilianella (?) sp.	GS
RANCHERIAS FORMATION	
Zone of *Kossmatia rancheriaensis* Imlay (Tithonian, probably Middle)	
Kossmatia varicostata Imlay	
Kossmatia kingi Imlay	GM
K. sp. cf. *alamitoensis* (Aguilera & Castillo)	G
K. rancheriaensis Imlay	G
Zone of *Waagenia* spp. (Kimmeridgian, Middle)	
Waagenia sp. cf. *knopi* (Neumayr)	G
Waagenia sp. cf. *beckeri* (Neumayr)	G
Waagenia sp. cf. *harpephora* (Neumayr)	G

Key to symbols for localities:

A—Southeastern Arizona.
B—Bexar Shale, South Texas subsurface.
V—Sierra de la Ventana, northeastern Chihuahua.
G—Placer de Guadalupe and vicinity, Chihauhua.
M—Malone Mountains, Texas.
P—Sierra del Presidio, northeastern Chihuahua.
Q—Quitman Mountains (southern) and vicinity, Texas.
S—Vicinity of Samalayuca, northern Chihuahua.
T—Central Texas.

distans (Cragin) is spotty, however, being replaced by rudistid facies in most areas. Rudistid facies occupy the interval between the zones of P. equidistans and Plesioturrilites brazoensis (Romer), and in some areas even replace the *P*. brazoensis zone. An exception to this statement is an area generally north of the rudistid facies of this age, from which Bose (1910) described the Cerro de Muleros fauna.

The boundary between the Upper and Lower Cretaceous (Albian-Cenomanian) is at the base of the P. brazoensis zone and is gradational throughout the area.

The Del Rio Claystone and Buda Limestone zones are Lower Cenomanian and include the zone of Graysonites lozoi Young in the Del Rio and the zone of Budaiceras *hyatti (Shattuck)* in the Buda Limestone.

The post-lower Cenomanian zones are restricted to that part of Chihuahua along the Rio Bravo next to Texas, except for a bed of Spathites in the Ojinaga Shale in the Sobaco syncline west of Cuchillo Parado (Powell, I. Dan, personal communication). The presumably Upper Cretaceous shales some 20 miles by road toward Ciudad Chihuahua from Placer de Guadalupe have not yet yielded fossils (Diaz, 1956, p. 34). Eventually some of the zones of the Ojinaga Formation may be found in the synclines of northern Chihuahua.

SUMMARY

In summary, I would like to point out that the above zonation is, as yet, highly incomplete. Detailed sections need to be measured, and many, many more fossils need to be collected before the zonal scheme can become entirely satisfactory. In addition, there is a great opportunity to collect rudists from the more massive limestone formations between the ammonite zones. Rudistid zones can then be intercalated with the ammonite zones so that a rudistid-ammonite zonation may be compiled that will be satisfac-

TABLE 2.
POST-FINLAY AMMONITE ZONES OF NORTHERN CHIHUAHUA.

OJINAGA & SAN CARLOS FORMATIONS
- Zone of *Delawarella delawarensis* (Morton) (Lower Campanian)
  - *Delawarella delawarensis* (Morton)
  - *Pseudoschloenbachia mexicana* (Renz)
  - *Submortoniceras vanuxemi* (Morton)
  - *Submortoniceras sancarlosense* Young
  - *Submortoniceras candelariae* Young
  - *Menabites belli* Young
  - *Placenticeras syrtale* (Morton)

OJINAGA FORMATION
- Zone of *Submortoniceras tequesquitense* Young (Lower Campanian)
  - *Submortoniceras tequesquitense* Young
  - *Submortoniceras candelariae* Young
  - *Placenticeras syrtale syrtale* (Morton)
  - *Placenticeras syrtale* (Morton) *adkinsi* Wolleben
  - *Texanites shiloensis* Young
  - *Texanites lonsdalei* Young
  - *Texanites* sp. aff. *omeraensis* Reeside
  - *Bevahites bevahensis* Collignon
  - *Bevahites costatus* Collignon *coahuilaensis* Young
  - *Pseudoschloenbachia chispaensis* Adkins
  - *Glyptoxoceras ellisoni* Young
- Zone of *Texanites stangeri densicostus* (Spath) (Lower Santonian)
  - *Texanites* sp. aff. *stangeri* (Spath) *densicostus* (Spath)
- Zone of *Prionocycloceras gabrielense* Young (Upper Coniacian)
  - *Prionocycloceras adkinsae* Young
  - *Placenticeras colquitti* Wolleben
- Zone of *Collignoniceras chispaense* (Adkins) (Upper Turonian)
  - *Collignoniceras chispaense* (Adkins)
  - *Mammites depressus* Powell
  - *Neoptychites xetriformis* Pervinquiere
  - *N. gorguechoni* Pervinquiere
  - *Romaniceras* sp.
  - *Coilopoceras* sp.
  - *Spathites rioensis* Powell
- Zone of *Mammites nodosoides* (Schlotheim) (Lower Turonian)
  - *Mammites nodosoides* (Schlotheim)
  - *Acanthoceras calvertense* Powell
  - *Acanthoceras* sp. aff. *hippocastanum* (J. Sowerby)
  - *Pseudaspidoceras flexuosum* Powell
  - *Vascoceras* sp.
  - *Fagesia harmanni* (Böse)
  - *Pachyvascoceras globosum* Reyment
  - *Pachyvascoceras compressum* (Barber)
  - *Allocrioceras* sp.
  - *Quitmaniceras reaseri* Powell
  - *Quitmaniceras brandi* Powell
- Zone of *Euhystrichoceras adkinsi Powell* (Lower Cenomanian)
  - *Euhystrichoceras adkinsi* Powell
  - *Desmoceras (Pseudouhligella) elgini* Young
  - *Pseudacompsoceras bifurcatum* Powell

DEL RIO CLAYSTONE
- Zone of *Graysonites lozoi* Young (Lower Cenomanian)
  - *Graysonites* spp.
  - *Prionocycloides* sp.
  - *Ficheuria* sp.
  - *Worthoceras* sp.

ESPY FORMATION
- Zone of *Plesioturrilites brazoensis* (Romer) (Lower Cenomanian)
  - *Plesioturrilites brazoensis* (Romer)

BENEVIDES FORMATION
- Zone of *Pervinquieria equidistans* (Cragin) (Upper Albian)
  - *Pervinquieria equidistans* (Cragin)
    [= *Pervinquieria kiliani* (Lasswitz)]
- Zone of *Boeseites romeri* (Haas) (Upper Albian)
  - *Boeseites romeri* (Haas)
  - *Boeseites* sp. aff. *armatum* (Haas)
  - *Hysteroceras* sp.
  - *Prohysteroceras* sp. cf. *angolanum* (Haas)
- Zone of *Adkinsites bravoensis* (Böse) (Upper Albian)
  - *Adkinsites bravoensis* (Böse)
  - *Adkinsites imlayi* Young
  - *Manuaniceras elaboratum* Young, s. l.

BUDA LIMESTONE
- Zone of *Budaiceras hyatti* (Shattuck) (Lower Cenomanian)
  - *Budaiceras hyatti* (Shattuck)
  - *Budaiceras franciscoense* (Kellum and Mintze)
  - *Faraudiella* n. sp.
  - *Sharpeiceras* sp. cf. *tlahualilloense* (Kellum and Mintze)

FINLAY LIMESTONE (usually in interbeds between reefs or north of reefs).
- Zone of *Manuaniceras powelli* Young (basal Upper Albian)
- *Oxytropidoceras stenzeli* Young
  - *Venezoliceras acutocarinatum* (Shumard)

tory for the entire northern Chihuahua area and adjacent Trans-Pecos Texas. The zonation presented here is the most reasonable for the present data, but can easily be altered with future data and more time.

REFERENCES

Bose, Emil, 1910, Monografia geolOgica y paleontológia del Cerro de Muleros circa de cuidad Juarez, Estado de Chihuahua y descripcion de la fauna Cretácea de la Encantada, Placer de Guadalupe, Estado de Chihuahua, Mexico: Inst. Geol. Mexico Bol., no. 25, vi + 193 pp., 48 pls., + maps and cross-sections.

Bridges, L. W., 1962, Geology of Mina Plumosas Area, Chihuahua, Mexico: Univ. of Texas, dissertation, 241 pp., + appendix, 34 figs., 3 pls., 11 tbls.

, 1965, Geologia del Area de Plomosas, Chihuahua: pp. 1-134, figs. 1-21, maps 1-3, tbls. 1-11, in BRIDGES, L. W., & ZOLTAN DE CSERNA, Estudios Geológicos en el Estado de Chihuahua: Inst. Geol. Mexico Bol., no. 74, 148 pp., il. [translated by Diego A. Cordoba].

Burckhardt, Carlos, 1930, etude synthetique sur le Mesozoique Mexicain: Soc. PaMont. Suisse, Mem., v. 49 & 50, 280 pp., il.

Campbell, D. H., 1968, Petrology of the Early Cretaceous Yucca Formation, Southern Quitman Mountains and Vicinity, Trans-Pecos Texas: Texas A&M Univ., dissertation, xvi 323 pp., 16 figs., 11 pls.

Casey, Raymond, 1961, The Stratigraphical Paleontology of the Lower Greensand: Paleontology, v. 3, pp. 487-621, 14 text figs., pls. 77-84.

Diaz, Teodoro, 1956, Ruta: Cuidad Juarez, Chihuahua, Chih.: pp. 23-32, 4 figs., in DIAZ, TEODORO, ET AL., Estratigrafia Mesozoica y Tectónica de la Sierra de Chihuahua: Pérmico de Placer de Guadalupe, Chih.: Geohidrologia de la Region Lagunera: Estratigrafia Mesozoica y Tectónica de la Sierra Madre Oriental entre Mapimi, Dgo. y Monterrey, N. L.: Congreso Geol. Internacional, Excursion A-13, 120 pp., il.

Gillerman, Elliot, 1958, Geology of the Central Peloncillo Mountains, Hidalgo County, New Mexico, and Cochise County, Arizona: New Mexico Bur. of Mines and Mineral Resources, Bull. 57, 152 pp., 1 fig., 14 pls., 2 tbls.

Haenggi, Walter T., 1966, Geology of El Cuervo Area, Northeastern Chihuahua, Mexico: University of Texas dissertation, 401 pp., 37 figs., 7 pls., 22 tbls.

Hyatt, Alpheus, 1903, Pseudoceratites of the Cretaceous: U.S. Geol. Survey, Monograph 44, 351 pp., 47 pls. (ed. by T. W. Stanton).

Imlay, Ralph W., 1938, Ammonites of the Taraises Formation of Northern Mexico: Geol. Soc. Am., Bull. v. 49, pp. 539-602, 4 figs., 15 pls.

, 1940, Neocomian Faunas of Northern Mexico: Geol. Soc. Am. Bull., v. 51, pp. 117-190, 7 figs., 21 pls.

, 1943, Upper Jurassic Ammonites from the Placer de Guadalupe District, Chihuahua, Mexico: Jour. Paleo., vol. 17, pp. 527-654, 1 text fig., pls. 87-95.

Jones, B. R., 1968, Geology of the Southern Quitman Mountains and vicinity, Hudspeth County, Texas: Texas A&M Univ., dissertation, 162 pp., il.

Powell, J. Dan, 1963a, Cenomanian-Turonian (Cretaceous) Ammonites from Trans-Pecos Texas and northeastern Chihuahua, Mexico: Jour. Paleontology, v. 37, pp. 309-322, 3 figs., pls. 31-34.

, 1963b, Turonian (Cretaceous) Ammonites from northeastern Chihuahua, Mexico: Jour. Paleontology, v. 37, pp. 1217-1232, 6 text-figs., pls., 166-171.

Ramirez, M. Jaime C., and Francisco Acevedo C., 1957, Notas Sobre la Geologia de Chihuahua: Assoc. Mexicana de Geológos Petroleros, v. 9, pp. 583-770, 61 figs., 7 tbls., 6 strat. columns.

Scott, Gayle, 1940, Cephalopods from the Cretaceous Trinity Group of the south-central United States: The Univ. of Texas Publ. 3945, pp. 969-1125, figs. 138-179, pls. 55-68.

Stoyanow, Alexander, 1949, Lower Cretaceous Stratigraphy in southeastern Arizona: Geol. Soc. Am. Memoir 38, 169 pp., 27 pls., 7 tbls.

Wolleben, J. A., 1967, Senonian (Cretaceous) Mollusca from Trans-Pecos Texas and northeastern Chihuahua, Mexico: Jour. Paleontology, v.41, pp. 1150-1165, 8 text figs., pls. 147-152.

Young, Keith, 1966a, Relict Lyellicerid Fauna of Texas and Northern Mexico: Program, Am. Assoc. Petro. Geol., 51st Ann Meeting, p. 116.

, 1966b, Texas Mojsisovicziinae (Ammonoidea) and the zonation of the Fredericksburg: Geol. Soc. Am. Memoir 100, viii + 225 pp., 21 figs., 38 pls., 5 tbls.

, 1968, Upper Albian (Cretaceous, *M.* romeri zone) ammonites in Texas and Mexico: Jour. Paleontology, v. 42, pp. 70-80, 1 text fig., pls., 15-19.

, 1969, Comanchean Barrier Reefs and Endemism of Comanchean Faunas: Carribean Geol. Assoc., 21 pp., 4 figs., 2 tbls. [in press].