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HANDBOOK OF TEXAS CRETACEOUS FOSSILS

By

W. S. ADKINS

Bureau of Economic Geology

J. A. Udden, Director E. H. Sellards, Associate Director

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The benefits of education and of useful knowledge, generally diffused through a community, are essential to the preservation of a free government.

Sam Houston

Cultivated mind is the guardian genius of democracy. . . . It is the only dictator that freemen acknowledge and the only security that freemen desire.

Mirabeau B. Lamar

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Illustrations

This paper on Texas Cretaceous Fossils is one of a series issued to make more readily usable general information on Texas geology and paleontology. The next of the series to be published will be a Handbook of Texas Stratigraphy.

E. H. SELLARDS,
Associate Director.

HANDBOOK OF TEXAS CRETACEOUS FOSSILS*

BY W. S. ADKINS

INTRODUCTION

This handbook aims to supplement the valuable check-list of Dr. R. T. Hill, which is now out of print and practically unobtainable, and to bring up to date the determinations of genera and species, in so far as this is possible with the facilities at the disposal of the writer. In certain groups it is hopeless at the present time to make authoritative generic assignments, and it is expected that many of the determinations here given will be changed. Some of these provisional determinations were made by inspection of the literature, without access to actual specimens, and some are made from casts. Since only a small part of the Texas Cretaceous fossils has yet been described, further research will add many species to those here listed. All the groups are in need of serious and critical revision, and in some groups, among which are corals, sponges, gastropods, rudistids and crustacea, scarcely a beginning has been made. The list therefore makes no pretense to either completeness or finality and it does not aim at a monographic treatment of the fossils. It includes most of the published records of specifically determined fossils and some new species which seem to have particular stratigraphic interest. Some of the species here listed may later prove to be synonyms of others. The keys are artificial: they apply only to the usual forms, especially to the type material of the describers, and do not cover unusual variants or species not included in this handbook. The stratigraphic ranges here given are not intended to be final: a species may range beyond these limits,

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*Published December, 1928.

a fact which can be determined only by experience. The dimensions and proportions given are only approximate for the species, and generally refer to the type material. In spite of these serious deficiencies, it is hoped that such a preliminary list will be of use to many persons by summarizing conveniently in one publication the main components of the Texas Cretaceous faunas, and by helping to indicate what still remains to be done.

In species titles, bold face type refers to recognized species known from Texas; *italics* to synonyms or to invalid species; and ROMAN CAPITALS to species described from nearby localities outside of Texas but which will likely be found in the Texan formations, or to foreign species cited from Texas.

In citations, bold-face numbers refer to consecutively numbered titles in the main bibliography; italicised generic or specific names in parenthesis refer to the identification made by the author cited.

When not otherwise indicated the description of genera and species is abstracted or summarized from the authors cited.

SUMMARY OF FORMATION NOMENCLATURE

The accompanying chart will serve roughly to locate in the stratigraphic column the formations mentioned in this handbook. The correlations with European étages are taken with some modifications from BÖSE AND CAVINS, 1928, *10*, and the other features are from HILL, STEPHENSON and others; the writer assumes no responsibility for the correctness of the correlations.

Étages	Culberson-Hudspeth Cos.	Big Bend	Eagle Pass	Austin	Fort Worth-Dallas-Paris	Arkansas	
MAESTRICHTIAN CAMPANIAN	Vieja	Chisos Tornillo Rattlesnake	Escondido Coal series	*Webberville*	Navarro *(Nacatoch)*	Marlbrook Annona	Upper Cretaceous
SANTONIAN	San Carlos	Terlingua Beds	San Miguel Anacacho Upson	Taylor	Taylor *(Pecan Gap, Wolfe City, Annona)*	Ozan	
CONIACIAN	Austin		Austin *(Pinto)*	Austin chalk	Austin chalk (and Blossom)	Brownstown	
TURONIAN	Boquillas flags	Boquillas flags	Eagle Ford flags	Upper Eagle Ford	Upper Eagle Ford	Tokio	
CENOMANIAN				Lower Eagle Ford *unnamed shale*	Lower Eagle Ford Woodbine	Woodbine	
	Buda Del Rio Upper Kgt	Buda Del Rio Upper Kgt	Buda Del Rio Upper Kgt	Buda Del Rio	Grayson Main Street		Washita
UPPER ALBIAN	Georgetown	Georgetown	Georgetown	Georgetown	Pawpaw Weno Denton Fort Worth Duck Creek	WASHITA beds	
MIDDLE ALBIAN	(formations not named)	Edwards *undifferen- tiated beds*	Edwards Comanche Peak Walnut?	Edwards Comanche Peak "Walnut"	Kiamichi "Goodland" Walnut	Kiamichi "Goodland"	Freder- icksburg
LOWER ALBIAN? APTIAN	Finlay Cox Etholen *(=Campagrande)*	Shafter Presidio	Glen Rose Travis Peak	Glen Rose Travis Peak	Paluxy Glen Rose Basal sand	Trinity beds	Trinity
HAUTERIVIAN- VALANGINIAN	Malone *(part)*	*missing*	*missing*	*missing*	*missing*	*missing*	

ZONE MARKERS AND CORRELATION

A. BASAL (MALONE) CRETACEOUS

Kitchin has summarized reasons for considering a part of the Malone[1] "formation" as Neocomian (Pre-Trinity) in age, probably mostly Valanginian. He states that:

> The strata comprised in Cragin's so-called Malone Jurassic formation belong to several, in part widely separated, horizons. There is no evidence of the presence of Jurassic beds of earlier age than Kimmeridge. Two or more Jurassic horizons are represented, and there may probably be breaks in the series. Overlying these strata, and with a relation to the lower series not yet made known, are Lower Cretaceous beds which may be regarded as of Valanginian age. These contain a bivalve fauna related to that of the southern *Trigonia* seas, in which were laid down the Lower Cretaceous deposits of sublittoral character found in the Andean region and in Patagonia; in Cape Colony, Madagascar, Tanganyika Territory and Cutch; and in the now isolated region of New Caledonia.

Zone fossils: *Astieria* sp. Baker, Univ. Texas Bull. 2745, pp. 12, 15 (footnote). Found in the sandstone near the top of the ridge south of the Gypsum Spur. Indicated age: Valanginian-Hauterivian.

Trigonia (group Pseudo-quadratae). *T. vyschetzkii* Cragin. The group is exclusively Lower Cretaceous.

Trigonia (group Costatae). This group extends up into the Cretaceous.

Ptychomya. The genus is nowhere known below the Cretaceous.

The full zonation of the basalmost Cretaceous beds in Texas is still unknown. Further ammonite collections from near Torcer should, if they are properly made, throw light on the Cretaceous zonation by enabling a comparison with Mazapil and other northern Mexican localities.

B. TRINITY DIVISION

In southern Hudspeth and Culberson counties, the Trinity division consists of three formations, in ascending order

[1]Some of the principal ammonites in the Jurassic portion of the Malone are:
Idoceras potosinus (Castillo and Aguilera)
Idoceras felixi (Castillo and Aguilera)
Idoceras schucherti (Cragin)
Kossmatia clarki (Cragin)
Kossmatia aguilerae (Cragin)
Kossmatia burckhardti (?)

(a) Etholen (=Campagrande) conglomerate, up to 250 feet thick; (b) Cox sandstone, up to 1,500 feet thick; (c) Finlay limestone, up to 1,500 feet thick. In Central Texas the Trinity division consists of (a) Travis Peak sands and conglomerates, up to 260 feet; (b) Glen Rose sands and limestones, up to 2,200 feet; (c) Paluxy, mainly sands, up to 100 feet in thickness. The correlations between these various formations have not been entirely worked out. However, the Travis Peak and basal Glen Rose formations near Austin contain ammonites which have been taken to indicate an upper Aptian level, probably near the Gargasian horizon. These are mainly *Dufrenoya,* probably also *Parahoplites* and *Douvilleiceras.* The succeeding Fredericksburg division is Middle Albian, and probably the entire Trinity division is to be considered as Upper Aptian and perhaps partly Lower Albian; but this cannot be decided at present because the Clansayes horizon and other important zones have not yet been located in Texas.

Zone fossils:

Dufrenoya texana and spp. These are known from western Travis County, and have been found at various Mexican localities by Burckhardt.

Parahoplites spp. This genus marks both upper Aptian and basal Albian. The affinities of the Texan species have not yet been clearly demonstrated. The zonation of the Trinity division in Texas is a problem for further research.

The following lists include most of the fossils reported from the formations of the Trinity division:

Travis Peak Formation

Dufrenoya justinae (Hill)
?———— roemeri (Cragin) (Hoplites)
Engonoceras roemeri Cragin
Porocystis globularis (Giebel) (=*pruniformis* Cragin)
Orbitulina texana (Roemer)
Ostrea alternans Cragin
———— camelina Cragin
———— crenulimargo Roemer
———— crenulimargo var stonewallensis Cragin
————franklini Hill (**Iredell)
Exogyra hilli Cragin

———— paupercula Cragin
———— weatherfordensis Cragin (Weatherford)
Cucullaea gracilis Cragin
———— gratioli Hill
———— terminalis Conrad
Cyprina roemeri Cragin
Homomya jurafacies Cragin
———— solida Cragin
Protocardia pendens Cragin
———— stonei Cragin
Trigonia concentrica Cragin
Pholadomya spp.
Buccinatrix regina Cragin
Nerinea hicoriensis Cragin
Rostellites pupoides Cragin
Lunatia (?) sp.

Glen Rose Formation

Trochotiara texana (Roemer) (Diadema)
Heteraster obliquatus (Clark) (Enallaster) (type: Austin)
Hemiaster (Mecaster) comanchei Clark (Santa Monica Springs)
Porocystis globularis (Giebel)
Orbitulina texana (Roemer)
Monopleura sp.
Homomya
Isocardia
Alectryonia aff. carinata (Lamarck)
Kingena
Nautilus aff. texanus Shumard
"Nodosaria" texana Conrad
Ammonites
Exogyra texana Roemer

Trinity Division

Hypodiadema elegans Clark (Murfreesboro, Ark.)
Epiaster electus Cragin
Exogyra quitmanensis Cragin (Quitman Mountains)
Avicula singleyi Cragin (Santa Monica Springs)

C. FREDERICKSBURG DIVISION

In Central Texas the formations of the Fredericksburg division are, in ascending order: (a) Walnut clay and shell marls; (b) Comanche Peak limestone and limy clay; (c)

Edwards limestone; and in addition, on paleontological grounds the thin overlying Kiamichi clay should be included in the Fredericksburg division. In the Red River region, the marginal (sand) facies has invaded the Fredericksburg to various, mainly high, levels; it is overlain by a thin clay (generally called "Walnut"); this is overlain by a thin limestone (called "Goodland") which represents a high Fredericksburg level; and the Kiamichi shell agglomerate is thick (reaching 150 feet). This northern Texas section has not been correlated with the section in Central Texas.

In the Rio Grande embayment and in southern Trans-Pecos Texas, the thick Fredericksburg has not been zoned; it consists mainly of pure, fossiliferous limestones of the rudistid-reef facies. In this limestone mass, probably zones corresponding to the Edwards and Comanche Peak formations can be differentiated.

Zone fossils: Zones of general validity can probably be established on rudistids, on *Oxytropidoceras*, *Engonoceras* and allied genera, and on a few other fossils; such zonation awaits further research.

Oxytropidoceras. This genus ranges from type Walnut up to the Kiamichi; its culmination may be taken as the top of the Fredericksburg division. *O. belknapi* and allied species are apparently restricted to top Fredericksburg; *O. chihuahuense* and allied species apparently occupy the middle of the division; some other species have definite ranges. Highest record for the genus at *Folkestone*, zone VIII.

Engonoceras and allies. Some will likely prove to be zone fossils.

Chondrodonta musoni. Apparently Upper Fredericksburg.

Toucasia spp. Some species may be zone markers.

Requienia; Monopleura. Not yet sufficiently investigated.

Eoradiolites davidsoni; Sauvagesia texana. Upper Fredericksburg.

Dipoloceras sp. aff. *cristatum.* Uppermost Fredericksburg (=uppermost "Goodland" of the Fort Worth region). Zone VIII at Folkestone.

Dipoloceras sp. aff. *cornutum.* Distinctly lower than the preceding in both Texas and England: Basal Comanche Peak (basal Goodland) near Fort Worth; zones V–VII at Folkestone.

Inoceramus concentricus. Comanche Peak and Edwards. It ranges from zone V to zone VIII at Folkestone. In the upper *Oxytropidoceras* levels in the Sierra de Tamaulipas.

Inoceramus subsulcatiformis (= aff. *sulcatus*). In Texas as in England, it is in general higher than the preceding species: uppermost Edwards at Valley Mills, zone VIII at Folkestone.

Some zonations of local validity have been established: at Austin, at Fort Worth, at Cerro de Muleros. These break down upon application to extended areas, although locally they are useful and perfectly valid.

Kiamichi markers. *Oxytropidoceras*. Highest range of genus; forms like *O. belknapi*, widespread in the northern facies in Texas (not in reef limestones except in marly-sandy interbeds). Several other species.

Elobiceras. Several species; ranges into basalmost Duck Creek; northern facies.

Gryphea navia. Widespread Kiamichi marker.

Gryphea tucumcari. Provincial Trans-Pecos Kiamichi marker; ranges into basal Duck Creek.

The following lists contain most of the fossils which have been identified from formations of the Fredericksburg division in Texas.

Fredericksburg Division

Salenia texana Credner
Tetragramma taffi (Cragin)
Holectypus planatus Roemer
Pyrina parryi Hall
Heteraster texanus (Roemer)
Epiaster whitei (Clark)

Engonoceras pierdenale (v. Buch)

Ostrea crenulimargo Roemer
Exogyra texana Roemer
Pecten duplicosta Roemer
Pecten occidentalis Conrad (="quadricostatus var." Roemer)
Cyprimeria crassa Meek (Cragin)
——— texana Roemer
Cyprina mediale Conrad (Cragin)
Modiola stonewallensis Cragin
——— pedernalis Roemer
——— concentrice-costellata Roemer
Opis texana Cragin
Solen irradians Roemer
Homomya alta Roemer
Pholadomya pedernalis Roemer
——— sancti-sabae Roemer

Protocardia texana (Conrad) ("hillanum")
Cardium spp. 55, 57, 58 Roemer
Isocardia spp. 59, 60 Roemer
Cypricardia texana Roemer
Venus ? sp. Roemer
Corbis sp. 49 Roemer
Trigonia crenulata Lamarck (Roemer) (=? emoryi Conrad)
Cucullaea sp. 66 Roemer
Arca sp. 68 Roemer
Mytilus tenuitesta Roemer
Pinna sp. 76 Roemer
Avicula pedernalis Roemer
——— convexo-plana Roemer
Pinna comancheana Cragin

Rostellaria sp. Roemer
Fusus pedernalis Roemer
Turritella seriatim-granulata Roemer
Nerinea texana Roemer
——— sp. Roemer
Actaeonella dolium Roemer
Natica pedernalis Roemer
——— sp. Roemer

Walnut Formation

Heteraster texanus (Roemer) (Toxaster)
Holectypus cfr. planatus Roemer
Salenia cfr. mexicana Schlüter

Oxytropidoceras acutocarinatum (Shumard)
Exogyra texana Roemer
——— weatherfordensis Cragin
Gryphea marcoui Hill and Vaughan
Pecten irregularis Böse
Remondia sp.
Trigonia cfr. emoryi Conrad

Comanche Peak Formation

Trochotiara texana (Roemer) (Diadema)
Tetragramma texanum (Roemer) (Cyphosoma)
——— taffi (Cragin) (Diplopodia)
Dumblea symmetrica Cragin
Holectypus planatus Roemer
Pyrina bulloides Cragin

Epiaster elegans var. praenuntius Cragin (=? boesei Lambert; type: Benbrook)
"Epiaster" whitei Clark (Hemiaster) (type: Benbrook, Rhome)

Anatina texana Cragin
Cyprimeria texana (Roemer) (Arcopagia)
Modiola jurafacies Cragin
Trigonia securiformis Cragin

Cerithium bosquense Shumard

Inoceramus aff. concentricus
Inoceramus (Actinoceramus) aff. sulcatus
Oxytropidoceras spp.
Diploceras spp.

Edwards Formation

Salenia sp.
Goniopygus zitteli Clark
Holectypus planatus Roemer
Heteraster texanus (Roemer)

?Biflustrea browni Cragin

Engonoceras emarginatus Cragin
Engonoceras piedernale (v. Buch)

Gryphea marcoui Hill and Vaughan
Chondrodonta munsoni (Hill)

Pecten (Neithea) texana Roemer
———— subalpinus Böse
———— occidentalis Conrad
Pecten duplicicosta Roemer
Lima wacoensis Roemer
———— n. sp.
Cyprimeria texana (Roemer) (Arcopagia)
Protocardia texana (Conrad) (Cardium)
Pleuromya ? n. sp.
Caprina crassifibra Roemer
———— occidentalis Conrad
———— n. sp.
Caprinula anguis (Roemer) (Ichthyosarcolites)
Caprotina n. sp.

Plagioptychus ? cordatus Roemer
Eoradiolites davidsoni (Hill) (Radiolites)
Radiolites n. sp.
Requienia texana Roemer
——— n. sp.
Toucasia patagiata C. A. White (Requienia) (aff. santaderensis H. Douvillé)
Monopleura texana
——— marcida C. A. White
——— n. sp.
——— pinguiscula C. A. White

Apporhais sp.
Cerithium bosquense Shumard
——— proctori Cragin
Cylindrites formosus Cragin
Nerinea pellucida Cragin
——— 2 spp. Roemer
——— n. sp.
Neritina apparata Cragin
Trochus texanus Roemer
Tylostoma tumidum Shumard

Parasmilia austinensis Roemer
Cladophyllia furcifera Roemer

Kingena sp.

Orbitulina sp.

Kiamichi Formation

Elobiceras serratescens (Cragin)
Elobiceras sp. aff. angustum Spath
Elobiceras sp. aff. arietiforme Spath
Elobiceras sp. aff. flexuicostatum Spath
Pervinquieria spp.
Oxytropidoceras acutocarinatum (Shumard)
Oxytropidoceras belknapi (Marcou)
Oxytropidoceras cfr. trinitense (Gabb)
Hamites comanchensis Adkins and Winton
Hamites fremonti Marcou

Alectryonia aff. quadriplicata (Shumard)
Alectryonia sp.

Avicula leveretti Cragin
Cyprimeria cfr. texana Roemer
Exogyra plexa Cragin
Exogyra sp. aff. plexa Cragin
Exogyra texana Roemer
Gryphea corrugata Gabb
Gryphea navia Hall
Gryphea tucumcari Marcou
Homomya sp.
Inoceramus sp.
Isocardia sp.
Ostrea sp.
Pecten irregularis Böse
Pecten subalpinus Böse
Pinna comancheana Cragin
Protocardia sp.
Trigonia emoryi Conrad
Heteraster aff. mexicanus (Cotteau)
Heteraster cfr. texanus (Roemer)
Heteraster adkinsi Lambert
Heteraster spp.
Holectypus spp.
Salenia sp.
Kingena wacoensis (Roemer)

D. WASHITA DIVISION

This division in Texas is mostly characterized by alternate limestone and marl (clay) beds, which have been called either members or formations. The basal marginal facies (sands, mainly) touches but does not invade the succession near the northern borders of Texas, near Denison, near Kent, and in Hudspeth County; there are local infingerings of sand at the Weno and Pawpaw levels. There are good zone fossils throughout the division, and its intra-state correlation is well established. In South-Central Texas and in southern Trans-Pecos Texas, the following formations exist, in ascending order: (a) Georgetown limestone; (b) Del Rio clay; (c) Buda limestone. In North-Central Texas and in northern Trans-Pecos Texas the Buda is thin or absent, the Del Rio is relatively unchanged (locally thinned); the Georgetown is thicker and shows a more obvious alternation of limy and marly members, as follows, in ascending order: Duck Creek limestone, Duck Creek marl, Fort Worth limestone, Denton clay, Weno limestone (and marl), Pawpaw clay (sand near Red River), Main Street limestone. The Grayson clay is nearly equivalent to the Del Rio clay of South Texas. The marl, clay and sand members thin to the south, some beds, as the Pawpaw, may even be unrepresented there, and the limestone members form a thinned formation with the zonation condensed (Georgetown limestone).

Zone fossils: Hamites (comanchensis, fremonti, spp.). Widespread and of general validity: throughout Central and West Texas, northern Mexico, Sierra de Tamaulipas, and numerous other localities.

"Desmoceras" (brazoense, laevicaniculatum, spp.). Widespread and valid, like the preceding zone.

Pervinquieria spp. aff. *trinodosa.* There are two or more Duck Creek species, not identical with Böse's very characteristic species of a higher level, which are widespread markers.

Pervinquieria kiliani. Duck Creek; possibly Fort Worth level (zone IX, Folkestone).

Prohysteroceras austinense. Duck Creek; possibly Fort Worth.

Macraster (aguilerae, nodopyga, elegans, texanus?). Fort Worth; upper Duck Creek (locally lower Duck Creek). These species are distinguishable from the sparser and higher (Weno) *Macraster* zone.

Pervinquieria trinodosa Böse. Middle Washita; apparently a West Texas provincial marker.

Pervinquieria maxima; P. leonensis. Fort Worth level; questionably upper Duck Creek. *Washitaster longisulcus,* a local Fort Worth marker.

Pervinquieria n. sp. Widespread Fort Worth-Denton-Weno marker.

Pervinquieria wintoni and allied species. Upper Washita, generally Weno.

Washitaster riovistae. Local Weno-Pawpaw marker.

Neokentroceras worthense. Widespread Pawpaw marker.

Flickia boesei; Stoliczkaia adkinsi. Local Pawpaw markers.

Submantelliceras. Species of this general group occur in two distinct levels: the Pawpaw contains *Subm. (?) worthense;* the Del Rio contains *Mant. brazoense, M. wacoense.* These are widespread markers.

Turrilites brazoensis. Main Street marker, widespread in Central Texas and northern Mexico, rare in Trans-Pecos Texas.

Turrilites bosquensis; Adkinsia (several species). Widespread Del Rio-Grayson markers.

Gryphea mucronata; Exogyra arietina. Widespread Grayson-Del Rio markers (occasional, basal Buda).

Hemiaster calvini. Widespread Grayson-Del Rio; rarer in Buda.

Exogyra cartledgei, Exogyra whitneyi. Del Rio; provincial Trans-Pecos Texas (very rare in Central Texas).

Budaiceras (several species). Widespread Buda marker.

Pecten roemeri. Widespread Buda marker.

Codiopsis texana and allies. Rare but important Buda marker.

Cottaldia sp. High Washita marker; rare.

Exogyra n. sp. Widespread Buda marker.

Several other less reliable fossils are used for identifying the Washita division. Some of these are:

Entire Washita: *Kingena; Pecten texanus; "Nautilus" texanus; Ostrea carinata.*

Upper Washita: *"Nodosaria" texana; Gryphea washitaensis; "Nautilus" hilli; Ptychomya ragsdalei; Spondylus hilli; Pecten georgetownensis; Ostrea quadriplicata; Ostrea marcoui.*

Lower Washita: *Holaster simplex; Gryphea corrugata.*

The following lists contain fossils identified from formations of the Washita division.

Washita Division

Cidaris sp. Cragin (Barton Creek, South Austin)
Holectypus transpecosensis Cragin (Sierra Blanca)
Cidaris texanus Clark (Bexar County)
Hemiaster (Proraster) dalli Clark (Bexar County)
Salenia texana Credner
Heterodiadema ornatum Clark (Fort Worth)
Tetragramma streeruwitzi Cragin (Kent, Sierra Blanca)
Orthopsis occidentalis Cragin (Sierra Blanca Mtn.)
Pyrina parryi Hall (Leon Springs)
Hemiaster (Leymeriaster) bexari Clark

Ostrea subovata Shumard

Denison Beds

Leptarbacia argutus Clark
Phymosoma volanum Cragin

Trigonia clavigera Cragin
Pholadomya postextenta Cragin
Tapes dentonensis Cragin

Duck Creek Formation

Hamites comanchensis A. & W.
Hamites fremonti Marcou
Hamites varians Scott
Hamites polyseptus Scott
Hamites tanïma A. & W.
Hamites nokonis A. & W.
Hamites spp.
Anisoceras sp.?
Desmoceras brazoense (Shumard)
Desmoceras laevicaniculatus (Roemer)
Desmoceras sp.
Pervinquieria leonensis (Conrad)
Pervinquieria shumardi (Marcou)
Pervinquieria ("Elobiceras") serratescens (Cragin)
Pervinquieria equidistans (Cragin) P. aff. trinodosa (Böse)
Pervinquieria austinensis (Roemer)
Pervinquieria kiliani (Lasswitz)
Pervinquieria minima (Lasswitz)
Pervinquieria burckhardti (Böse)
Pervinquieria whitei (Böse)
Pervinquieria n. spp. (c, p, st)
Pervinquieria n. sp. 1 (aff. stolizkai Spath)
Pervinquieria aguilerae Böse (at 1026)
Pervinquieria nodosa Böse
Worthoceras platydorsum (Scott)

Ostrea sp.
Alectryonia sp. 1
Alectryonia sp. 2
Gryphea corrugata H. & V.
Gryphea tucumcari Marcou
Pecten subalpinus Böse
Cyprimeria
Lima
Trigonia
Gervilliopsis sp.
Alectryonia aff. carinata (Lambert)
Epiaster whitei (Clark)
Pliotoxaster sp.
Heteraster sp.
Macraster sp.
Pedinopsis aff. symmetrica

Kingena wacoensis (Roemer)
Pyritic micromorphs[1a]

Fort Worth Formation

Macraster nodopyga Lambert
Macraster elegans (Shumard) (Epiaster) (type: Fort Washita)
Macraster aguilerae (Böse) (Epiaster) (type: El Paso)
Washitaster longisulcus Adkins and Winton
Epiaster whitei (Clark) (Hemiaster)
Holaster simplex Shumard
Leptarbacia argutus Clark
Pyrina parryi Hall (Cragin)
Salenia sp.
Ophioglypha texana Clark
Pervinquieria minima (Lasswitz)
——— austinensis (Roemer)
——— maxima (Lasswitz)
——— spp.
Cymatoceras texanum (Shumard)
Ostrea subovata Shumard
——— sp.
Exogyra americana Marcou
Gryphea washitaensis Hill
——— gibberosa Cragin
Alectryonia aff. carinata (Lamarck)
Pecten (Neithea) subalpinus (Böse)
——— texanus Roemer
?——— catherina Cragin
——— bellula Cragin
——— wrighti Shumard
Plicatula incongrua Conrad (subgurgitis Böse)
——— dentonensis Cragin
——— ?spp.
Lima wacoensis Roemer
——— spp.
——— (Ctenostreon) n. sp.
——— generosa Cragin
?Spondylus hilli Cragin
Pholadomya shattucki Böse (roemeri Shattuck)

[1a]Dwarfed faunules have been reported in Texas from the following formations: Kiamichi, Duck Creek marl, Denton, Pawpaw, Grayson-Del Rio, Eagle Ford, Terlingua beds; they occur at several places in northern Mexico in Upper Cretaceous formations, notably in the Cárdenas beds at Tula, Tamaulipas. A summary of the conditions of dwarfing is given in Shimer, Hervey W., 1908, Dwarf Faunas. Amer. Nat., XLII, no. 499, 472–490. For summary of literature, and references, see Grabau, Principles of Stratigraphy.

Remondia robbinsi Cragin
Trigonia sp.
Pinna sp.
Pachymya n. sp. aff. austinensis Shumard
Turritella marnochi White
———— seriatim-granulata Roemer
———— spp.
Pleurotomaria austinensis Shumard
———— macilenta Cragin
———— robusta Cragin
Cinulia aff. tarrantensis Cragin
?Nerinea sp.
?Neritina sp.
Trochosmilia sp.
Serpula sp.
Lamna sp.
Fucoids

Denton Formation

Cymatoceras texanum (Shumard)
Acanthoceras sp. aff. aumalense Coquand
Engonoceras spp.
Pervinquieria spp.
Alectryonia sp. aff. carinata Lamarck
Alectryonia quadriplicata (Shumard)
Gryphea washitaensis Hill
Plicatula dentonensis Cragin
Pecten subalpinus Böse
Pecten sp. aff. inconspicuus Cragin
Trigonia emoryi Conrad
Ophioglypha texana Clark
Goniophorus sp.
Leiocidaris hemigranosus (Shumard)?

Weno Formation

Cymatoceras texanum (Shumard)
Cymatoceras sp.
Ancyloceras bendirei Adkins
Engonoceras serpentinum (Cragin)
Engonoceras spp.
Pervinquieria wintoni (Adkins)
Pervinquieria spp.
Alectryonia sp. aff. carinata Lamarck
Alectryonia marcoui (Böse)

Alectryonia quadriplicata (Shumard)
Barbatia simondsi Whitney ?
Cardium sp. aff. congestum
Corbula basiniformis Adkins
Corbula littoralis Adkins
Corbula wenoensis Adkins
Cyprimeria washitaensis Adkins
Exogyra sp. aff. arietina Roemer
Gervilliopsis invaginata (White)
Homomya sp.
Leda sp.
Lima wacoensis Roemer
Nucula nokonis Adkins
Nucula wenoensis Adkins
Ostrea perversa Cragin
Ostrea subovata Shumard
Plicatula incongrua Conrad
Pecten inconspicuus Cragin
Pecten georgetownensis Kniker
Pecten subalpinus Böse
Pecten texanus Roemer
Protocardia aff. multistriata Conrad
Protocardia aff. texana (Conrad)
Protocardia vaughani Shattuck
Pholadomya shattucki Böse
Pachymya austinensis Shumard
Pachymya sp.
Remondia acuminata (Cragin)
Tapes spp.
Cardita wenoensis (Adkins)
Trigonia clavigera Cragin
Amberleya graysonensis Adkins
Anchura mudgeana White
Cinulia washitaensis Adkins
Cinulia sp. aff. pelletti Whitney
Cerithium sp.
Trochus laticonicus Adkins
Turritella graysonensis Adkins
Turritella worthensis Adkins
"Nodosaria" texana Conrad
Pentagonaster texensis Adkins and Winton
Ophioglypha texana Clark?
Starfish, indet.
Dumblea symmetrica Cragin
Hemiaster calvini Clark
Hemiaster sp. aff. bexari Clark

Heteraster bravoensis (Böse)
Heteraster sp. aff. texanus (Roemer)
Heteraster wenoensis (Adkins)
Holaster sp. aff. simplex Shumard
Holectypus charltoni Cragin
Holectypus limitis Böse
Leiocidaris hemigranosus (Shumard)?
Macraster subobesus (Adkins)
Macraster wenoensis (Adkins)
Macraster sp. (large)
Phymosoma sp.
Salenia sp.
Washitaster riovistae (Adkins)

Pawpaw Formation

Phymosoma volanum (Cragin)
Salenia volana Whitney
Peltastes n. sp.
Heteraster bravoensis (Böse)
Heteraster cf. texanus (Roemer)
Heteraster wenoensis (Adkins)
Macraster wenoensis (Adkins)
Macraster subobesus (Adkins)
Macraster n. sp.
Washitaster sp. aff. riovistae (Adkins)
"Metopaster" hortensae (Adkins)
"Comptonia" wintoni Adkins
"Pentaceros" americana Adkins
gen. indet. (Asteroidea)
Ophioglypha sp.
Arca washitaensis Adkins
Alectryonia aff. carinata, (Lamarck)
Alectryonia quadriplicata (Shumard)
Ostrea subovata Shumard (?)
Ostrea marcoui Böse
Gryphea washitaensis Hill
Leda (?) sp.
Lima wacoensis Roemer
Nucula spp.
Plicatula incongrua Conrad
Pecten subalpinus Böse
Remondia acuminata Cragin
Cardita wenoensis (Adkins)
Baculites comanchensis Adkins
Engonoceras serpentinum (Cragin)

Engonoceras n. spp.
Flickia boesei Adkins
Hamites tenawa Adkins and Winton
Hamites aff. armatus Sowerby
Kossmatella aff. marut Stoliczka
Neokentroceras worthense (Adkins)
Pervinquieria wintoni (Adkins)
Pervinquieria spp.
Stoliczkaia adkinsi Böse
Scaphites hilli Adkins and Winton
Scaphites spp.
Turrilites worthensis Adkins and Winton
Turrilites spp.
Submantelliceras worthense (Adkins)
Mantelliceras (?) spp.
Worthoceras worthense (Adkins)
Cymatoceras texanus (Shumard)
Cymatoceras spp.
Cinulia sp.
Nerinea sp.
Turbo (?) sp.
Turritella sp.
Helicocryptus mexicanus Böse
"Nodosaria" texana Conrad
Pleisiosaur, indet.

Main Street Formation

Pervinquieria sp.
Stoliczkaia n. sp.
Ostrea sp. aff. marcoui Böse
Ostrea carinata (?) Lamarck
Ostrea quadriplicata Shumard
Lopha sp.
Ostrea subovata Shumard
Exogyra arietina Roemer
Exogyra sp.
Gryphea sp.
Pecten texanus Roemer
Pecten subalpinus Böse
Pecten wrighti Shumard
Pecten roemeri Hill
Pecten spp.
Spondylus cragini Whitney
Lima wacoensis Roemer
Protocardia vaughani Shattuck

Pholadomya shattucki Böse
Ptychomya ragsdalei Cragin
Pachymya sp. aff. austinensis Shumard
Homomya sp.
Barbatia simondsi Whitney
Trigonia sp.
Schloenbachia sp. aff. inflata
Turrilites brazoensis Shumard
Turrilites sp.
Nautilus texanus Shumard
Nautilus hilli Shattuck
Kingena wacoensis (?) Roemer
Cyphosoma volanum Cragin
Holectypus limitis (?) Böse
Heteraster bravoensis Böse
Heteraster sp.
Hemiaster sp.
Leiocidaris sp. aff. hemigranosus Shumard

Del Rio Formation

Adkinsia bosquensis (Adkins)
——— adkinsi Böse
——— semiplicata Böse
——— sparsicosta Böse
——— tuberculata Böse
Baculites cfr. comanchensis Adkins
Engonoceras bravoense Böse
Engonoceras spp.
Engonoceras uddeni Cragin
Engonoceras retardum Hyatt
Stoliczkaia aff. dispar d'Orbigny
Stoliczkaia texana Cragin
Stoliczkaia uddeni Böse
Scaphites bosquensis Böse
Scaphites subevolutus Böse
Submantelliceras (?) brazoense Böse
Submantelliceras (?) wacoense Böse
Tetragonites brazoensis Böse
Turrilites bosquensis Adkins
Wintonia graysonensis Adkins
Hemiaster calvini Clark
Leiocidaris hemigranosus (Shumard)
Leptarbacia arguta Clark
Goniophorus sp.

Peltastes n. sp.
Phymosoma cfr. volanum (Cragin)
Cardita n. sp.
Exogyra n. sp.
Exogyra arietina Roemer
Exogyra cartledgei Böse
Exogyra whitneyi Böse
Gryphea mucronata Gabb
Inoceramus sp.
Lima wacoensis Roemer
Pecten subalpinus Böse
Pecten texanus Roemer
Plicatula sp.
Turritella sp.
"Nodosaria" texana Conrad

Buda Formation

Cymatoceras hilli (Shattuck)
Cymatoceras texanum (Shumard)
Budaiceras evae (Lasswitz)
Budaiceras frechi (Lasswitz)
Budaiceras frechi var. curvata (Lasswitz)
Budaiceras hyatti (Shattuck)
Budaiceras mexicanum Böse
Budaiceras roemeri (Lasswitz)
Budaiceras roemeri var. elegantior (Lasswitz)
Budaiceras roemeri var. harpax (Lasswitz)
Budaiceras texanum Shattuck
Turrilites sp. aff. brazoensis Roemer
Turrilites roemeri Whitney
Turrilites wysgorskii Lasswitz
Carthaganites sp. aff. kerimensis Perv.
Stoliczkaia texana Cragin
Stoliczkaia spp.
Anatina austinensis Shattuck
Anatina shattucki n. n.
Alectryonia sp. aff. carinata Lamarck
Cardium (Granocardium) budaense Shattuck
Exogyra n. sp. aff. texana Roemer
Exogyra clarki Shattuck
Exogyra whitneyi Böse
Gervilliopsis invaginata (White) ?
Gryphea mucronata Gabb
Homomya austinensis Shattuck
Homomya budaensis Whitney

Homomya vulgaris Shattuck
Inoceramus sp.
Isocardia medialis (Conrad)
Lima shumardi Shattuck
Lima wacoensis Roemer
Pachymya austinensis Shumard
——— var. budaensis Whitney
Pecten roemeri Hill
Pecten subalpinus Böse
Pecten texanus Roemer
Pecten spp.
Pinna sp.
Pholadomya shattucki Böse
Ptychomya ragsdalei Cragin
Protocardia texana (Conrad)
Protocardia vaughani Shattuck
Remondia robinsi White
Spondylus hilli Cragin
Trigonia emoryi Conrad
Leptophyllia spp. 1, 2 Vaughan
Orbicella (?) texana Vaughan
Parasmilia texana Vaughan
Trochosmilia (?) sp. Vaughan
Codiopsis texana Whitney
Cottaldia rotula Clark
Echinobrissus angustatus Clark
Hemiaster calvini Clark
Heteraster traski (Whitney)
Holaster completus Cragin
Holaster nanus Cragin
Holaster charltoni Cragin
Cerithium (?) texanum Shattuck
Cinulia pelletti Whitney
Cypraea sp. Shattuck
Fusus texanus Shattuck
Fusus sp. Shattuck
Harpagodes shumardi (Hill)
Nerinea volana Cragin
Patella sp. Shattuck
Pleurotomaria stantoni Shattuck
Trochus sp. Shattuck
Turritella budaensis Shattuck
Tylostoma harrisi Whitney
Tylostoma shumardi Whitney
Volutilithes austinensis Whitney

E. UPPER CRETACEOUS

A considerable unconformity at the beginning of the Upper Cretaceous in many parts of Texas has been assumed by various writers. Dumble records extensive ravining in the top of the Comanchean in West Texas. In McLennan County there is evidence for at least a disconformity, for at some places the basal black shale beneath the Eagle Ford flags rests directly on the Del Rio clay, although at other nearby places the Buda or even beds apparently Woodbine intervene. It is likely that other unconformities or disconformities exist. Above the Cenomanian (Acanthoceras) flags of the Eagle Ford, no Salmurian fossils have so far come to light in Texas; and Stephenson has published evidence (phosphate zones, field relations) indicating breaks at the Austin-Taylor contact.

In Central Texas, the Upper Cretaceous consists of the following formations, in ascending order: (a) Woodbine; (b) Eagle Ford; (c) Austin chalk; (d) Taylor clay (marl); (e) Navarro clay. In the Sabine-Arkansas-Louisiana areas, and in the Sabinas-Eagle Pass-Chisos Mountains districts, the Upper Cretaceous has been elaborately partitioned; in central Texas some members have been established; these subdivisions are indicated in the table.

Woodbine zone fossils: The fossils of Woodbine are almost all confined to this formation in Texas, and therefore are characteristic. They are mainly pelecypods, *Ostrea carica, O. soleniscus, Barbatia, Pteria;* leaves; fish remains; and a few ammonites.

Acanthoceras sp. (exact affinity uncertain). Upper Woodbine, Dallas County.

Scaphites sp. Hill (affinities unknown).

Most recent writers consider the Woodbine to be of Cenomanian age.

Eagle Ford zone fossils: The lower part of the Eagle Ford, including the "flag member" in Bell and McLennan counties, is of Upper Cenomanian age. A higher portion of the Eagle Ford, containing *Inoceramus* cfr. *labiatus* and some ammonites, as exposed in North-Central Texas and elsewhere, is of Turonian age. So far, the Salmurian (Lower Turonian) level has not been clearly demonstrated in Texas.

Cenomanian portion of the Eagle Ford: In the general region of Midlothian and Britton, Moreman has attributed about 300 feet of Eagle Ford to the portion below his first recorded occurrence of *Inoceramus labiatus* (in his *Metoicoceras whitei* zone); it is uncertain how much of this 300 feet is Cenomanian. The rest of his section containing *I. labiatus* and *Prionotropis ("Gauthiericeras")* sp. aff. *bravaisi* is Turonian. In McLennan and Bell counties, there is less than 50 feet of middle Eagle Ford flags, with a Cenomanian ammonite fauna. It has not been zoned, but contains the following ammonites:

Acanthoceras aff. turneri WHITE
Acanthoceras aff. discoidale STOLICZKA
Acanthoceras aff. meridionale var. africana PERV.
Acanthoceras aff. confusum GUÉRANGER
Acanthoceras aff. cunningtoni SHARPE
Acanthoceras aff. cornutum KOSSMAT
Acanthoceras spp.
"Mantelliceras" aff. rowei SPATH
Eucalycoceras aff. newboldi KOSSMAT
(or aff. gothicum Kossmat)
Turrilites aff. costatus SOWERBY
Turrilites aff. desnoyersi D'ORBIGNY
Turrilites aff. hugardianus D'ORBIGNY (?)
Turrilites aff. tuberculatus BOSQ.
Turrilites spp.

The fauna now being studied contains several other species. Below these flags is a small thickness of black shales whose fossils have not yet been sufficiently studied to warrant conclusions concerning its age. This shale at most places in these two counties rests directly on the Del Rio; at a few places it rests on Buda or else on strata believed to be Woodbine.

Turonian portion of Eagle Ford: This portion in Central Texas consists of 200 feet or more of shales with some limestone flags and ironstone; it contains *Inoceramus* aff. *labiatus, Prionotropis* sp., *Metoicoceras* spp., *Placenticeras pseudoplacenta, Baculites gracilis, Scaphites* aff. *aequalis* var. *turonensis, Scaphites vermiformis* (?), *Exiteloceras* *pariense, Prionotropis* aff. *woollgari, Metoicoceras gibbosum, Alectryonia lugubris.* Hill, and later Scott, supposed that in the thinned deposits over the Belton-Austin-Medina high area separating the Fort Worth geosyncline from the Rio Grande embayment, the basal members of the Eagle Ford are absent, and the thinned remnant represents the upper zones.

In Val Verde County and in northern Coahuila, there have been reported some localities in which the upper part of the Eagle Ford (Turonian in age according to Böse) is a chalky marl like the overlying Austin chalk.

Austin chalk zone fossils: Böse considers that the Austin chalk consists of two divisions according to age: basal division (Coniacian=Emscherian), with *Inoceramus undulatoplicatus;* and upper division (Santonian) marked especially by *Mortoniceras texanum,* but also at the top by *Exogyra* n. sp. aff. *ponderosa.* There are several species of *Mortoniceras* and of other ammonites in the Austin chalk, but their zonation has not yet been published for Texas.

Taylor zone fossils: The zonation of the Taylor has not been published. Böse considers the Taylor to be mainly Upper Santonian in age, and suggests that *Placenticeras syrtale* and *Gaudryceras kayei* are zone fossils. Stephenson has found *Exogyra ponderosa* to be of widespread value as a general marker for the Taylor and the upper Austin. Numerous other ammonites of the *Desmoceras* group, *Baculites, Scaphites*-like forms, and others are known from the Taylor. The Anacacho, a Taylor rudistid-reef, contains forms like *Radiolites,* and also unnamed ammonites.

Navarro zone fossils: No zonation has been published for the Navarro. Böse considers it to be Campanian in age. In the Sabinas-Eagle Pass district it contains non-marine or brackish beds (Coal series, San Miguel), and near Lampazos, Nuevo Leon, there are brackish beds (Tulillo facies). Stephenson has found *Exogyra costata* to be of widespread use as a general marker for the Navarro and its equivalents. Several ammonites are known from this formation, notably the series of turrilitic species which Hyatt described from Chatfield under the name of *Nostoceras.*

Escondido zone fossils: Böse considered these beds to be of Maestrichtian age, and established five zones in northern Mexico, as follows, in ascending order: (a) *Coahuilites sheltoni;* (b) *Sphenodiscus lenticularis;* (c) *Sphenodiscus intermedius;* (d) *Coahuilites cavinsi;* (e) *Sphenodiscus pleurisepta.* No zones have yet been established for the Texas area.

The presence of Danian has not been incontrovertibly established in Texas; Scott has correlated the Danian with Midway on the basis of the supposed identity of *Hercoglossa uhlrichi* and *Hercoglossa danica.*

The following lists contain fossils identified or reported from the Upper Cretaceous formations:

Woodbine Formation

Ostrea carica Cragin
——— lyoni Shumard
——— soleniscus Meek
Exogyra columbella Meek
——— ferox Cragin
Aguilera cumminsi C. A. White
Arca siouxensis Meek and Hayden (Cragin)
——— gallieni var. tramitensis Cragin
Cytherea leveretti Cragin
——— taffi Cragin
Modiola filisculpta Cragin
Pteria ? salinensis C. A. White
plants
Acanthoceras wintoni n. sp.
Scaphites sp. (Hill)
Brachyura (Hill)
Cerithium tramitensis Cragin
Natica humilis Cragin
Neritopsis tramitensis Cragin
Turritella coalvillensis Meek

Eagle Ford Formation

*Acanthoceras bellense n. sp.
*Acanthoceras stephensoni n. sp.
*Acanthoceras lonsdalei n. sp.
*Acanthoceras aff. cornutum Kossmat
*Acanthoceras aff. turneri White
*Acanthoceras aff. discoidale Stoliczka
*Acanthoceras aff. meridionale var. africana Pervinquière
*Acanthoceras aff. cunningtoni Sharpe
*Acanthoceras spp.
*Mantelliceras sellardsi n. sp. (aff. rowei Spath)
*Eucalycoceras leonense n. sp.
*Metacalycoceras (?) tarrantense n. sp. +spp.
Metoicoceras swallovi (Shumard)
Metoicoceras gibbosum (Hyatt)
Metoicoceras irvini Moreman
Metoicoceras whitei Hyatt
Metoicoceras inequiplicatum (Shumard)
Ancyloceras annulatum Shumard
†Exiteloceras pariense (White)
Placenticeras syrtale var. cumminsi Cragin
Placenticeras pseudoplacenta var. occidentale Hyatt
†Prionotropis spp.
Epengonoceras dumblei (Cragin)
Prionotropis woolgari (Mantell) Cragin
*Ptychoceras n. sp.
*Hamites n. sp.
*Turrilites sp. aff. costatus Sowerby
*Turrilites sp. aff. desnoyersi d'Orbigny
*Turrilites sp. aff. tuberculatus Böse
Scaphites septem-seriatus Cragin
†Scaphites sp. aff. aequalis var. turonensis Roman and Mazerin
†Prionotropis eaglensis n. sp.
Scaphites vermiculus Shumard
†Exogyra sp. aff. laeviuscula Roemer
†Inoceramus aff. labiatus Schlotheim
Inoceramus cfr. fragilis
Ostrea alifera Cragin
Ostrea alifera var. pediformis Cragin
†Alectryonia lugubris Conrad (=bellaplicata Shumard)
Cyprimeria ? excavata Morton
Isocardia humilis Cragin

*Species from the Eagle Ford flag member in Bell and McLennan counties.
†Species of the Upper (Turonian) Eagle Ford near Austin.
Other species are listed by Shumard, Scott, and Hill.

Yoldia septariana Cragin
Nucula haydeni Shumard
Anchura modesta Cragin
Cerithium interlineatum Cragin
Fusus graysonensis Cragin
Natica striaticosta Cragin
Neritopsis biangulatus Shumard
Turbinopsis septariana Cragin
Turritella renauxiana d'Orbigny (Cragin)
Portheus sp.
Plant remains
Lingula shumardi Cragin
Belemnitella (?) sp.
Hemiaster (?) sp.

Austin Formation

Codiopsis aff. valotairei Lambert
Cyphosoma hilli Cragin
Diplopodia hilli (Clark)
Pedinopsis pondi Clark
Echinobrissus texanus Clark
?Echinocorys texana (Cragin)
Hemiaster texanus Roemer

Mortoniceras texanum (Roemer)
Planticeras guadalupae (Roemer)
Ammonites flaccidicosta Roemer
Ammonites dentatocarinatus Roemer
Baculites asper Morton Roemer
———— anceps Lamarck Roemer
Nautilus simplex Sowerby Roemer
———— elegans Sowerby Roemer
Parapuzosia spp.
Durania austinensis (Roemer)
Exogyra laeviuscula Roemer
———— sp. aff. ponderosa Roemer
Alectryonia aff. diluviana (Lamarck)
Pholadomya ingens Cragin
Pecten bensoni Kniker
———— simondsi Kniker
———— casteeli Kniker
Lima crenulicosta Roemer
Spondylus guadalupae Roemer
Avicula planiuscula Roemer
Inoceramus undulato-plicatus Roemer

———— mytiloides Mantell Roemer
———— striatus Mantell Roemer
Modiola sp. 72 Roemer
Aucella sp. 65 Roemer
Liopistha elegantula (Roemer)
Psammobia cancellato-sculpta Roemer

Pyrula sp. Roemer 1852
Rostellaria sp. Roemer
Phasianella sp. Roemer
Cerithium? sp. Roemer
Scalaria texana Roemer
Eulima? texana Roemer
Chemnitzia? gloriosa Roemer

Favia texana Cragin

Anomia anomiaeformis (Roemer)
Gryphea aucella Roemer

Taylor and Anacacho Formations

Cidaris dixiensis Clark
Salenia spp.
Echinocorys texana (Cragin)
?Echinobrissus texanus Clark

Bostrychoceras aff. polyplocum (Roemer)
Scaphites texanus Roemer 1852
———— semicostatus Roemer 1852
Sphenodiscus lenticularis Owen
Placenticeras placenta Dekay + sp.
Parapachydiscus streckeri n. sp.

Durania austinensis (Roemer)
Radiolites spp.
?Ostrea bella Conrad
Ostrea plumosa Morton
———— glabra
Exogyra ponderosa Roemer

Inoceramus cumminsi Cragin

Micrabacia spp.

Lamna texana Roemer 1852
Oxyrhina mantelli Agassiz
Oxodus appendiculatus Agassiz
Corax heterodon Reuss

Mendez (northeastern Mexico)

Inoceramus cfr. balticus
——— cfr. barabini Morton
——— cfr. vanuxemi Meek
——— spp.
?Durania austinensis (Roemer)
——— manuelensis Stephenson
Sauvagesia degolyeri Stanton
——— belti Stephenson
——— coloradensis Stephenson
Tampsia bishopi Stephenson
——— chocoyensis Stephenson
Coralliochama cfr. boehmi Böse
mososaur
foraminifera

Navarro Formation

Nostoceras helicinum (Shumard)
Nostoceras stantoni Hyatt
——— var. retorsus Hyatt
——— var. prematurum Hyatt
——— var. aberrans Hyatt
Oxybeloceras texanum (Shumard)
——— sp.
Turrilites splendens Shumard
Helicoceras navarroensis Shumard
Sphenodiscus lenticularis Owen
Baculites sp.
Hamites sp.
Pachydiscus complexus M. & H.
Eutrephoceras dekayi
Ostrea lugubris Conrad (?)
Ostrea owenana Shumard
Cucullaea tippana Conrad
Pecten argentaria Morton

Other fossils are listed by Shumard 1862, **90**, and by Stephenson 1923, **96**.

Escondido Formation

Sphenodiscus pleurisepta Conrad
Parapachydiscus sp. aff. colligatus
Parapachydiscus sp.

Ostrea cfr. glabra
Exogyra costata Say
gastropods
foraminifera
Cassidulus sp.
Other Escondido fossils are listed by Böse and Cavins 1928, **10.**

TYPES OF TEXAS CRETACEOUS FOSSILS

Some species which occur in the Texas Cretaceous, especially in the Upper Cretaceous, were described at an early date from material discovered outside of Texas. The principal describers were Say, Morton, Lea, Conrad, Gabb, Hall, Meek, and a few European writers. The earliest geological memoirs which dealt with fossils from the Texas Cretaceous are ROEMER'S *Texas* (1849, *77)* and *Die Kreidebildungen von Texas* (1852, *78); B. F. SHUMARD'S report on fossils collected by the Marcy Expedition up the Red River (1854, *87)*, and G. G. SHUMARD'S report on fossils collected by the Pope Expedition along the Pecos (published at Austin, 1886, *91)*; CONRAD'S AND HALL'S reports in the Mexican Boundary Survey of Emory (1857, *18)*; and MARCOU'S *Geology of North America* (1858, *68)*. There was a period of geological exploration under the Shumard Survey at Austin, which ended with the outbreak of the Civil War; some Cretaceous fossils from this period of activity were published by SHUMARD *(88, 89, 90)*, and by WHITE *(106)*.

The next essentially important work on these fossils centered around the activities of the Dumble Survey and the work of HILL, TAFF, and CRAGIN (about 1888–1894). The present formational classification, most of the essential features of the intra-state correlation, and description of many common Cretaceous fossils date from that period. HILL'S classical work on the *Black and Grand Prairies* (1901, *57)* may be said to summarize the stratigraphic and paleontological results of these investigations on the Texan Cretaceous. The Mexican Survey published several works which bear on the Texas Cretaceous, particularly BÖSE'S monograph on the El Paso section (1910, *8)*.

A third major period of investigations on the Cretaceous (and other) rocks of Texas dates from about 1917 to the present time. It centers in part around renewed activities of various geological agencies, the Federal survey, the University of Texas, and others, but particularly around the increasingly intensive use of geological methods by oil companies in Texas. This period has produced numerous papers on Texas Cretaceous fossils.

The types of ROEMER'S *Kreidebildungen von Texas* are in the Geological Institute of the University of Bonn, but are not segregated and are somewhat difficult to locate. The types from ROEMER 1888, *80,* from BÖHM 1898, *7,* and from LASSWITZ 1904, *67,* are at Breslau. Brief visits and investigation failed to locate the types from ROEMER'S other papers *(79, 81)*. Two Duck Creek ammonites left in manuscript by ROEMER were later published by LASSWITZ (1904, *67),* and one Austin chalk fossil, *Inoceramus crenistriatus,* was published by AIRAGHI (1904, *124)*. The SCHLÜTER collection (types of *82, 83),* including the type of *Inoceramus subquadratus* and other fossils from Austin, is at Bonn. This and another large collection bought from the Krantz establishment by the University of Bonn, were apparently collected by Mr. George Stolley of Austin, who was likewise the collector of Roemer's later fossils *(79, 80, 81,* and LASSWITZ 1904, *67)*. Some Texan fossils at Breslau were, however, donated by the Dumble Survey, and bear the labels of that survey and the handwriting of Dumble and of Streeruwitz (?). The types of GIEBEL (1854, *45)* were not located. SHUMARD'S 1860 fossils have not been relocated, but are possibly at the St. Louis Academy of Science in storage; the species refigured by White were apparently entirely from drawings. The location of his 1862 fossils *(90)* is unknown to the writer. Some of the Mexican Boundary Survey types are in the United States National Museum, as the holotype of *Pervinquieria leonensis;* but the type of *Ammonites geniculatus* is missing. On the other hand, some of Conrad's species were based on Roemer's figures (types at Bonn). The types of MARCOU

(1858, *68)*, all holotypes, are in the British Museum of Natural History, South Kensington, to which they were transferred from the collections of the Geological Society of London.[2]

The following list includes the principal collections containing types of Texas Cretaceous fossils.

TEXAS

University of Texas, Austin, Bureau of Economic Geology: Adkins 1920, **1**; Adkins and Winton 1920, **3**; Böse 1919, **9**; Böse 1928, **10**; Plummer 1926, **74**.

University of Texas, Department of Geology: Carsey 1926, **13**; Cragin 1893, **21**; Ellisor 1919, **41**; Kniker 1919, **62**; Whitney 1911, **111**; Whitney 1916, **112**.

Texas Christian University, Fort Worth: Adkins and Winton 1920, **3**; Moreman 1927, **73**; Scott 1924, **84**.

Baylor University, Waco: Hay 1916, **50**.

UNITED STATES EXCEPT TEXAS

United States National Museum, Washington: Berry 1922, **6**; Conrad 1857, **18**; Cragin 1906, **27**; Fontaine 1893, **42**; Gidley 1913, **44**; Hill 1898, **58**; Hyatt 1894, **60**; Hyatt 1903, **61**; Stanton 1897, **92**; Stanton 1901, **93**; Vaughan 1903, **102**; White 1879, **104**(?); White 1883, **106**(?); White 1884, **108**; White 1888, **110**; Dall 1907, **120**.

Johns Hopkins University, Baltimore: Clark 1893, **14**; Clark 1916, **15**; Hill 1893, **56**; Shattuck 1903, **86**.

Yale University, New Haven: Wieland 1916, **113**; Wieland 1921, **114**.

Princeton University, Princeton: Alexander 1927, **4**.

Cushman Laboratory, Sharon: Cushman 1926, **29**; Cushman 1927, **31**; Cushman and Waters 1927, **32**.

Walker Museum, Chicago: Plummer 1926, **74**.

St. Louis Academy of Sciences, St. Louis: Shumard 1860, **89**(?).

Colorado College, Colorado Springs: Cragin 1894, **22**; Cragin 1895 **23**; Cragin 1900, **26**.

University of California, Berkeley: Böse 1928, **10**.

FOREIGN

Instituto Geológico de México, Mexico: Böse 1910, **8**.

British Museum, Natural History, South Kensington: Marcou 1858, **68**; White 1888, **110**.

[2]Blake, J. F., 1902. List of the types and figured specimens recognized by C. D. Sherborn, F. G. S., in the collection of the Geological Society of London. London, p. 66.

Lambert Collection, Paris: Lambert and Thiéry 1924, **66**; Lambert 1927, **64**.

University of Bonn, Bonn: Roemer 1849, **77**; Roemer 1852, **78**; Schlüter 1887, **82**; Schlüter 1887, **83**; Yabe and Shimizu 1923, **116**.

University of Breslau, Breslau: Böhm 1898, **7**; Lasswitz 1904, **67**; Roemer 1888, **80**; Yabe and Shimizu 1923, **116**.

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2. Adkins, W. S., 1927. Geology and mineral resources of the Fort Stockton quadrangle. Univ. Texas Bull. 2738.

3. Adkins, W. S., and Winton, W. M., 1920. Paleontological correlation of the Fredericksburg and Washita formations in North Texas. Univ. Texas Bull. 1945.

4. Alexander, C. I., 1927. The stratigraphic range of the Cretaceous ostracod *Bairdia subdeltoidea* and its allies. Jour. Pal., I, 1, 29–33.

5. Berry, E. W., 1912. Contributions to the Mesozoic flora of the Atlantic coastal plain—VIII, Texas. Torrey Bot. Club Bull., Vol. XXXIX, 387–406, pls. 30–32.

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[3]One asterisk following a title in the bibliography indicates that the publication is rare; two asterisks, that it is generally inaccessible.

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LIST AND DESCRIPTION OF SPECIES

PLANTS

Phylum THALLOPHYTA

Class FUNGI

Order SCHIZOMYCETES (Bacteria)

COCCACEAE

Gen. indet., sp. indet. *(Micrococcus)*

Bacteria of the *Micrococcus* group have been reported by Mr. W. B. McCarter from phosphatic nodules and coprolites in the Fish Bed "Conglomerate" of Taff. They are found in limestone slabs (and in shale) with agglomerates of pebbles, coprolites, pharyngeal and other fish teeth, fish bones, carbonized plant remains, oysters, ammonites and other fossils. (Unpublished MS.)

Eagle Ford (flag member): Travis County, Bouldin Creek Watters Park, and elsewhere.

Class ALGAE

Order CHARALES

CHARACEAE

Chara brewsterensis GROVES 1925, **49**, 12–14, text fig. ADKINS 1927, **2**, 33–36. Oögonia only.

Trinity division: Twin City Oil and Gas Company's Kokernot No. 1 well, near Hovey, Brewster County, at 3,375 feet (type locality?), and probably at other depths in the same well; wells near Fort Stockton (possibly Trinity division).

Chara texensis GROVES 1925, **49**, 12–14, text fig. Oögonia only. Same type locality.

Position uncertain:

Halymenites sp. UDDEN 1907, **100**, p. 44.

Rattlesnake beds: Brewster County. Coal series: Near Eagle Pass (Udden).

Phylum PTERIDOPHYTA

Class FILICES

Order FILICALES

SCHIZACEAE

Ruffordia gopperti (DUNKER) SEWARD.

Sphenopteris valdensis ? HEER. FONTAINE 1893, **42**, 263, pl. XXXVI, fig. 2. KNOWLTON 1919, **63**, p. 556.

Glen Rose: Near Glen Rose (Identification?).

Order EQUISETALES

EQUISETACEAE

Equisetum texense FONTAINE 1893, **42**, 263, pl. XXXVI, fig. 1.

Glen Rose: Near Glen Rose.

Phylum SPERMATOPHYTA

Class GYMNOSPERMAE

Order CYCADALES

CYCADACEAE

Dioonites buchianus (SCHIMPER) FONTAINE 1893, **42**, 264, pl. XXXVI, fig. 5.

Glen Rose: Near Glen Rose.

Dioonites buchianus var. **rarinervis** FONTAINE 1893, **42**, 264, pl. XXXVI, figs. 3–4.

Glen Rose: Near Glen Rose.

Dioonites buchianus var. **angustifolius** FONTAINE 1893, **42**, 265, pl. XXXVI, fig. 6.

Glen Rose: Near Glen Rose.

Dioonites dunkerianus (Göpp.). FONTAINE 1893, **42**, 265, pl. XXXVI, fig. 12; pl. XXXVII, fig. 1.

Glen Rose: Near Glen Rose.

Podozamites acutifolius FONTAINE? 1893, **42**, 266, pl. XXXVI, fig. 7.

Glen Rose: Near Glen Rose.

Podozamites sp. FONTAINE 1893, **42**, 267, pl. XXXVI, fig. 8.

Glen Rose: Near Glen Rose.

Podozamites lanceolatus (LINDLEY AND HUNTON). F. BRAUN. BERRY 1912, **5**; BERRY 1922, **6**, 159, pl. XXXVI, fig. 2.

Woodbine: Lamar County (Arthur's Bluff of Red River).

Zamites tenuinervis FONTAINE 1893, **42**, 267, pl. XXXVII, figs. 3–4; pl. XXXVIII, figs. 1–2.

Glen Rose: Near Glen Rose.

Williamsonia texana FONTAINE 1893, **42**, 278, pl. XLIII, figs. 1–2.

Glen Rose: Near Glen Rose.

Cycadeospermum rotundatum FONTAINE 1893, **42**, 279, pl. XLIII, fig. 6.

Glen Rose: Near Glen Rose.

Order BENNETTITALES

BENNETTITACEAE

Cycadeoidea bart-johnsoni WIELAND MS.

Found about 1921, and described from material donated to the United States National Museum by Mr. Bart Johnson, of Comanche. Dr. Wieland writes that this species has close affinities to certain Lakota types.

Trinity sand: Near Cross Plains (type locality). Types, U. S. Nat. Mus.

Cycadeoidea boesiana WIELAND 1921, **114**, p. 84, pls. XI–XII.

Basal Cretaceous sandstones, transgressing the Pennsylvanian, possibly equivalent to higher Trinity (Upper Aptian, Böse): Near

Bridgeport, Wise County (type locality), collected by Dr. E. Böse in 1917. The cycad was found associated with much petrified wood. Type, Yale University.

Cycadeoidea sp. WIELAND MS. SELLARDS, E. H., 1927: Fossil cycad localities in Texas. Paleont. Soc. Cleveland meeting..**Plate I, figures 1–4**

Gillespie sands (=Glen Rose?): About 2 miles south of Fredericksburg (type locality; types in Bureau of Economic Geology, collected 1927).

Cycadeoidea uddeni WIELAND 1916, **113**, Vol. II (Taxonomy), p. 113, pl. III, figs. 1–3. UDDEN, J. A., 1908. A cycad from the Upper Cretaceous in Maverick County, Texas. Science (n. s.), 28, 159–160. KNOWLTON 1919, **63**, p. 218.

Upson clay (Taylor): Three miles north and 1.5 miles west of Paloma, Maverick County (type locality); collected by Dr. Udden. Types, Yale University.

Cycadeoidea (?) sp.

Professor Winton reports having seen a cycad at a locality near Belton.

Horizon: **Comanche Peak** (?).

Order CONIFERALES

PINACEAE

Sub-family ABIETINEAE

Abietites linki (ROEMER) DUNKER. FONTAINE 1893, **42**, 268, pl. XXXVII, fig. 2.

Glen Rose: Near Glen Rose.

Abietites foliosus (FONTAINE) BERRY. KNOWLTON 1919, **63**, p. 727.

Glen Rose: Near Glen Rose.

Abietites sp. FONTAINE 1893, **42**, 277, pl. XLIII, fig. 4.

Glen Rose: Near Glen Rose.

Laricopsis longifolia FONTAINE 1893, **42**, 268, pl. XXXVI, fig. 9

Glen Rose: Near Glen Rose.

Pinus sp. FONTAINE 1893, **42**, 269, pl. XXXVI, fig. 11.

Glen Rose: Near Glen Rose.

Sub-family TAXODIEAE

Sequoia pagiophylloides FONTAINE 1893, **42,** 276, pl. XLII, figs. 1–3 a.
Glen Rose: Near Glen Rose.

Sphenolepidium sternbergianum var. **densifolium** FONTAINE 1893, **42,** 268, pl. XXXVI, fig. 10.
Glen Rose: Near Glen Rose.

Sub-family CUPRESSINEAE

Frenelopsis varians FONTAINE 1893, **42,** 273, pl. XL, figs. 1–2; pl. XLI, figs. 1–3 a.
Glen Rose: Near Glen Rose.

Thuyoxylon americanum UNGER 1852, in: ROEMER, **78,** p. 95.
Exact horizon unknown. Knowlton (1919, **63,** p. 623) says: "Trinity?, New Braunfels, Texas." Roemer says: "Kreideschichten unmittelbar aufliegend am Wege von New Braunfels nach Austin."

Frenelopsis hoheneggeri (Ett.) SCHENK. FONTAINE 1893, **42,** 275, pl. XLVII, figs. 4–4 a.
Glen Rose: Near Glen Rose.

Widdringtonites ramosus (FONTAINE) BERRY. KNOWLTON 1919, **42,** p. 651.
Glen Rose: Near Glen Rose.

ARAUCARIACEAE

Tribe BRACHYPHYLLEAE

BRACHYOXYLON HOLLICK AND JEFFREY 1909

Brachyoxylon comanchense TORREY 1923, **119,** 82, pl. XIII, figs. 44–46.
Glen Rose: One mile south of Cottondale (type locality).

TELEPHRAGMOXYLON TORREY 1921

Telephragmoxylon brachyphylloides TORREY 1923, **119,** 86, pl. XIV, figs. 52–55.
Trinity division: Three miles from Weatherford, on Curtis Branch (type locality).

Telephragmoxylon comanchense TORREY 1923, **119,** 86, pl. XIV, fig. 56; pl. XV, figs. 57–60.
Trinity division: Three miles from Weatherford, on Curtis Branch (type locality).

Tribe ARAUCARIEAE

PARACUPRESSINOXYLON HOLDEN 1913

Paracupressinoxylon trinitense TORREY 1923, **119,** 85, pl. XIV, fig. 51.

Trinity division: Three miles from Weatherford, on Curtis Branch (type locality).

ARAUCARIOXYLON KRAUS 1872

Araucarioxylon texense TORREY 1923, **119,** 89, pl. XV, figs. 61–64.

Glen Rose: One mile south of Cottondale (type locality).

BRACHYPHYLLACEAE

Brachyphyllum texense FONTAINE 1893, **42,** 269, pl. XXXVIII, figs. 3–5; pl. XXXIX, figs. 1–1 a.

Glen Rose: Near Glen Rose.

Brachyphyllum macrocarpum formosum BERRY 1912, **5;** BERRY 1922, **6,** 160, pl. XXXVI, fig. 1.

Woodbine: Lamar County (Arthur's Bluff).

Brachyphyllum parceramosum FONTAINE 1890, U. S. Geol. Surv., Mon. 15, p. 223, pl. CX, fig. 4. KNOWLTON 1919, **63,** p. 124.

Glen Rose: At Glen Rose.

Position uncertain:

Pagiophyllum dubium FONTAINE 1893, **42,** 271, pl. XXXIX, figs. 2–11.

Glen Rose: Near Glen Rose.

Class ANGIOSPERMAE

Sub-Class MONOCOTYLEDONES

Order ARECALES

ARECACEAE

Palmoxylon sp. STEVENS 1912. Stevens, N. E., A palm from the Upper Cretaceous of New Jersey. Am. Jour. Sci. (4), XXXIV, 421–436.

A Texan species is recorded on page 436: "Only last year (1911) Brown observed a large silicified root clump in the **"Rattlesnake beds"** on the "big bend" of the Rio Grande in Chisos County, Texas." This likely refers to Brewster County, Texas.

A **Tertiary** species may be put on record here: *Palmoxylon cannoni*(?) Stevens 1921. Two petrified palms from interior North America. Am. Jour. Sci., I, 431–433. Locality: Huntsville, Texas. Dr. Wieland provisionally identified the Texan specimen with *P. cannoni* described from the Denver formation (Eocene). Specimen in Bureau of Economic Geology.

Sub-Class DICOTYLEDONAE

MYRICACEAE

Myrica emarginata HEER. BERRY 1922, **6**, p. 161; BERRY 1912, **5**.
Woodbine: Arthur's Bluff.

Myrica longa (HEER) HEER. BERRY 1922, **6**, 161, pl. XXXIX, fig. 5. HILL 1901, **57**, 314, pl. XXXIX, fig. 7.
Woodbine: Arthur's Bluff.

SALICACEAE

Salix lesquereuxi BERRY 1922, **6**, p. 162 (bibliography).
Woodbine: Arthur's Bluff.

Salix deleta LESQUEREUX. BERRY 1922, **6**, p. 163. HILL 1901, **57**, p. 314.
Woodbine: Arthur's Bluff.

Salix hayesi LESQUEREUX. HILL 1901, **57**, 316, pl. XXXIX, fig. 6.
"**Woodbine** formation."

Populus harkeriana LESQUEREUX. BERRY 1912, **5**; BERRY 1922, **6**, p. 163.
Woodbine: Arthur's Bluff.

Populus sp. HILL 1901, **57**, p. 318.
Woodbine: Denison (Rhamney's Hill).

MORACEAE

Ficus daphnogenoides (HEER) BERRY 1922, **6**, 163, pl. XXXIX, fig. 1; BERRY 1912, **5**.
Woodbine: Arthur's Bluff.

Ficus glascoena LESQUEREUX. BERRY 1922, **6**, p. 164; HILL 1901, **57**, p. 314.
Woodbine: Arthur's Bluff.

Ficus sp. HILL 1901, **57**, p. 317.
Woodbine: Arthur's Bluff.

PLATANACAEAE

Platanus latior (Lesquereux) Knowlton. Berry 1922, **6**, p. 164.
Woodbine: Arthur's Bluff.

Platanus primaeva Lesquereux. Hill 1901, **57**, p. 314.
Woodbine: Arthur's Bluff.

MAGNOLIACEAE

Magnolia speciosa Heer. Berry 1922, **6**, 165, pl. XL, fig. 6; Berry 1912, **5**; Hill 1901, **57**, p. 318.
Woodbine: Arthur's Bluff; Denison (Rhamney's Hill).

Magnolia lacoeana Lesquereux. Berry 1922, **6**, p. 165.
Woodbine: Arthur's Bluff.

Magnolia boulayana Lesquereux. Hill 1901, **57**, p. 318.
Woodbine: Denison (Rhamney's Hill).

Liriodendron quercifolium Newberry. Berry 1922, **6**, 166, pl. XXXVI, fig. 3; Berry 1912, **5**.
Woodbine: Arthur's Bluff.

Liriodendron snowi Lesquereux. Hill 1901, **57**, p. 317.
Woodbine: Arthur's Bluff.

Liriodendron pinnatifidum Lesquereux. Hill 1901, **57**, p. 317.
Woodbine: Arthur's Bluff.

TROCHODENDRACEAE

Trochodendroides rhomboideus (Lesquereux) Berry 1922, **6**, 166, pl. XXXVI, fig. 5.
Woodbine: Arthur's Bluff.

RANUNCULACEAE(?)

Dewalquea insigniformis Berry 1922, **6**, p. 167.
Woodbine: Arthur's Bluff.

HAMAMELIDACEAE

Liquidambar integrifolium Lesquereux. Hill 1901, **57**, p. 318.
Woodbine: Denison (Rhamney's Hill).

CAESALPINACEAE

Paleocassia laurinea LESQUEREUX. BERRY 1922, **6**, 167, pl. XL, fig. 8; BERRY 1912, **5**.

Woodbine: Arthur's Bluff.

PAPILIONACEAE

Colutea primordialis HEER. BERRY 1922, **6**, p. 168; BERRY 1912, **5**.

Woodbine: Arthur's Bluff.

MIMOSACEAE

Inga cretacea LESQUEREUX. HILL 1901, **57**, 318.

Woodbine: Denison (Rhamney's Hill).

SAPINDACEAE

Sapindus morrisoni HEER. BERRY 1922, **6**, p. 168; BERRY 1912, **5**; HILL 1901, **57**, p. 317.

Woodbine: Arthur's Bluff.

ANACARDACEAE

Rhus redditiformis BERRY 1912, **5**; BERRY 1922, **6**, 169, pl. XXXVII, fig. 2.

Woodbine: Arthur's Bluff.

RHAMNACEAE

Rhamnus tenax LESQUEREUX. BERRY 1922, **6**, 169, pl. XL, fig. 7.

Woodbine: Arthur's Bluff.

Zizyphus lamarensis BERRY 1912, **5**; BERRY 1922, **6**, 170, pl. XXXVI, fig. 4.

Woodbine: Arthur's Bluff.

VITACEAE

Cissites formosus HEER. BERRY 1922, **6**, 170, pl. XL, fig. 5.

Woodbine: Arthur's Bluff.

STERCULIACEAE

Sterculia lugubris LESQUEREUX?. BERRY 1912, **5**; BERRY 1922, **6**, 171, pl. XXXVI, fig. 6.

Woodbine: Arthur's Bluff.

LAURACEAE

Benzoin venustum (LESQUEREUX) KNOWLTON. BERRY 1922, **5**; BERRY 1922, **6**, 171, pl. XXXVIII, fig. 2.
Woodbine: Arthur's Bluff.

Malapoenna falcifolia (LESQUEREUX) KNOWLTON. BERRY 1912, **5**; BERRY 1922, **6**, 172.
Woodbine: Arthur's Bluff.

Oreodaphne alabamensis BERRY 1912, **5**; BERRY 1922, **6**, 172, pl. XXXVII, fig. 1.
Woodbine: Arthur's Bluff.

Cinnamomum newberryi BERRY 1922, **6**, 173, pl. XXXIX, fig. 3.
Woodbine: Arthur's Bluff.

Cinnamomum membranaceum (LESQUEREUX) HOLLICK. BERRY 1922, **6**, p. 174; BERRY 1912, **5**.
Woodbine: Arthur's Bluff.

Cinnamomum heeri LESQUEREUX. HILL 1901, **57**, 318, pl. XXXIX, fig. 5.
Woodbine: Denison (Rhamney's Hill).

Cinnamomum ellipsoideum SAPORTA AND MARION. HILL 1901, **57**, p. 317.
Woodbine: Woodbine.

Cinnamomum n. sp. HILL 1901, **57**, p. 317.
Woodbine: Woodbine.

Laurus plutonia HEER. BERRY 1912, **5**; BERRY 1922, **6**, 174, pl. XXXVIII, fig. 5.
Woodbine: Arthur's Bluff.

Laurus antecedens LESQUEREUX?. BERRY 1922, **6**, p. 175.
Woodbine: Arthur's Bluff.

Laurus proteaefolium LESQUEREUX. HILL 1901, **57**, p. 318.
Woodbine: Denison (Rhamney's Hill).

Laurophyllum minus NEWBERRY. BERRY 1912, **5**; BERRY 1922, **6**, p. 175.
Woodbine: Arthur's Bluff.

MYRTACEAE

Eugenia primaeva LESQUEREUX. HILL 1901, **57**, p. 317.
Woodbine: Woodbine.

Eucalyptus? sp. HILL 1901, **57**, p. 317.
Woodbine: Arthur's Bluff.

Eucalyptus geinitzi (HEER) HEER. BERRY 1912, **5**.
Woodbine: Arthur's Bluff.

Myrtonium geinitzi (HEER) BERRY 1922, **6**, p. 175.
Woodbine: Arthur's Bluff.

ARALIACEAE

Aralia wellingtoniana LESQUEREUX. BERRY 1912, **5**; BERRY 1922, **6**, 176, pl. XXXVII, fig. 3; pl. XXXVIII, figs. 3–4.
Woodbine: Arthur's Bluff.

Aralia wellingtoniana var. **vaughani** KNOWLTON, in: HILL 1901, **57**, 317.
Woodbine: Arthur's Bluff.

Aralia saportana LESQUEREUX?. BERRY 1922, **6**, p. 177.
Woodbine: Arthur's Bluff.

Aralia(?) sp. HILL 1901, **57**, p. 317.
Woodbine: Arthur's Bluff.

CORNACEAE

Cornophyllum vetustum NEWBERRY. BERRY 1912, **5**; BERRY 1922, **6**, 177.
Woodbine: Arthur's Bluff.

ERICACEAE?

Andromeda novaecaesarae HOLLICK. BERRY 1912, **5**; BERRY 1922, **6**, 177, pl. XXXVIII, fig. 1.
Woodbine: Arthur's Bluff.

Andromeda snowi LESQUEREUX. BERRY 1912, **5**; BERRY 1922, **6**, p. 178.
Woodbine: Arthur's Bluff.

Andromeda pfaffiana HEER. HILL 1901, **57**, p 317.
Woodbine: Woodbine.

EBENACEAE

Diospyros primaeva HEER. BERRY 1922, **6**, 178, pl. XXXIX, fig. 2; HILL 1901, **57**, 317, pl. XXXIX, fig. 3.
Woodbine: Arthur's Bluff; Woodbine.

Diospyros steenstrupi? HEER. HILL 1901, **57,** 318, pl. XXXIX, fig. 1.
Woodbine: Denison (Rhamney's Hill).

CAPRIFOLIACEAE

Viburnum robustum LESQUEREUX. BERRY 1912, **5;** BERRY 1922, **6,** 179, pl. XXXIX, fig. 4; HILL 1901, **57,** p. 317.
Woodbine: Arthur's Bluff.

Position uncertain:

Carpolithus sp. 1. BERRY 1922, **6.** p. 179.
Woodbine: Arthur's Bluff.

Carpolithus sp. 2. BERRY 1922, **6,** p. 180.
Woodbine: Arthur's Bluff.

Carpolithus sp. 3. BERRY 1922, **6,** p. 180.
Woodbine: Arthur's Bluff.

Carpolithus harveyi FONTAINE 1893, **42,** 278, pl. XLIII, fig. 3.
Glen Rose: Glen Rose.

Carpolithus obovatus FONTAINE 1893, **42,** 278, pl. XLIII, fig. 5.
Glen Rose: Near Glen Rose.

Lindera venusta LESQUEREUX. HILL 1901, **57,** 317, pl. XXXIX, fig. 2.
Woodbine: Arthur's Bluff.

Phyllites aristolochiaeformis LESQUEREUX?. HILL 1901, **57,** p. 317.
Woodbine: Woodbine.

Phyllites rhomboideus LESQUEREUX. HILL 1901, **57,** p. 317.
Woodbine: Arthur's Bluff.

Sabi sp.? HILL 1901, **57,** p. 318.
Woodbine: Denison (Rhamney's Hill).

Tricalycites papyraceus NEWBERRY. BERRY 1912, **5;** BERRY 1922, **6,** 179, pl. XL, fig. 9.
Woodbine: Arthur's Bluff.

WINTON 1925, **115,** has recorded some undetermined Woodbine plants from a Denton County locality.

Taxonomic position unknown:

Porocystis globularis (GIEBEL) 1853.................**Plate I, figures 9–10**

Giebel, C. G., Beitrag zur Paläontologie des Texanischen Kreidegebirges. Naturwiss. Verein für Sachsen und Thüringen in Halle, Jahresber. f. 1852, 5, 358–375 (p. 375), Taf. 7, fig. 3a, Berlin, 1853 *(Siphonia globularis,* considered an alga). Hill, R. T., 1890, Occurrence of *Goniolina* in the Comanche Series of the Texas Cretaceous. Am. Jour. Sci. (3), XL, 64–65 (as a fruit). Hill, R. T., 1893, Inv. pal. Trinity division. Proc. Biol. Soc. Wash., Vol. VIII, 39–40, pl. I, figs. 1 a–d (as *Araucarites wardi* Hill, a coniferous fruit). Cragin, F. W., 1893, **21**, 165, pl. XXIV, figs. 2–6 (as bryozoon, *Porocystis).* Rauff, H., 1895, Über *Porocystis pruniformis* Cragin (=*Araucarites wardi* Hill) aus dem Kreide in Texas. N. Jahrb., I, p. 2, (lit. in footnote, p. 4; good figures). Jarvis, May M., 1905, On the fossil genus *Porocystis* Cragin. Biol. Bull., 9, 338–390, 6 text figs. Böhm, Joh., 1912, Literarische Bemerkung über *Porocystis pruniformis* Cragin. Centr. f. Min., 1912, 86–87. Udden, J. A., 1907, Univ. Texas Bull. 24, pp. 31, 32, 37.

This genus has been referred to various groups, mainly plants. Dr. Udden suggests its resemblance to *Receptaculites.* **Glen Rose:** Cibolo Creek and (or) near New Braunfels (type locality); widely distributed in Central and West Texas; Finlay Mountains; Solitario. There is probably more than one species.

ANIMALS

Phylum PROTOZOA

Class FORAMINIFERA

The more recent Texan records are listed here, following the classification of CUSHMAN 1926, **30.** Cushman's general treatise on Foraminifera[4] gives full diagnoses and separations of families and genera.

SACCAMMINIDAE

Proteonina difflugiformis (H. B. BRADY). CUSHMAN AND WATERS 1927, **32**, 82, pl. X, fig. 1.

Navarro: Near Richland.

REOPHACIDAE

Reophax texana CUSHMAN AND WATERS 1927, **32**, 82, pl. X, fig. 2.

Navarro: East of Richland (type locality).

AMMODISCIDAE

Ammodiscus incertus (D'ORBIGNY). PLUMMER 1927, **74**, p. 64.

Taylor; Navarro.

[4]Cushman, Joseph A., 1928. Foraminifera, their classification and economic use. 400 pp., 59 pls. Sharon, Mass.

LITUOLIDAE

Haplophragmoides calcula CUSHMAN AND WATERS 1927, **32,** 83, pl. X, figs. 5 a–b.

Navarro: Near Quinlan, Hunt County (type locality).

Haplophragmoides excavata CUSHMAN AND WATERS 1927, **32,** 82, pl. X, figs. 3 a–b.

Navarro: Near Quinlan, Hunt County (type locality).

Haplophragmoides glabra CUSHMAN AND WATERS 1927, **32,** 83, pl. X, figs. 6 a–b.

Navarro: Hunt County (type locality).

Haplophragmoides rugosa CUSHMAN AND WATERS 1927, **32,** 83, pl. X, figs. 4 a–b.

Navarro: East of Richland (type locality).

Flabellammina alexanderi CUSHMAN 1928, Contr. Cushm. Lab. Foram. Res., Vol. IV, pt. 1, no. 54, p. 1, pl. I, figs. 3–4. ALEXANDER 1928, Jour. Pal., Vol. II, no. 1, p. 44, figs. 1–2.

Upper Goodland of Fort Worth region: Tarrant County, marl seam at road level, Stove Foundry road, 6 miles west of Fort Worth (type locality; holotype Cushman Collection No. 7061). Only in upper one-third of the Goodland formation, most abundant near the middle of its stratigraphic range and less common toward the upper and lower limits; and in one exposure of the uppermost Kiamichi (Mustang Creek, northern Johnson County) according to Alexander.

TEXTULARIDAE

"Nodosaria" texana CONRAD 1857, **18,** 159, pl. XIV, figs. 4 a–c. BÖSE 1910, **8,** 177, pl. XXXV, figs. 4–6, 9; pl. XLV, fig. 3. CHRISTNER AND WHEELER 1918, Univ. Texas Bull. 1819, pl. VIII. ADKINS AND WINTON 1920, **3,** 76, pl. XXI. ADKINS 1920, **1,** 145, pl. XI, fig. 2. WINTON 1925, **115,** pl. XV, fig. 4.

Test consists of a linear, straight or slightly curved, single (in later stages) series of overlapping chambers, with the aperture of each chamber projecting into the next as a slightly pyriform protrusion, resulting in a sagittal profile of the cavity. Shell finely arenaceous, apparently with calcareous cement; no coarse grains or inclusions. Aperture a set of terminal multiple perforations, varying in number but this variation relatively independent of the stage of growth. Initial stage unknown. Externally the species has some resemblance to *Cribrogenerina* Schubert; Mrs. Plummer suggests a resemblance to *Haplostiche* Reuss depending on the labyrinthic character of the chambers. There are several species in the Texas Comanchean. Its reference to the *Textularidae* is quite uncertain.

Trinity: Solitario.
Fredericksburg: Near Austin.
Goodland: Near Fort Worth.
Weno: North-central Texas; northern Trans-Pecos Texas.
Del Rio: South-central Texas; southern Trans-Pecos Texas.

Textularia conica D'ORBIGNY. CARSEY 1926, **13**, 23, pl. VII, fig. 1.
Del Rio: Washita division.

Textularia costata CARSEY 1926,[5] **13**, 26, pl. I, fig. 4.
Navarro: (?=Guembelina ecolata).

Textularia globulosa EHRENBERG. PLUMMER 1927, **74**, p. 37, (**Navarro**); CARSEY 1926, **13**, 25, pl. V, figs. 2 a–b.
Gulf Series. (?=Guembelina globosa).

Textularia globifera REUSS. CARSEY 1926, **13**, 25–26.
Taylor; Navarro.

Textularia rioensis CARSEY 1926, **13**, 24, pl. VII, fig. 2.
Del Rio; Washita.

Textularia semicomplanata CARSEY 1926, **13**, 25, pl. III, fig. 4.
Taylor; Navarro.

Textularia washitensis CARSEY 1926, **13**, 24, pl. VII, fig. 6.
Del Rio.

VERNEUILINIDAE

Clavulina triquetra (REUSS). PLUMMER 1927, **74**, 36; MARTINOTTI 1925, **69**, 176, pl. VI.
Navarro.

Gaudryina bulletta CARSEY 1926, **13**, 28, pl. IV, fig. 4; PLUMMER 1927, **74**, 36–37.
Taylor; Navarro.

Gaudryina filiformis BERTHELIN. CARSEY 1926, **13**, 28, pl. VII, fig. 7; MOREMAN 1927, **73**, 99, pl. XVI, fig. 8.
Del Rio; Eagle Ford: Six miles northwest of Irving.

[5]Type localities of the species described in this bulletin are not recorded by the author.

Gaudryina pupoides D'ORBIGNY. CARSEY 1926, **13,** 27, pl. IV, fig. 5; PLUMMER 1927, **74,** p. 36.

Taylor; Navarro.

Tritaxia tricarinata (REUSS). CARSEY 1926, **13,** 27, pl. VI, figs. 4 a–b.

Del Rio; Taylor; Navarro.

OPHTHALMIDIIDAE

Cornuspira carinata (COSTA). PLUMMER 1927, **74,** 160, pl. XII, fig. 9.

Navarro: (Texas).

MILIOLIDAE

Miliolina sp. CARSEY 1926, **13,** 51, pl. VIII, fig. 5.

(Massilina?) Edwards.

Quinqueloculina rotunda CARSEY 1926, **13,** 50, pl. I, figs. 3 a–b.

Navarro.

Quinqueloculina stelligera SCHLUMBERGER. MOREMAN 1927, **73,** 100, pl. XVI, figs. 11–12.

Eagle Ford: Six miles northwest of Irving.

TROCHAMMINIDAE

Trochammina diagonis (CARSEY) 1926, **13,** 22, pl. III, fig. 1 *(Haplophragmoides).* CUSHMAN AND WATERS 1927, **32,** 83, pl. X, figs. 7 a–c.

Taylor; Navarro; and in well cores at Mexia.

Trochammina gyroides CUSHMAN AND WATERS 1927, **32,** 84, pl. X, figs. 8 a–b.

Navarro: East of Richland.

Trochammina texana CUSHMAN AND WATERS 1927, **32,** 85, pl. XI, figs. 8 a–c.

Navarro: Near Quinlan, Hunt County (type locality).

ORBITOLINIDAE

Orbitolina texana (ROEMER) 1852, **78,** 86, pl. X, figs. 7 a–d. HILL 1893, **55,** 20, pl. I, figs. 2, 2 a–d *(Patellina).* CARSEY 1926, **13,** 22, pl. 6, figs. 6 a–c.

Glen Rose: New Braunfels-Fredericksburg road at Wasp Creek east of Guadalupe River, and upper part of Pedernales River with

Natica praegrandis (type localities); Travis County; Central Texas; southern Trans-Pecos Texas.

Orbitolina walnutensis CARSEY 1926, **13,** 23, pl. VII, figs. 11 a–b; pl. VIII, fig. 3.

Walnut: Near Austin.

Orbitolina whitneyi CARSEY 1926, **13,** 22, pl. VI, figs. 9 a–b.

Glen Rose.

Vaughan[6] states that the species referred to *Orbitolina* from the Lower Cretaceous of Texas also need restudy. "I have had several thin sections prepared of the Texas species. They belong to genera different from those of the Tertiary species (Vaughan 1923, Studies of larger Tertiary foraminifera from tropical and subtropical America, Nat. Acad. Sci., Proc., Vol. IX, p. 254) and appear to represent at least two distinct genera."

LAGENIDAE

Cristellaria turbinata PLUMMER 1927, **74,** p. 94.

"Cretaceous."

Cristellaria degolyeri PLUMMER 1927, **74,** p. 98.

Texas: **Cretaceous.**

Cristellaria scitula BERTHELIN(?). PLUMMER 1927, **74,** p. 100.

Navarro.

Cristellaria earlandi PLUMMER(?). PLUMMER 1927, **74,** p. 104.

Taylor.

Cristellaria gibba D'ORBIGNY. CARSEY 1926, **13,** 37, pl. V, figs. 4 a–b.

Austin chalk; Taylor; Navarro.

Cristellaria rotulata LAMARCK. CARSEY 1926, **13,** 39, pl. VI, fig. 2.

Taylor.

Cristellaria sp. CARSEY.

Cristellaria lineara CARSEY 1926 (not REUSS 1862) **13,** 36, pl. II, fig. 3.

Navarro.

Cristellaria reniformis D'ORBIGNY. CARSEY 1926, **13,** 37, pl. III, fig. 2.

Austin chalk; Taylor; Navarro.

Cristellaria washitensis CARSEY 1926, **13,** 38, pl. VII, fig. 9.

Del Rio.

[6]Vaughan, T. W., 1928. Species of large arenaceous and orbitoidal foraminifera from the Tertiary deposits of Jamaica. Jour. Pal., Vol. I, no. 4, 277–298 (page 282).

Cristellaria navarroensis PLUMMER 1927, **74,** 39–40, 97, fig. 4 (on page 40).

Navarro.

Robulus cultratus MONTFORT. CARSEY 1926, **13,** 38, pl. VI, fig. 3 *(Cristellaria).* MOREMAN 1927, **73,** 99, pl. XVI, figs. 6–7.

Eagle Ford, 6 miles northwest of Irving; **Taylor; Navarro.**

Cushman[7] proposes that if the name *Cristellaria* be abandoned, it should be replaced by *Lenticulina* Lamarck 1804, whose genotype *L. rotula* Lamarck, preserved in the Defrance collection at Caen and examined by Cushman, was collected from the white chalk at Meudon, just outside Paris. He suggests[8] that *Robulus* Montfort 1808 (genotype: *R. cultratus)* be retained for Cristellarias having a radiate aperture and in addition a rounded opening below the apex in the apertural face.

Marginulina regularis D'ORBIGNY. PLUMMER 1927, **74,** p. 107.

Cretaceous: Texas.

Frondicularia alata D'ORBIGNY. CARSEY 1926, **13,** 40, pl. II, fig. 1. MOREMAN 1927, **73,** 99, pl. XVI, fig. 3.

Eagle Ford, 2 miles north of Hebron; **Navarro.**

Frondicularia christneri CARSEY 1926, **13,** 41, pl. VI, fig. 7.

Austin chalk; Taylor.

Frondicularia hebronensis MOREMAN 1927, **73,** 99, pl. XVI, fig. 1.

Eagle Ford: Six miles north of Hebron (type locality).

Frondicularia projecta CARSEY 1926, **13,** 41, pl. VI, fig. 5.

Taylor.

Frondicularia reticulata REUSS. PLUMMER 1927, **74,** 39, 172, pl. II, fig. 5.

Navarro.

Frondicularia archiaciana var. **strigillata** BAGG. PLUMMER 1927, **74.** 115.

Upper Cretaceous: Texas.

Frondicularia interpunctata VON DER MARCK. PLUMMER 1927, **74.** p. 120.

Taylor: Texas.

Lagena hispida REUSS. CARSEY 1926, **13,** 30, pl. IV, fig. 8.

Navarro.

[7]Cushman, J. A., 1927, Contr. Cushm. Lab. Foram. Res., III, pt. 3, no. 45, 142.
[8]Cushman, J. A., 1927, Contr. Cushm. Lab. Foram. Res., III, pt. 4, no. 50, 169

Lagena incidenta CARSEY 1926, **13,** 30, pl. IV, fig. 12.
Taylor.

Lagena sulcata WALKER AND JACOB. CARSEY 1926, **13,** 31, pl. VII, fig. 4.
Del Rio.

Nodosaria alternata CARSEY 1926, **13,** 35, pl. IV, fig. 7.
Taylor.

Nodosaria communis D'ORBIGNY. CARSEY 1926, **13,** 34, pl. VII, fig. 5. MOREMAN 1927, **73,** 99, pl. XVI, fig. 5.
Del Rio; Eagle Ford, 6 miles norwest of Irving; **Taylor; Navarro.**

Nodosaria consobrina D'ORBIGNY. CARSEY 1926, **13,** 32, pl. II, fig. 5.
Taylor; Navarro.

Nodosaria farcimen SOLDANI. CARSEY 1926, **13,** 34, pl. IV, fig. 11.
Taylor.

Nodosaria filiformis D'ORBIGNY. CARSEY 1926, **13,** 33, pl. VII, fig. 8.
Del Rio; Navarro.

Nodosaria sp. CARSEY.
Nodosaria fragilis CARSEY 1926 (not DEFRANCE 1825), **13,** 35, pl. IV, fig. 1.
Del Rio; Taylor; Navarro.

Nodosaria intrasegma CARSEY 1926, **13,** 33, pl. 4, fig. 10.
Taylor.

Nodosaria laevigata NILSSON. CARSEY 1926, **13,** 31, pl. IV, fig. 1.
Taylor; Navarro. (=Glandulina.)

Nodosaria larva CARSEY 1926, **13,** 31, pl. II, fig. 2.
Navarro. (?=Nodosaria radicula.)

Nodosaria marla CARSEY 1926, **13,** 34, pl. IV, fig. 6.
Taylor.

Nodosaria obliqua LINNAEUS. CARSEY 1926, **13,** 35, pl. II, fig. 6.
Del Rio; Navarro.

Nodosaria vertebralis BATSCH. PLUMMER 1927, **74,** p. 89.
Navarro.

Nodosaria vertebralis BATSCH var. **austinensis** CARSEY 1926, **13,** 31, pl. VII, fig. 12.
Austin chalk; Taylor.

Nodosaria affinis D'ORBIGNY. PLUMMER 1927, **74,** p. 90.
Taylor; Navarro.

Nodosaria sagrinensis BAGG. PLUMMER 1927, **74,** p. 86.
Navarro.

Nodosaria spinulosa MONTAGU. PLUMMER 1927, **74,** p. 85.
Navarro.

Nodosaria spinescens (REUSS). PLUMMER 1927, **74,** p. 84.
Taylor; Navarro.

Nodosaria radicula (LINNAEUS). PLUMMER 1927, **74,** p. 78.
Navarro.

Nodosaria longiscata D'ORBIGNY. PLUMMER 1927, **74,** p. 82.
Cretaceous.

Nodosaria granti PLUMMER 1927, **74,** 83, pl. V, figs. 9 a–d.
Taylor; Navarro.

Vaginulina gracilis PLUMMER var. **cretacea** PLUMMER 1927, **74,** 172, pl. II, fig. 8.
Navarro: Six miles north 15° east of Cameron (type locality).

Vaginulina simondsi CARSEY 1926, **13,** 40, pl. II, fig. 4. MOREMAN 1927, **73,** 98, pl. XVI, fig. 1.
Eagle Ford, 2 miles north of Hebron; **Navarro.**

Vaginulina webbervillensis CARSEY 1926, **13,** 39, pl. II, fig. 7. PLUMMER 1927, **74,** 172, pl. II, fig. 7. MOREMAN 1927, **73,** 98, pl. XVI, fig. 2.
Eagle Ford, 2 miles north of Hebron; **Navarro,** clay pit south of Corsicana.

POLYMORPHINIDAE

Polymorphina communis D'ORBIGNY. CARSEY 1926, **13,** 42, pl. I, fig. 5. PLUMMER 1927, **74,** p. 124.
Navarro. (=Guttulina.)

NONIONIDAE

Nonion scapha (FITCHEL AND MOLL). CARSEY 1926, **13,** 49, pl. I, figs. 2 a–c.
(Nonionina). **Navarro.**

Nonion turgida (WILLIAMSON). PLUMMER 1927, **74.** 159. pl. XII, figs. 6 a–c, 7 a–b *(Nonionina).*
Upper Navarro.

HETEROHELICIDAE

Bolivinita planata CUSHMAN 1927, **31**, 115, pl. XXIII, figs. 9 a–b.

Pecan Gap chalk: One and eight-tenths miles northeast of Rockwall (holotype).

Guembelina concinna REUSS(?). THOMAS AND RICE 1927, **98**, fig. 6.

Austin chalk.

Guembelina decurrens CHAPMAN. THOMAS AND RICE 1927, **98**, fig. 9.

Taylor.

Guembelina globifera (REUSS). THOMAS AND RICE 1927, **98**, fig. 4. CARSEY 1926, **13**, p. 25.

Austin chalk: No locality stated.

Guembelina globulosa (EHRENBERG). CUSHMAN 1926, **30**, 61, pl. XIII, fig. 3. MOREMAN 1927, **73**, 99, pl. XVI, fig. 10.

Eagle Ford, 6 miles northwest of Irving; **Upper Cretaceous.**

Guembelina cf. **globulosa** WOODWARD AND THOMAS (not EHRENBERG). THOMAS AND RICE 1927, **98**, fig. 2.

Eagle Ford.

Guembelina striata (REUSS). THOMAS AND RICE 1927, **98**, fig. 12.

Navarro.

Ventilabrella spp. CUSHMAN 1928, Contr. Cushm. Lab. Foram. Res., Vol. IV, pt. 1, no. 54, p. 3.

Taylor: "Species of *Ventilabrella* occur often in great numbers in certain horizons of the Taylor marl of Texas"; Mendez shale in northeast Mexico.

Planoglobulina acervulinoides (EGGER). CUSHMAN 1926, **30**, 61, pl. XIII, fig. 5. THOMAS AND RICE 1927, **98**, fig. 8. CUSHMAN 1926, Contr. Cushm. Lab. Foram. Res., II, 17, pl. II, fig. 5. *(Pseudotextularia)*

Taylor.

Pseudotextularia fracticosa (EGGER). THOMAS AND RICE 1927, **98**, fig. 11.

Navarro.

Pseudotextularia *a* PLUMMER 1927, **74**, 172, pl. II, fig. 3.

Navarro: Six miles south 15° east of Cameron.

Pseudotextularia *b* PLUMMER 1927, **74**, 172, pl. II, fig. 2.

Navarro: Same locality.

Pseudotextularia *c* PLUMMER 1927, **74,** 172, pl. II, fig. 3.

Navarro: Same locality.

Pseudotextularia *d* PLUMMER 1927, **74,** 172, pl. II, fig. 3.

Navarro: Same locality.

Pseudouvigerina plummerae CUSHMAN 1927, **31,** 115, pl. XXIII, figs. 8 a–b.

Pecan Gap chalk: One and eight-tenths miles northeast of Rockwall (holotype).

Spiroplectoides rosula (EHRENBERG). CUSHMAN 1927, Contr. Cushm. Lab. Foram. Res., II, pt. 4, no. 33, p. 78. "**Upper Cretaceous** of Texas." CUSHMAN 1927, **31,** 114, pl. 23, figs. 6–7.

Pecan Gap chalk: One and one-eighth miles northeast of Rockwall.

BULIMINIDAE

Bolivina clavata CUSHMAN 1927, **29,** 87, pl. XII, figs. 5 a–b.

Taylor: Clay pit of Dallas Brick Company, one-half mile west of Mesquite (holotype).
Navarro: Limestone and Navarro counties.

Bolivina decurrens (EHRENBERG). CUSHMAN 1927, **29,** 88, pl. XII, fig. 4.

Navarro: East of Richland.

Bolivina gemma CUSHMAN 1927, **29,** 87, pl. XII, figs. 3 a–b.

Navarro (and **Brownstown marl** of Arkansas).

Bolivina latticea CARSEY 1926, **13,** 27, pl. IV, fig. 9.

Taylor. (?=Bolivinoides decorata Cushman.)

Bolivina incrassata REUSS. CUSHMAN 1927, **29,** 86, pl. XII, figs. 1 a–b.

Annona chalk: Ten miles east of Dekalb, Bowie County.
Navarro: Northwest of Annona and east of Richland.

Bolivina tegulata REUSS. CUSHMAN 1927, **29,** 86, pl. XII, fig. 2.

Taylor: Clay pit of Dallas Brick Company, one-half mile west of Mesquite.
Navarro: One-half mile south of Kemp.

Bolivina watersi CUSHMAN 1927, **29,** 88, pl. XII, fig. 6.
Navarro: East of Richland (holotype).

Bolivinoides decorata (JONES). CUSHMAN 1927, **29,** 89, pl. XII, fig. 9.
Austin chalk: Ten miles north by east of Dekalb, Bowie County.

Taylor: Four miles southwest of Taylor; 1.8 miles northwest of Annona.

Bolivinoides decorata var. **delicatula** CUSHMAN 1927, **29**, 90, pl. XII, fig. 8.

Upper Taylor; Navarro.

Bulimina sp. CARSEY.

Bulimina compressa CARSEY 1926 (not BAILEY 1851), **13**, 29, pl. IV, fig. 14.

Taylor.

Bulimina pupoides D'ORBIGNY. CARSEY 1926, **13**, 29, pl. IV, fig. 3. PLUMMER 1927, **74**, 37, 172, pl. II, fig. 11.

Taylor; Navarro, clay pit south of Corsicana.

Bulimina aculeata D'ORBIGNY. PLUMMER 1927, **74**, p. 74.

Navarro.

Buliminella sp. PLUMMER 1927, **74**, p. 37.

Upper Navarro.

Virgulina sp. PLUMMER 1927, **74**, p. 37.

Upper Navarro.

Bolivina plaita CARSEY 1926, **13**, 26, pl. IV, fig. 2 *(Bolivina);* PLUMMER 1927, **74**, pp. 36–37; CUSHMAN 1927, **29**, 89, pl. XII, figs. 7 a–b.

Taylor; Navarro.

Cushman (Contr. Cushm. Lab. Foram. Res., I, 3, 214) states that species with terminal aperture should be called *Loxostomum,* and that *Proroporus* and *Bolivina* are synonyms.

Uvigerina tenuistriata REUSS. CARSEY 1926, **13**, 42, pl. I, fig. 1.

Navarro.

Siphogenerina elegantula PLUMMER 1927, **74**, 126, pl. VIII, figs. 1 a–c.

Taylor; Navarro.

Siphogenerina plummeri CUSHMAN 1926, Contr. Cushm. Lab. Foram. Res., II, pt. 1, 15, pl. I, figs. 7 a–c.

Upper Navarro: Six and one-half miles north of Cameron (holotype).

Navarro: One-half mile south of Kemp.

ELLIPSOIDINIDAE

Pleurostomella subnodosa (REUSS). CUSHMAN 1927, Contr. Cushm. Lab. Foram. Res., III, pt. 2, 131.

Navarro: Branch of Kickapoo Creek, 1.8 miles northwest of Annona and 1,200 feet south of public road.

Pecan Gap chalk: Greenville-Wolfe City road, 5.1 miles south by west of Wolfe City.

Ellipsopleurostomella attenuata PLUMMER 1927, **74,** 131, pl. VIII, figs. 6 a–d.

Taylor: Two miles southwest of Taylor.

Eouvigerina americana CUSHMAN 1926, Contr. Cushm. Lab. Foram. Res., II, pt. 1, p. 4, pl. I, figs. 1 a–c.

Taylor: Dallas Brick Company's clay pit, one-half mile west of Mesquite (holotype).

Eouvigerina gracilis CUSHMAN 1926, Contr. Cushm. Lab. Foram. Res., II, pt. 1, p. 5, pl. I, figs. 2 a–c.

Taylor: Dallas Brick Company's clay pit, one-half mile west of Mesquite (holotype).

ROTALIIDAE

Discorbis correcta CARSEY 1926, **13,** 45, pl. III, figs. 5 a–b.

Taylor; Navarro.

Rotalia cretacea CARSEY 1926, **13,** 48, pl. V, figs. 1 a–b.

Taylor; Navarro.

Rotalia perplexa PLUMMER 1927, **74,** 156, pl. XII, figs. 2 a–c.

Upper Navarro.

Rotalia soldani D'ORBIGNY. PLUMMER 1927, **74,** p. 154.

Navarro. (=Gyrordina.)

Rotalia aequilateralis PLUMMER 1927, **74,** 155, pl. XII, fig. 3.

Navarro.

Siphonina prima PLUMMER 1927, **74,** 148, pl. XII, figs. 4 a–c.

Uppermost Navarro.

Pulvinulina partschiana (D'ORBIGNY). PLUMMER 1927, **74,** 154, pl. XL, figs. 5 a–c.

Upper Navarro: Hunt and Hopkins counties. (Referred to **Epistomina elegans** d'Orbigny 1826, CUSHMAN 1927, Contr. Cushm. Lab. Foram. Res., III, pt. 4, 182, pls. XXXI–XXXII.)

CASSIDULINIDAE

Ceratobulimina cretacea CUSHMAN AND HARRIS 1927, Contr. Cushm. Lab. Foram. Res., III, pt. 4, 173, pl. XXIX, figs. 1 a–c; pl. XXX, fig. 11.

Navarro: Mexia oil field (holotype, Cushman Coll. No. 7030).

Ceratobulimina perplexa (PLUMMER) 1927, **74**, 156, pl. XII, figs. 2 a–c *(Rotalia)*. CUSHMAN AND HARRIS 1927, Contr. Cushm. Lab. Foram. Res., III, pt. 4, 173, pl. XXIX, figs. 2 a–c.

Topmost Navarro: Texas. The types are from the Midway in Texas. *Ceratobulimina* TOULA 1920 (genotype: *Rotalia contraria* REUSS 1851) is stated to be derived from *Discorbis*-like forms and to be related to *Pulvinulinella* and *Cassidulina*.

CHILOSTOMELLIDAE

Pullenia quinqueloba REUSS. PLUMMER 1927, **74**, 136, pl. VIII, figs. 12 a–b.

Navarro: Northeast Texas.

Allomorphina trigona (REUSS). PLUMMER 1927, **74**, 129, pl. VIII, figs. 5 a–b.

Navarro: Hunt County.

GLOBIGERINIDAE

Globigerina aequilateralis H. B. BRADY. PLUMMER 1927, **74**, p. 36.

Navarro.

Globigerina cretacea D'ORBIGNY. CARSEY 1926, **13**, 43, pl. V, figs. 5 a–b. PLUMMER 1927, **74**, p. 36. MOREMAN 1927, **73**, 100, pl. XVI, figs. 14–15.

Del Rio: Upper Cretaceous; Eagle Ford, 6 miles northwest of Irving; **Navarro.**

Globigerina cretacea D'ORBIGNY var. **del-rioensis** CARSEY 1926, **13**, p. 43. *(Globigerina cretacea* var. *del rioensis* CARSEY: varietal name invalid because quadrinomial.)

Georgetown; Del Rio.

Globigerina rosetta CARSEY 1926, **13**, 44, pl. V, figs. 3 a–c. PLUMMER 1927, **74**, 36, 172, pl. II, fig. 9.

Del Rio; Austin chalk; Taylor; Navarro, 6 miles north 15° east of Cameron.

MOREMAN (1927, **73**, p. 100) and CUSHMAN state that this species is identical with *Globotruncana arca* (listed below).

Globigerina rugosa PLUMMER 1927, **74**, 38–39, 172, pl. II, fig. 10.

Navarro: Six miles north 15° east of Cameron.

Globigerina washitensis CARSEY 1926, **13**, 44, pl. VIII, fig. 2.

Georgetown; Del Rio.

Orbulina universa D'ORBIGNY. CARSEY 1926, **13**, p. 45.

Georgetown.

GLOBOROTALIIDAE

Globotruncana arca (CUSHMAN). MOREMAN 1927, **73**, 100, pl. XVI, figs. 16–17.
Eagle Ford: Two miles north of Hebron.

Globotruncana calcarea CUSHMAN 1927, **31**, 115, pl. XXIII, figs. 10 a–b.
Pecan Gap chalk: Farmersville (type locality).

Globotruncana canaliculata (REUSS). CUSHMAN 1927, **31**, 116, pl. 23, figs. 11 a–c.
Pecan Gap chalk: Farmersville (type locality).

ANOMALINIDAE

Anomalina eaglefordensis MOREMAN 1927, **73**, 99, pl. XVI, fig. 9.
Eagle Ford: Two miles north of Hebron.

Anomalina grosserugosa GUMBEL. CARSEY 1926, **13**, 46, pl. III, figs. 3 a–b.
Taylor; Navarro.

Anomalina navarroensis PLUMMER 1927, **74**, 38, 150, 172, pl. II, fig. 6.
Navarro.

Anomalina ammonoides REUSS, var. **acuta** PLUMMER 1927, **74**, 149, pl. X, figs. 2 a–c.
Taylor(?): Texas.

Anomalina petita CARSEY 1926, **13**, 48, pl. 7, fig. 3.
Del Rio.

Anomalina pseudopapillosa CARSEY 1926, **13**, 47, pl. I, figs. 6 a–b.
Navarro.

Anomalina taylorensis CARSEY 1926, **13**, 47, pl. VI, figs. 1 a–b.
Austin; Taylor.

Cibicides refulgens MONTFORT, var. **conica** CARSEY 1926, **13**, 46, pl. IV, figs. 15 a–b *(Truncatulina)*.
Taylor.

Truncatulina alleni PLUMMER 1927, **74**, 144, pl. X, figs. 4 a–c.
Navarro: Hunt and Hopkins counties.

Phylum COELENTERATA

Subphylum PORIFERA[9]

Class SPONGIAE

Sub-Class SILICISPONGIAE *(Siliceous Sponges)*

Order MONACTINELLIDA ZITTEL

Axinella (?) sp. aff. **dispersa** HINDE. MERRILL 1895, **72,** 12, figs. 1–2 (not rare).

Renieria (?) sp. MERRILL 1895, **72,** 12, figs. 3–4.
gen. indet., MERRILL 1895, **72,** 12, fig. 5.
gen. indet., MERRILL 1895, **72,** 13, fig. 6.
gen. indet., MERRILL 1895, **72,** 13, fig. 7 (common).
gen. indet., MERRILL 1895, **72,** 13, fig. 8.

Esperites (?) sp. aff. **haldonensis** CARTER. MERRILL 1895, **72,** 13, fig. 9 (very common); on page 25 it is given as "*Esperia* (?) sp."

Renieria (?) sp. aff. **zitteli** POCTA. MERRILL 1895, **72,** 14, fig. 10 (not uncommon).

Renieria (?) sp. MERRILL 1895, **72,** 14, fig. 36.

Order TETRACTINELLIDA MARSHALL

Geodia spini-curvata MERRILL 1895, **72,** 15, fig. 13.
Edwards: Near Austin (type locality).

Geodia (?) **cretacea** MERRILL 1895, **72,** 15, fig. 12.
Edwards: Near Austin (type locality).

Geodia (?) **austini** MERRILL 1895, **76,** 16, fig. 11.
Edwards: Near Austin (type locality).

Geodia (?) **irregularis** MERRILL 1895, **72,** 16, fig. 14.
Edwards: Near Austin (type locality).

Geodia (?) **tripuncta** MERRILL 1895, **72,** 16, fig. 15; and fig. 22 (questionably).
Edwards: Near Austin (type locality).

Geodia (?) **texana** MERRILL 1895, **72,** 16, fig. 18.
Edwards: Near Austin (type locality).

[9]The locality of all sponges described by Merrill as listed below is a "quarry near Austin, Texas." They occur in flint nodules in the Edwards limestone.

Geodia (?) spinipansata MERRILL 1895, **72,** 17, fig. 20 *(Geodia? spini-pansata,* on page 25).

Edwards: Near Austin (type locality).

Geodia (?) **hilli** MERRILL 1895, **72,** 17, fig. 21.

Edwards: Near Austin (type locality).

Geodia (?) sp. MERRILL 1895, **72,** 17, 25, fig. 27 (very common).

Geodia (?) sp. MERRILL 1895, **72,** 18, 26, fig. 29.

Geodia (?) sp. MERRILL 1895, **72,** 18, 26, fig. 31.

Geodia (?) sp. MERRILL 1895, **72,** 18, fig. 32.

Hymeraphia (?) sp. MERRILL 1895, **72,** 16, fig. 16.

Hymeraphia (?) sp. MERRILL 1895, **72,** 17, fig. 19.

Hymeraphia (?) sp. MERRILL 1895, **72,** 17, 25, figs. 24, 25, 26.

Chondrilla (?) sp. MERRILL 1895, **72,** 16, fig. 17.

gen. indet. MERRILL 1895, **72,** 17, fig. 28.
gen. indet. MERRILL 1895, **72,** 26, fig. 30.

Order LITHISTIDA SCHMIDT

gen. indet. MERRILL 1895, **72,** 19, fig. 23.

Order HEXACTINELLIDA SCHMIDT

Stauractinella (?) sp. MERRILL 1895, **72,** 19, fig. 33 (common).

Stauractinella (?) sp. MERRILL 1895, **72,** 19, fig. 34 (common).

gen. aff. **Leptophragma** ZITTEL. MERRILL 1895, **72,** 19, fig. 35.

Dr. J. A. Udden reports having collected the following calcareous sponges from Cretaceous strata in Texas. Both sponges are stated to have essentially similar microscopic structure, *i.e.*, spicules as in the *Hexactinellida* but much finer, and both calcareous.

Sponge indet., sp. A., UDDEN.

Form definite, in shape an oblate spheroid, with clearly defined outline along which it breaks from the matrix.

Austin chalk: Brewster County, about three miles south of McKinney Spring, southeast of Stillwell ranch and west of the Boquillas (Carmen) range (common). Maverick County, 4 to 10 miles southwest of Spofford, in a small excavation.

Sponge indet., sp. B., Udden 1907, **100**, p. 25.

Microscopic structure like the preceding species, but habit different: outline of mass not definitely delimited, but on fracture thin meandering bands of spicular tissue (separated by matrix) are seen to compose the mass.

Buda: Brewster County, west slope of Mariscal Mountain, not far from the Rio Grande. Kinney County, on Buda outcrop north of Southern Pacific Railway track and north of the west end of Anacacho Mountains.

Some sponges have been collected from the Washita cap rocks near Fort Stockton.

Clione (?) sp. Cp.: Fischeur, P., Recherches sur les éponges perforantes fossiles. Mus. Hist. Nat., Nouv. Mém., 117–172, pls. XXIV–XXV (genus *Cliona).*

Perforations generally attributed to this boring sponge are common on Comanchean and on Upper Cretaceous shells in Texas; at certain Comanchean levels great numbers of oysters *(Ostrea, Gryphea, Exogyra)* are affected.

Comanchean, Upper Cretaceous: Generally in Central Texas.

Subphylum CNIDARIA

Class ANTHOZOA (=ACTINOZOA). Corals

Order MADREPORARIA

Suborder APOROSA

ASTRAEIDAE Milne-Edwards and Haime

The first two genera here listed are branched corals, the last three genera are compound corals.

PLEUROCORA Milne-Edwards and Haime

Pleurocora texana Roemer 1888, **80**, 7, pl. I, fig. 2.

Edwards: Austin, Barton Creek (type locality).

Pleurocora coalescens Roemer 1888, **80**, 7, pl. I, fig. 3.

Edwards: Austin, Barton Creek (type locality).

CLADOPHYLLIA

Cladophyllia furcifera Roemer 1888, **80**, 8, pl. I, figs. 4 a–c. Hubbard 1920, Proc. N.Y. Acad. Sci., Vol. 3, pt. 2.

Edwards: Austin, Barton Creek (type locality).

ORBICELLA DANA

Orbicella (?) **texana** VAUGHAN, in SHATTUCK 1905, **86**, 38, pl. XXVI, fig. 1; pl. XXVII, fig. 6.

Corallum forming rather large masses, as much as 140 mm. high and more than that much across. The corallites are small, the usual diameter being between 1 and 2 mm.; they are crowded or not, the distance between adjacent corallites being in some cases as great as the diameter of the corallites. The costae are prominent and join the corallites one to another. The usual number of septae is 20, 10 small and 10 large; they are much thicker at the wall than in the costal or inner portion. The lateral faces bear rather tall, erect spines. Exotheca present; endotheca rare. Columella poorly developed, composed of a few processes from the inner ends of the septa. (Vaughan)

Buda: Austin, Shoal Creek (type locality; type at Johns Hopkins University).

HINDESASTRAEA WHITE

Corallum depressed or discoid, simple in the earlier stages of growth, but afterward becoming compound by gemmation; basal epitheca marked by both radiating striae and concentric rugae; corallites few, without true columella, their outer walls fused together when in contact, and moderately strong; radiating septae bilaminate, subequal in thickness at their peripheral ends, consisting of three or four cycles as regards their length, subspinulose, tuberculose, or rugose upon their sides and upon their free upper edge; dissepiments few or absent.

Genotype: *H. discoidea* WHITE (Navarro of Texas).

Hindesastrea discoidea WHITE 1888, **110**, 363, text figs. 1–5.

Corallum irregularly discoid or much depressed, attached by the apex of the original corallite, or free; corallites few, very short but moderately broad; the walls of the adjacent corallites usually in contact and fused together, when the border is polygonal; but they sometimes have a tendency to separate, when the border is subcircular; calices slightly concave or nearly flat; their borders more or less prominent and clearly defined; radiating septa prominent, 22 to 26, usually 24, in number; those of the first cycle, 4 to 6 in number, reaching nearly or quite to the center of the corallite, where they are more or less contorted. Those of the second cycle do not usually terminate interiorly by free ends, but are there joined to one another or to those of the first cycle. Those of the third cycle usually terminate like those of the second, but are sometimes free at the inner end; the sides and free edges of the septa subspinulose or tuberculose. The number of corallites in a corallum varies from

1 to 7 or 8, their gemmation taking place at the margin of the calice, and usually after the original corallite had attained considerable size. Diameter of the largest calice observed is 8 mm.

Navarro: Kaufman County (type locality; types in United States National Museum).

FAVIA OKEN

Favia texana CRAGIN 1893, **21**, 145, pl. XXIV, fig. 1; pl. XLVI, fig. 5.

Stock depressed-pulvinate, or sublenticular, broadly and somewhat irregularly ovate or rotund-ovate as viewed from above; calyxes irregularly distributed, united by thick walls, provided with a slightly raised border, rounded or often with one or several obtuse angles, varying from rotund, ovate, or elliptical to irregularly bilobate or trilobate, according to the particular stage of fission; intercalycular surface radially sulcate, roughened.

Height of larger stock 40 mm., length 90 mm., breadth 78 mm.; major and minor diameters of an average calyx respectively about 5 and 3.5 mm.; length of longest lobate calyx 9 mm.; average interval between neighboring calyxes 2 mm.

Horizon uncertain: Drift at Pilot Knob, Travis County (calcitized).

EUSMILIIDAE Verrill

Like the *Astraeidae* except that upper septal edges are entire, not serrated. *Astrocoenia* is a compound coral; the others here listed are simple corals.

TROCHOSMILIA MILNE-EDWARDS AND HAIME

Trochosmilia sp. VAUGHAN, in SHATTUCK 1905, **86**, 38, pl. XXVII, figs. 4–5.

Simple coral; fragment 19 mm. tall, greater diameter of calyx 15.5 mm., lesser diameter 10 mm. or more. The corallum is nearly straight; the calyx is apparently inclined to the vertical axis, the shorter transverse axis not lying in a horizontal plane. Wall solid; costae well developed, corresponding to all septa, regularly alternating in size. The larger costae are tall, narrow and thin, with sharp edges. Over the costae are many granulations.

Buda: Austin, Shoal Creek.

TROCHOSMILIA CHIHUAHUENSIS AGUILERA. BÖSE 1910, **8**, pp. 51, 53.

Fredericksburg: Placer de Guadalupe, Chihuahua.

PARASMILIA

Parasmilia austinensis ROEMER 1888, **80,** 6, pl. I, figs. 1 a–b.

Edwards: Austin, Barton Creek (type locality).

Parasmilia texana VAUGHAN, in SHATTUCK 1905, **86,** 37, pl. XXVII, figs. 1–3.

Corallum short, subcornute; cross-section elliptical, somewhat curved in the plane of the shorter transverse axis. Base not preserved intact, but evidently small. Septae in four cycles, septal edges granulate. Columella well developed, vesicular.

Buda: Austin, Shoal Creek (type locality).

COELOSMILIA MILNE-EDWARDS AND HAIME

Like *Trochosmilia,* but with dissepiments sparsely developed.

Coelosmilia americana ROEMER 1888, **80,** 6, pl. I, figs. 5 a–b.

Edwards: Austin, Barton Creek (type locality).

ASTROCOENIA

Astrocoenia texana ROEMER 1852, **78,** 87, pl. X, figs. 8 a–b. VAUGHAN, in SHATTUCK 1905, **86,** p. 39.

Float: New Braunfels.

Astrocoenia maloniana VAUGHAN, in CRAGIN 1905, **27,** 34, pl. II, figs. 1–3.

Jurassic? or Cretaceous: One and one-half miles east of Torcer Station (type locality).

Suborder FUNGIDA DUNCAN

AGARICIIDAE Verrill

Leptophyllia sp. 1 VAUGHAN, in SHATTUCK 1905, **86,** 39, pl. XXVII, figs. 9–11.

Buda: Austin, Shoal Creek.

Leptophyllia sp. 2 VAUGHAN, in SHATTUCK 1905, **86,** 39, pl. XXVII, figs. 7–8.

Buda: Austin, Shoal Creek.

ANABACIIDAE Duncan

MICRABACIA MILNE-EDWARDS AND HAIME

Micrabacia mineolensis STEPHENSON 1916, U. S. Geol. Surv., Prof. Paper 98-J, 122, pl. XXIII, figs. 6–8.

Navarro (probably): Well of Hoard Oil and Gas Company, 7 miles east of Mineola, Woods County, at depths of 3,146–3,160 feet (type locality).

Phylum ANNELIDA

Class CHAETOPODA

Tube non-operculate, lacks longitudinal ridges........................**Serpula**
Tube operculate, with longitudinal ridges, generally six....**Hamulus**

SERPULA Linnaeus

A composite group of calcareous tubes, free or adherent, single, clustered or colonial; of various shapes, straight, spiral, tortuous; ornamented or smooth. The Texan species have not been well studied.

Tubes smooth:
  Tubes tortuous, mainly attached...............**S. gordialis; S. cragini**
  Tubes nearly straight and parallel, aggregated in masses........
  ....**S. paluxiensis; S. socialis**
Tubes with circular constrictions...................**S. texana; S. cretacea**

Serpula gordialis Goldfuss. Giebel 1853, **45,** 363.

Horizon unknown: Cibolo Creek and (or) near New Braunfels.

Serpula cragini Twenhofel 1924, **99,** 52, pl. VII, fig. 1. *Serpula championi* Cragin 1895, Amer. Geol. XVI, 369 *(nomen nudum).*

Tube smooth, tortuous, attached, cross-section circular, wall composed of one or three layers; tube diameter 2 mm., thickness .33 mm.

Described from **Champion shell bed** of Kansas; similar to a form from the Comanchean of Texas.

Serpula aff. **socialis** Goldfuss. Cragin 1903, **27.**

Malone beds: East of Torcer.

Serpula texana Giebel 1853, **45,** 363, pl. VI, fig. 4.

Tube ornamented with rings and constrictions, every sixth one more prominent; cross-section circular, diameter at aperture 5 mm.

Horizon uncertain: Cibolo Creek and (or) near New Braunfels (type locality).

Serpula filosa Goldfuss. Giebel 1853, **45,** 363.

Horizon uncertain: Cibolo Creek and (or) near New Braunfels.

Serpula paluxiensis Hill 1893, **55,** 21, pl. I, figs. 4, 4 a, 4 b.

Basal Glen Rose: Paluxy River near Glen Rose (type locality).

Serpula cretacea (Conrad). Stephenson 1923, **96,** 67, pl. IX, figs. 1–12.

Single, paired or colonial tubes composed of numerous, thin, concentric layers arranged as a series of truncated cones, one within the other; the cones gradually increase in size from the apex of the tube toward the larger end; diameter of tube at small end 1.5 mm., or less; diameter at large end 12 mm., or more. Outer surface of tube with fine annular growth rings and, nearer the larger end, with variable, coarser, raised annulations.

Navarro (*Exogyra costata* zone): Kaufman County: Near Kaufman (U. S. N. M. cat. no. 21001); Simpson's Hill, on public road two miles southwest of Kaufman (7546); Simpson's field, two miles southwest of Kaufman (7547). Navarro County: Near Corsicana (U. S. N. M. cat. no. 20906).

HAMULUS Morton

Straight or slightly curved tubes with generally six longitudinal ridges; tubes mainly unattached; cross-section oval to circular; operculum present.

Longitudinal (axial) ridges subequal..**H. onyx**
Two ridges, on opposite sides, more salient than others:
Tall ridges extend to aperture; low ridges closely spaced..**H. jonahensis**
Tall ridges reduced near aperture; low ridges widely spaced..**H. squamosus**

Hamulus onyx Morton 1834. Morton, Synopsis Organ. Rem. Cret. Group, p. 73, pl. II, fig. 8; pl. XVI, fig. 5 (genotype). Wade 1921, The fossil annelid genus *Hamulus* Morton, an operculate Serpula. Proc. U. S. Nat. Mus., no. 2359, Vol. XLIX, 41–46, pls. IX–X. Stephenson 1923, **96**, 76, pl. X, fig. 11. Wade 1926, **103**, 30, pl. II, figs. 4–7, 12 (bibliography). Dane and Stephenson 1928, **118**, p. 53.

Taylor (upper part of *Exogyra ponderosa* zone): Guadalupe River, four miles below New Braunfels (U. S. N. M. cat. no. 21205). **Taylor (Marlin chalk)**: Limestone or Falls County.

Navarro (*Exogyra costata* zone): Bluff on Onion Creek, 2.5 miles west of Garfield, Travis County (7605); 2 miles west of Webberville (U. S. N. M. cat. no. 21195).

Austin chalk (upper): Travis County. Cárdenas beds; 6.5 km. east of Cárdenas, San Luis Potosí.

Hamulus jonahensis (Cragin) 1893, **21**, 260, pl. XXIX, figs. 12–14 (*Serpula*). Wade 1926, **103**, p. 44.

Austin chalk (uppermost): Williamson County, San Gabriel River 2 miles below Jonah (type locality). Travis County, near Sprinkle; Manor road, 3 miles east of Austin.

Navarro: Guadalupe County.

Hamulus squamosus GABB. WADE 1926, **103**, 31, pl. II, figs. 8, 13 (lit. refs.). DANE AND STEPHENSON 1928, **118**, p. 53.

Taylor (Marlin chalk): Limestone or Falls County.

Phylum MOLLUSCOIDEA

Class BRACHIOPODA

TEREBRATELLIDAE King

KINGENA DAVIDSON[10]

Cardinal margin curved, no area; pedicel opening not common to the two valves. Brachial apparatus consists of long, rather simple descending loops (attached above by crura to cardinal process), and shorter ascending loops joined ventrally by broad jugum, which extends backwards to attach to the medium septum. The shell structure is punctate, but the unweathered surface is generally smooth, with growth lines of variable prominence; punctation is thus a feature of the inner shell layers, and indicates weathering.

Kingena wacoensis (ROEMER) 1852, **78,** 81, pl. VI, figs. 2 a–c *(Terebratula).* CONRAD 1857, **18,** 147, pl. III, figs. 1 a–d *(Terebratula).*

Texan specimens of *Kingena* have a great range in size, thickness and contour: some are thin ventro-dorsally, others thick; some are subcircular, others basally truncated and of subpentagonal outline. Roemer's figures show a rather thick, subpentagonal, basally truncated species.

Range of genus: Entire **Washita** division. In north-central Texas, generally abundant in **upper Duck Creek,** entire **Main Street, basal Grayson,** and locally abundant in the **Denton** (large individuals) and **Pawpaw.** Near Austin, thin zones occur through most of the **Georgetown** limestone. Rare in **Fredericksburg** and **Trinity** divisions: **Edwards** (Round Rock), **Glen Rose** (Solitario). Type locality: Waco camp, above New Braunfels **(Georgetown limestone).**

Kingena leonensis (CONRAD) 1857, **18,** 164, pl. XXI, figs. 2 a–c *(Terebratula).*

Internal characters unknown. Differs from *K. wacoensis* in outline: basally, instead of being truncated, it is sharply rounded and gives the general effect of being pointed; it has a less quadrate contour, and the basal sinuation is absent.

Kiamichi-Duck Creek: Pecos County, Leon Springs (type locality).

[10]Sandidge, John R., 1928. The recurrent brachiopods of the lower Cretaceous of northern Texas. Am. Jour. Sci. (5), XV, 314–318, 1 text fig.

Kingena choctawensis (SHUMARD) 1854, **87,** 181 *(Terebratula).*

Shumard states that it differs from *K. wacoensis* in being smaller, more punctate, less truncate, and in having a narrower area. The figures show it to be a small, very thick species, with almost circularly rounded basal margin. A detailed study of the Texan Kingenas will be necessary to determine whether it will stand as a valid species.

Kiamichi-Duck Creek(?): Fort Washita (type locality).

Terebratula guadalupae ROEMER 1852, **78.**

Austin chalk: Falls of Guadalupe River, near New Braunfels (type locality).

Lingula (?) sp.

Terlingua beds (Taylor): Alpine road, 12 miles north of Terlingua, 3 miles east of Hen Egg Mountain.

Lingula (?) **shumardi** CRAGIN 1893, **21,** 166.

Eagle Ford: Fannin County, one-half mile east of Ector on Bonham-Sherman road (in fish-tooth conglomerate).

Phylum ARTHROPODA

Class CRUSTACEA

OSTRACODA[10a]

CYTHERIDAE Zenker

CYTHERE MULLER

Cythere cornuta (ROEMER). MOREMAN 1927, **73,** p. 98.

Eagle Ford: Locality not stated.

CYTHEREIS JONES

Cythereis ornatissima (REUSS). MOREMAN 1927, **73,** p. 97.

Eagle Ford: Locality not stated.

CYPRIDAE Zenker

CYPRIDEA BOSQ

Cypridea texana HILL. HILL 1893, **55,** 39, pl. I, figs. 3 a–b.

Glen Rose: Mount Bonnell, Austin (type locality).

BAIRDIA M'COY

Bairdia subdeltoidea (MÜNSTER). MOREMAN 1927, **73,** 94, 95, pl XVI, fig. 18. ALEXANDER 1927, **4,** 31, pl. VI, figs. 2, 4.

Eagle Ford: Localities not stated.

[10a]Alexander, C. I., 1928. The ostracoda of the Cretaceous of North Texas. Univ Texas Bull. (in press).

Bairdia subdeltoidea var. **rotunda** ALEXANDER. ALEXANDER 1927, **4**, 31, pl. VI, figs. 1–2.

Taylor: No locality stated. Holotype 9003 Princeton University Collections.

Bairdia obliqua ALEXANDER. ALEXANDER 1927, **4**, 32, pl. VI, fig. 6.

Taylor: No locality stated. Holotype 9005 Princeton University Collections.

Bairdia magna ALEXANDER. ALEXANDER 1927, **4**, 32, pl. VI, figs. 7–8.

Navarro: No locality stated. Holotype 9006 Princeton University Collections.

CYTHERELLIDAE Sars.

CYTHERELLA JONES

Cytherella muensteri (ROEMER). MOREMAN 1927, **73**, 94, 95, 97, pl. XVI, fig. 13.

Eagle Ford: Locality not stated.

WINTON, 1925 (Univ. Texas Bull. 2544, pp. 65, 67, 77, pls. 14, 18) reports the following ostracoda from the Texas Cretaceous:

Cythere sp. **115**, pl. XIV, fig. 4.

Duck Creek.

Cythereis spp. **115**, pl. XIV, figs. 3, 4, 6, 8.

Duck Creek.

Cythereis sp. **115**, 77, pl. XVIII, fig. 14.

Eagle Ford.

Cythereis sp. **115**, pl. XIV, figs. 9, 12–16.

Fort Worth.

Cythereis sp. **115**, 65, pl. XVIII.

Goodland.

Cytheridea sp. **115**, 65, pl. XVIII.

Goodland.

Cytherella sp. **115**, pl. XIV, fig. 17.

Fort Worth.

Bythocypris sp. **115**, pl. XIV, fig. 10.

Fort Worth.

Paracypris sp. **115,** pl. XIV, fig. 11.
Fort Worth.

Paracypris sp. **115,** 65, pl. XVIII.
Goodland.

MACRURA

Paramithrax walkeri (WHITFIELD). WHITE 1883, **106,** 37–38, pl. XVI, fig. 1 a; pl. XVII, fig. 1 a.

Cretaceous: Near San Antonio.

Thenops n. sp. aff. **tuberculatus** REED 1911, Geol. Mag., VIII, 118, pl. VII, figs. 1–1a–1b.
Hoploparia? ADKINS 1920, **1,** p. 62.

Denton: Two miles north of Denison.

Callianassa ? sp.

Goodland, Duck Creek: Near Fort Worth.

Other Cretaceous macrura have been reported by WHITNEY (1913. **111,** p. 27, pl. XIII, fig. 3), by ADKINS (1920, **1,** p. 62), and by WINTON (**115,** 1925, 71, pl. XV, fig. 2).

BRACHYURA

Graptocarcinus texanus ROEMER. ROEMER 1887, N. Jahrb., Bd. I, Heft 2, 173–176, text figs. a–b. WHITNEY 1913, **111,** 27, pl. XIII, figs. 1–2.

Buda: Shoal Creek and Barton Creek, near Austin.

Other brachyura have been reported from the Texan Cretaceous by HILL (1901 **57,** p. 302), and by ADKINS (1920, **1,** p. 62).

CIRRIPEDA[11]

LEPADIDAE Darwin *Goose Barnacles*

Scalpellum (?) sp.

A single plate from the upper Austin chalk (*Hamulus* zone) resembles figured examples of the carina of *Scalpellum.*

Austin chalk: Travis County, Manor road, 2 miles northeast of Austin at Houston & Texas Central Railway crossing.

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[11]Darwin, Charles, 1851. A monograph of the fossil Lepadidae. Paleontogr. Soc., Vol. V. Leriche, M., 1909. Sur la limite entre le turonien et le sénonien dans le Cambrésis et sur quelques fossiles de la craie grise. Ann. Soc. Géol. Nord., XXXVIII, 53–73, esp. p. 60, pl. II, figs. 1–11. Logan, W. N., 1897. Cirripeds from the Cretaceous of Kansas. Kans. Univ. Qt., VI. Withers, T. H., 1910. The cirripede genus *Scalpellum.* Geol. Mag., Vol. VII. Withers, T. H., Die Cirripeden der Kreide Rügens.

Scalpellum inaequiplicatum SHUMARD 1862, **90**, 199.

"Shell depressed conical, length about one-third greater than the height; apex situated nearer the anterior margin than the center; surface marked with prominent unequal folds or costae, which commence at the beak and radiate to the lateral and front margins; posterior side smooth, or marked with one or two obscure, longitudinal elevations. The number of ribs on the only specimen I have seen amounts to 11, those of the left side being smaller and more numerous than those of the right. The specimen is so embedded in the matrix that the interior characters cannot be made out. It is therefore only placed provisionally in the above genus. Length 1¼ inches, height 7½ lines."

Navarro: Near Chatfield Point (type locality).

It may be noted that PILSBRY[12] has described two cirripedes from the Texan Tertiary strata: *Scalpellum chamberlaini* PILSBRY, based on terga, from the Lower Claiborne, at Berryman's place, three miles northeast of Alto, Cherokee County; and *Balanus* sp. from the Eocene of Black Shoals, Brazos River, Texas (a worn scutum).

Phylum MOLLUSCA

Class PELECYPODA

Order PRIONODESMACEA

Superfamily NUCULACEA

NUCULIDAE Adams

NUCULA LAMARCK

Oval triangular, teeth taxodont in two series, meeting below the umbo and separated by a chondrophore; sculpture weak or strong, concentric and (or) radial; the sub-genus (or genus) *Acila* has divaricate sculpture. Silurian to Recent.

The longer end of the shell is anterior. WOODS AND BÖSE call the posterior (short) area the lunule, and the anterior (long) area the escutcheon. Many authors in the Texan literature reversed anterior and posterior, and consequently right and left valves. The genus has four groups: (1) with low beaks, and oval elongate form; (2) tall beaks, triangular form, lunule deep; (3) tall beaks, postero-dorsal border straight, lunule deep; (4) form angular, postero-dorsal border convex, ribs V-shaped *(Acila)*.

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[12]Pilsbry, H. A., 1898. *Scalpellum* and *Balanus* from Texas. Proc. Acad. Nat. Sci., Phila., 1897, pp. 332–333, text fig. 1.

Postero-dorsal margin of shell concave
  Beaks subterminal (⅘ length of shell from anterior end) .... N. aff. **bellastriata** (WHITE, fig. 5c)
  Beaks subcentral (⅗ length of shell from anterior end)
    Posterior end of shell prolonged and sharply rounded; postero-dorsal margin prominently concave .... **N. haydeni**
    Posterior end of shell broadly rounded; postero-dorsal margin slightly concave .... **N. bellastriata**

Postero-dorsal margin nearly straight
  Shell nearly smooth .... **N. wenoensis**
  Shell ribbed
    Beaks subcentral .... **N. nokonis**
    Beaks subterminal
      Sculpture V-shaped .... **N. (Acila) chickasaensis**
      Sculpture radial or reticulate
        Shell compressed .... **N. guadalupae**
        Shell gibbous .... **N. serrata**

Fredericksburg Species

NUCULA (ACILA) CHICKASAENSIS CRAGIN 1895, **23**, 56.

Ovate triangular, beaks low, subterminal, posterior side very short and obliquely truncate, base long, gently convex, anterior end produced, narrowly rounded, antero-dorsal margin long, gently convex; anterior area not described. Fine divaricate ribs, the V's pointed toward the beaks, posterior limbs short, strongly convex upwards, anterior limbs long, gently convex upwards. According to the description (no figure), the species belongs to the section or subgenus *Acila.*

Comanche Peak ("Goodland"): Love County, Oklahoma, on Little Hickory Creek, south of Overbrook (type locality).

Nucula guadalupae BÖSE 1910, **8**, 120, pl. XXIII, figs. 1–10.

Shell angular in contour, beaks almost three-fourths of the way to the posterior end; postero-dorsal border nearly straight, posterior end sharply rounded, anterior end broadly rounded; form rather compressed laterally; fine radial ribs.

Upper Fredericksburg (with *Oxytropidoceras chihuahuense* and *Oxy. bravoense):* La Encantada, Chihuahua; and El Paso section near Smelter, bridge of El Paso and Southwestern Ry.(?) (type localities).

NUCULA(?) CATHERINA CRAGIN 1894, **22,** p. 4. TWENHOFEL 1924, **99,** p. 77 *(N. catharina).*

"Compressed, triangular, or cuneate ovate." Dentition unknown. Genus ? Belvidere beds: Two and one-half miles southwest of Belvidere, Kansas (type locality).

Washita Species

Nucula wenoensis ADKINS 1920, **1,** 120, pl. X, figs. 10–11.

Shell medium-sized, subovate triangular, basal margin broadly rounded, beaks subcentral, postero-dorsal margin nearly straight; numerous radial striae weak or disappearing.

Weno: North of Union Station, Denison (type locality); brickyard, Gainesville.

Nucula nokonis ADKINS 1920, **1,** 118, pl. X, figs. 12–16, 19–20.

Subovate-triangular species, with beaks subcentral; prominent radial costae.

Weno: North of Union Station, Denison; Gainesville brickyards (type locality).

Eagle Ford Species

Nucula serrata SHUMARD 1860, **89,** 603.

According to the description, the outline is very similar to that of *Nucula guadalupae* BÖSE, but *N. serrata* differs from that species in being very gibbous instead of compressed (length 23.5 mm.; thickness 15 mm.).

Eagle Ford: Lamar County (bluffs of Red River), type locality.

Nucula bellastriata SHUMARD 1862, **90,** 202. WHITE 1883, **106,** 38, pl. XVIII, figs. 5 a–b.

Shell distinctly angular; lima-shaped, posterior end broadly rounded, postero-dorsal margin rather concave, beaks subcentral; flattened radial ribs. Length 12.5 mm.; width 7.5 mm.; thickness 6 mm.

Eagle Ford: Fannin County, bluffs of Red River (type locality).

Nucula sp. aff. **bellastriata** WHITE 1883, **106,** pl. XVIII, fig. 5 c (only). BÖSE 1910, **8,** 121.

WHITE figured under the name of *N. bellastriata* SHUMARD, an individual which differs from the other two in having the beaks subterminal and in the proportions of the shell. It probably is a different species.

Eagle Ford: Fannin County, bluffs of Red River.

Nucula haydeni SHUMARD 1860, **89**, 602. WHITE 1883, **106**, 38, pl. XVIII, figs. 6a–b.

Postero-dorsal margin of shell deeply excavated, posterior end of shell prolonged and sharply rounded, basal margin broadly curved, anterior end rather acutely rounded; beaks subcentral; numerous, fine flattened, radial ribs.

Eagle Ford: Fannin County, bluffs of Red River (type locality).

LEDIDAE Adams

LEDA SCHUMACHER

Shell rostrate, elongate, often keeled; pallial sinus small.

Leda (?) harveyi HILL 1893, **55**, 25, pl. I, figs. 7–8. GILLET 1924, **47**, 233. *(Anthonya? harveyi.)*

Minute species, only a few millimeters long; concentric ribs.

Glen Rose: Paluxy River near Glen Rose.

LEDA ACUMINATA TWENHOFEL 1924, **99**, 72, pl. XXI, fig. 4.

Mentor beds: Southern Kansas.

YOLDIA MÖLLER 1842

Elongate subovate or trapezoidal, inequilateral, mostly has anterior end broadly rounded, posterior end narrowed or pointed, shell gaping posteriorly, shorter antero-dorsal and longer postero-dorsal margins nearly straight, with numerous taxodont teeth; exterior smooth, or with fine, radial or concentric lines, and with a polished epidermis; inner layer pearly; pallial sinus deep and wide. Genotype: *Nucula limatula* Say. Carboniferous-Recent.

It differs from *Nucula* in having a pallial sinus, in shape, and in its less nacreous shell. It has a much longer and taller pallial sinus than *Leda*.

Yoldia microdonta MEEK 1872, U. S. Geol. Geogr. Surv. Terr. (HAYDEN) 6th Ann. Rept., p. 304. MEEK 1876, **70**, 109, pl. II, fig. 2. CRAGIN 1893, **21**, 218. CRAGIN 1895, **23**, p. 60. TWENHOFEL 1924, **99**, 86, pl. XV, figs. 11–12.

Shell small, elongate ovate, anteriorly moderately rounded, posteriorly narrowed and sharply rounded, basal margin broadly and gently curved, both dorsal margins nearly straight, beaks rather depressed and located anterior to middle of shell, 20 anterior and 26 posterior teeth. Casts; muscle scars, pallial line and ornamentation not described. Length (holotype) 12.5 mm., height 7 mm., thickness 3.5 mm. Kansas localities: Dakota group 12 miles west of Salina (type locality); Mentor beds, 5 miles west of Smolan, Salina County; Natural Corral, McPherson County.

Pawpaw: Pawpaw Creek, east of Denison (CRAGIN).

Yoldia septarina CRAGIN 1893, **21,** 218.

Beaks less elevated, beak angle more obtuse, postero-ventral margin more prominently convex, posterior part of shell less narrowed, and beaks more anterior than in *Yoldia microdonta.* Exterior of shell has concentric growth lines. Anterior teeth 16-20, posterior 21-29. Length 16 mm., height 9 mm., thickness 5 or 6 mm.

Eagle Ford: Sherman County [Grayson County], type locality.

Superfamily ARCACEA

PARALLELODONTIDAE Dall

CUCULLAEA LAMARCK

Cucullaea s. s. (type *Arca concamerata* Martini) has narrow hinge plate mostly occupied with small vertical denticles (teeth), end teeth few, straight, short and subhorizontal. The sub-genus *Idonearca* Conrad (type: *Cuculaea tippana* Conrad) has a thicker shell, longer hinge margin, with a few short median vertical teeth, and long, horizontal, striated lateral teeth.

Cucullaea (Idonearca) terminalis CONRAD 1857, **18,** 148, pl. IV, figs. 2 a–b. HILL 1893, **55,** p. 26. CRAGIN 1893, **21,** p. 174.

Large casts; beaks nearly terminal; abundant species.

Glen Rose: Widespread in Central Texas.

Cucullaea gracilis CRAGIN 1893, **21,** p. 173.

More compressed and elongated than *C. terminalis.*

Glen Rose: Burnet County; Gillespie County.

Cucullaea (Idonearca) gratiola HILL 1888, **51,** 133, pl. XIV, figs. 2–2 a. HILL 1893, **55,** p. 25. CRAGIN 1893, **21,** p. 173.

Thin shell with coarse ornamentation.

Glen Rose: Wise County, one-half mile south of Cottondale.

Cucullaea (Idonearca) comanchensis HILL 1893, **55,** 25, pl. III, figs. 1–2.

Outline cordate, taller and thicker than long; shell thick, umbones small, high, incurved.

Basal Glen Rose: Parker, Hood and Comanche counties; 3 miles east of Millsap (type locality); near Springtown, Parker County; at Comanche.

Cucullaea recedens CRAGIN 1894, **22,** 3, pl. I, fig. 19.

Beaks more posterior than in *C. terminalis.*

Lower Fredericksburg: Weatherford.

Cucullaea sp. SHATTUCK 1903, **86**, p. 23.

"It bears a striking resemblance to *C. terminalis*."

Buda: Shoal Creek, Austin; Onion Creek, near Buda.

CRAGIN has described the following species from near Malone Mountain: From 1½ miles east of Malone, *C. transpecosensis, C? texticostata* and *C. catorcensis* Castillo and Aguilera; and from the northwest end of Malone Mountain, *C. castilloi* CRAGIN. These may be of basalmost Cretaceous age.

Cucullea millestriata SHUMARD 1862, **90**, 202.

Shell somewhat trapeziform, gibbous, longer than wide, rounded anteriorly, truncate posteriorly; surface with numerous, fine growth lines and with radiating lines. Hinge with 13–14 strong teeth. Length 22 mm., width 17 mm., thickness 13 mm.

Upper Cretaceous: Lamar County, near Red River (type locality).

ARCIDAE Dall

ARCA Lamarck

Arca sp. ind. ROEMER 1849, **77**, 404. HILL 1889, **52**, p. 10 (compared with *Arca pholadiformis* d'Orbigny).

Fredericksburg: Fredericksburg; New Braunfels.

Arca proutiana SHUMARD 1860, **89**, p. 601.

Edwards: Comanche Peak; Parker County.

Arca subelongata CONRAD 1857, **18**, 148, pl. VI, figs. 3 a–b.

Washita: Between El Paso and Frontera [near Cerro de Muleros].

Arca washitaensis ADKINS 1920, 1856, 121, pl. X, fig. 5...**Plate XX, figure 12**

Limonitic micromorph; obese species, short hinge line; casts.

Pawpaw: Fort Worth (type locality).

Grayson: Tarrant County.

Arca tramitensis CRAGIN 1893, **21**, 168 *(Arca galliennei* d'Orbigny var. *tramitensis).*

WHITNEY states that this is the equivalent of *Barbatia micronema* Meek (1911, **111**, p. 11).

Woodbine: Denton County, Timber Creek; Dallas County, Bear Creek.

Arca (Trigonarca) siouxensis HAYDEN AND MEEK. CRAGIN 1893, **21**, 170.

Woodbine: Denton County, Timber Creek.

BARBATIA Gray

Barbatia simondsi Whitney 1911, **111,** 11, pl. I, fig. 6.

Beaks near anterior end; dorsal and ventral margins roughly parallel; growth lines crossed by pronounced, subequal, radiating striae.

Buda: Barton Creek and Shoal Creek, near Austin; **Main Street,** near Fort Worth.

Superfamily PTERIACEA

PINNIDAE Meek

PINNA Linnaeus

Pinna comancheana Cragin 1894, **22,** p. 3............**Plate XVIII, figure 6**

Cross-section subcircular; sparse radial costellae and even fainter sparse concentric lines.

Fredericksburg division: Texas, New Mexico and Kansas (types from Kansas and Texas); Tucumcari, N.M.; Belvidere, Kan.; Fort Worth; near Waco; widespread in the **Comanche Peak** limestone.

Pinna guadalupae Böse 1910, **8,** 85, pl. XIII, figs. 1–9; pl. XIV, figs. 1–2.

Cross-section subrectangular, slightly more rounded with age. Ornamentation a rectangular network of about 15 vertical ribs (on each side), crossed by numerous prominent growth lines.

Fredericksburg (subd. 2, *Exogyra texana)* and **Lower Washita** (subd. 4–6, *Pervinquieria trinodosa):* El Paso, Cerro de Muleros (type locality).

Pinna petrina White (?) 1874, Prelim. Rept. Geogr. Geol. Expl. and Surv. west of 100th Mer. (Wheeler), 24–25. White 1875, Rept. (same survey) for 1875, Vol. IV, pt. 1, 182–183, pl. XIII, figs. 7 a–b. Stanton 1893, U. S. Geol. Surv. Bull. 106.

Comanche Peak: Near Waco (specific identification doubtful).

Pinna sp. Roemer 1849, **77,** 402.

Fredericksburg: At Fredericksburg.

Pinna sp. Roemer 1852, **78,** 56.

Austin chalk: Between New Braunfels and Seguin.

Pinna sp. Hill 1889, **52,** 10.

Washita division: At Fort Worth.

Pinna sp. Hill 1889, **52,** 10.

Buda: At Austin.

Pinna laqueata Conrad. Whitfield 1889. Hill 1889, **52,** p. 10.

PERNIDAE Zittel

Monomyarian (anterior adductor absent); teeth irregular or absent; with a serial multivincular ligament.

GERVILLEA DEFRANCE

Beak terminal, pointed, posterior ear reduced; shape elongated or (rarely) shorter and subquadrate. Hinge with several vertical cartilage pits and a few obscure dental ridges ("teeth").

Gervillea gregaria SHUMARD 1860, **89**, 606. WHITE 1883, **106**, 38, pl. XVIII, fig. 3 a.

Subovate, nearly subquadrate; beaks nearly terminal 3–4 ligament pits.

Eagle Ford: Lamar County, bluffs of Red River.

GERVILLIOPSIS WHITFIELD 1886

Differs from *Gervillea* in having posterior wing prominent, anterior end truncate, no dental ridges ("teeth"), valves gaping anteriorly. Some authors (Frech, Böse) deny the validity of the genus. Genotype: *G. ensiformis* Conrad. Synonym: *Dallioconcha* White 1888.

Gorvilliopsis sp. aff. **solenoides** SÖHLE. BÖSE 1910, **8**, 86, pl. XIV, fig. 3.

Weno-Pawpaw: El Paso, subd. 6 of Monument Mountain (Cerro de Muleros).

Gervilliopsis invaginata WHITE 1887, **109**, 35, pl. II, figs. 4–5. HILL 1889, **52**, p. 9. BÖSE 1910, **8**, p. 86. ADKINS AND WINTON 1920, **3**, 67, pl. XVIII, fig. 1. SHATTUCK 1902, **86**, 19, pl. V, fig. 12 .... **Plate XVIII, figure 1**

Elongated subparallel to posterior margin; posterior wing prominent; several ligament pits.

Weno: Grayson to Tarrant counties (mainly nacreous shells). **Pawpaw:** Grayson County; Tarrant County (rare). **Duck Creek:** Kingston, Oklahoma (rare). **Kiamichi:** Bosque County (rare). **Buda:** Travis County? (Shattuck). **Weno-Pawpaw** (subd. 6): El Paso section. It is not certain that these are all the same species.

INOCERAMUS SOWERBY[13]

Inner layer thin, nacreous; outer layer thicker, prismatic. Form rather rounded; beaks anterior; sculpture concentric, more rarely with radiating folds. Hinge generally straight, edentulous, with

[13]Literature: Böhm, Joh., 1911: Zusammenstellung der Inoceramen der Kreideformation. Jahrb. kön. preuss. geol. Landesanst., XXXII, 375–406 (bibliography). Böhm, Johannes, 1914: Zusammenstellung der Inoceramen der Kreideformation (Nachtrag). *Ibid.*, XXXV, 595–599. Böhm, Joh., 1909: *Inoceramus cripsi* auct. *ibid.*, Abh., (N. F.), Bd. 56. Böhm, Joh., 1919: Uber *Inoceramus cardissoides* auct., *ibid.*, Jahrb., XL, 65–70. Böse, E., 1913: Algunas faunas del Cretácico superior de

numerous small ligament pits. Rare in Jurassic and Comanchean; abundant in Upper Cretaceous.

Genotype: *Inoceramus cuvieri* Sowerby. In practice *Inoceramus* may frequently be recognized in fragments and in well samples by its prismatic shell layer. (The *Pinnidae* and some other groups also have this feature.)

INOCERAMUS BARABINI MORTON 1834. BÖSE 1913, Inst. Geol. Mex., Bol. 30 (Peyotes), 37, pl. III, fig. 7; pl. IV, fig. 1.

Medium-sized, rather inflated species, subquadrangular in outline, beak forms a right angle; numerous, unequal, eccentric plications.

Senonian: Various localities in Coahuila.

Inoceramus biformis TUOMEY. SHUMARD 1860, **89**, 606.

Austin chalk: Locality unknown.

Inoceramus capulus SHUMARD 1860, **89**, 606.

Elongate-ovate in outline, dorso-ventral dimension greater than antero-posterior; umbonal region very gibbous, with a few obscure radial ribs. Beaks terminal, elevated, pointed, curved forwards. Shell with small, unequal, distinct, concentric folds.

Eagle Ford (with *Tapes hilgardi* and *Metoicoceras swallovi*): Lamar County, bluffs of Red River.

Inoceramus comancheanus CRAGIN 1895, **23**, 53. ADKINS AND WINTON 1920, **3**, 73, pl. XVII, figs. 1–3............**Plate XVIII, figure 5**

Hinge line short, dorsal margins rather straight, form not much inflated; shell thin; surface with numerous concentric folds of irregular spacing and strength.

Duck Creek: One to two miles northeast of Denison (type locality); Marietta, Oklahoma; generally distributed in North-Central Texas and in northern Trans-Pecos Texas.

Coahuila y regiones limitrofes. Inst. Geol. Mexico, Bol. XXX. *Conrad, T. A., 1857, **18**. *Cragin, F. W., 1893, **21**. **Cragin, F. W., 1895, **23**. Grabau, A. W., and Shimer, H. W., 1909: North American Index Fossils. *Meek F. B., 1876, **70**. **Roemer, Ferd., 1852, **78**. Schlüter, Cl., 1877: Zur Gattung *Inoceramus*. Paleontogr., Bd. 24. **Schlüter, Cl., 1887: Vorlage einiger Inoceramen und Cephalopoden der texanischen Kreide. Sitz.-ber., niederrhein. Ges. Bonn, in: Verh. naturhist. Verein preuss. Rheinl. und Westf., Bd. 44. Stanton, T. W., 1893: The Colorado formation and its invertebrate fauna. U. S. Geol. Surv. Bull. 106. Stephenson, L. W., 1923: Invertebrate fossils from the Upper Cretaceous formations. North Car. Geol. Econ. Surv., Vol. V, pt. 1. Wade, Bruce, 1926: The fauna of the Ripley formation on Coon Creek, Tennessee. U. S. Geol. Surv., Prof. Paper 137. Whitfield, R. P., 1886: Brachiopoda and lamellibranchiata of the Raritan clays and green sand marls of New Jersey. U. S. Geol. Surv., Mon. 9. Woods, H., 1911: Monograph of the Cretaceous lamellibranchia of England. Vol. II, Paleontogr. Soc. Woods, H., 1912: The evolution of *Inoceramus* in the Cretaceous period Quart. Jour. Geol. Soc. London, LXVIII, 1–20.

Inoceramus confertim-annulatus ROEMER 1849, **77**, 402; ROEMER 1852, **78**, 59, pl. VII, fig. 4. CONRAD 1857, **18**, 151, pl. V, fig. 5 (Conrad's pl. V, fig. 5=Roemer's pl. VII, fig. 4). UDDEN 1907, **100**, p. 33.

Beak forms obtuse angle, dorsal margin of shell straight, ventral margins oval in contour. Numerous subequal principal concentric ribs.

Austin chalk: Ford of Guadalupe River, near New Braunfels (type locality).

Boquillas flags: Brewster County (Udden).

Inoceramus crenistriatus F. ROEMER 1904, in: AIRAGHI, Inocerami del Veneto, Boll. soc. geol. ital., 23, p. 197, pl. IV, fig. 16. BÖHM 1911, Zusam. Inoc. Kr., 390. BÖSE 1913, Inst. Geol. Mex., Bol. 30, p. 38..**Plate XXXIV, figure 7**

Transversely elongated, longer than tall, surface with wavy, thick, concentric folds, which are separated by deep, broad interspaces containing weaker, more irregular, secondary folds.

This species, left in manuscript by Roemer, is considered by Böse to be possibly identical with *I. barabini.* Roemer included various horizons in his Turonian.

"**Turon:** Austin" (type locality).

INOCERAMUS CRIPPSI MANTELL. ROEMER 1852, **78**, 56, pl.VII, fig. 2. BÖSE 1913, Inst. Geol. Mex., Bol. 30, 28, pl. II, fig. 8. BÖHM 1909, *Inoceramus crispii* Auctt. Abh. k. preuss. geol. Landesanst., Bd. 56.

Subquadrangular in outline, with concentric, prominent ribs of quadrate contour, as in *I. subquadratus,* but lacking the cross ribbing of that species.

Austin chalk: Ford of Guadalupe River near New Braunfels; Coahuila, numerous localities.

Inoceramus cumminsi CRAGIN 1893, **21**, 192, pl. XXXVI, figs. 1–2; pl. XXXVII.

Large species, elongated antero-posteriorly, inequivalve, inflated in umbonal region, somewhat quadrilateral in side view, ornamented with remotely spaced, concentric undulations.

Taylor: Chihuahua, four miles south of Presidio (type locality); San Carlos region.

INOCERAMUS DIVERSE-SULCATUS ROEMER. SCHLÜTER 1887, **83**; HILL 1889,**52**, p. 9.

Hill says: "Same as *Inoceramus diverse-digitatus* Sowerby." The species does not appear under this name in the Roemer papers on Texas.

Austin chalk: At Austin (Schlüter 1887, **83**).

Inoceramus exogyroides MEEK.

Austin chalk: Austin (Schlüter 1887, **83**. Hill 1889, **52**, pp. 9, 53).

Inoceramus fragilis HALL AND MEEK 1854 (not SINZOW 1872).

Beak somewhat produced and sharply rounded; form thin, elongate ovate, with irregular, obscure, concentric ribs.

Eagle Ford: Near Austin.

INOCERAMUS (HAPLOSCAPHA) GRANDIS CONRAD 1875 (?). UDDEN 1907, **100**, pp. 35–36.

Austin chalk (basal): Austin.

Terlingua beds: Brewster County, Cottonwood Creek, and south of Cuesta Blanca.

INOCERAMUS INVOLUTUS SOWERBY. SCHLÜTER 1887, **83**.

Austin chalk: Austin.

Inoceramus labiatus SCHLOTHEIM. BÖSE 1913, Inst. Geol. Mex., Bol. 30, 25, pl. I, fig. 14; pl. II, figs. 1–6; pl. III, fig. 2. BÖHM 1911, Zusam. Inoc. Kr., pp. 396–397 (lists several varieties). MOREMAN 1927, **73**, 95. BÖSE AND CAVINS 1928, **10**.

Thin species, elongate ovate in outline, beak right-angled or more acute; numerous concentric main undulations with 3–6 fine concentric lines between, the undulations being ovate or subquadrate in contour.

Upper Eagle Ford: North-Central Texas.

Eagle Ford flags: Bell County; Austin.

Turonian (Salmurian, and **Upper Turonian):** Generally distributed in northern and eastern central Mexico (locality lists in Böse and Cavins, **10**).

INOCERAMUS LATUS MANTELL. ROEMER 1852, **78**, 60.

Austin chalk: Ford of Guadalupe River, near New Braunfels.

Inoceramus multistriatus CRAGIN 1893, **21**, 192=**Pteria pedernalis** (ROEMER) (CRAGIN 1895, **23**, 56).

Inoceramus munsoni CRAGIN 1895, **23**, 55.

Beaks stated to be more elevated above hinge-line and more incurved than in *Inoceramus comancheanus*, and shell with about five prominent radial folds.

Duck Creek: On Duck Creek, one to two miles northeast of Denison (type locality).

Inoceramus mytilopsis CONRAD 1857, **18**, 152, pl. V, figs. 6 a–b.

Inoceramus mytiloides ROEMER (not MANTELL) 1852, **78**, 60, pl. VII, fig. 5. Conrad's pl. V, fig. 6 a=Roemer's pl. VII, fig. 5; Conrad's pl. VII, fig. 6 b is original (West Texas?). Conrad's species seems to be based on Roemer's figure, since no locality is given.

Austin chalk?: New Braunfels, ford and waterfall of Guadalupe River (type locality).

INOCERAMUS PROBLEMATICUS SCHLÜTER. HILL 1889, **52**, p. 9.

Eagle Ford: Near Austin.

Inoceramus striatus MANTELL. ROEMER, 1852, **78**, 60.

Austin chalk: Waterfall of Guadalupe River near New Braunfels.

Inoceramus subquadratus SCHLÜTER 1887, **83**, p. 43 .... **Plate XXXIV, figure 6**

Thin species, subquadrate in outline; has subequal, prominent, sharp-topped ribs of quadrate contour, crossed by numerous intermittent radial ridges.

Austin chalk: Near Austin (type locality); widespread in Central Texas.

Inoceramus sulcatus ROEMER 1852, **70**, 57, pl. VII, fig. 2 *(Inoceramus cripsi* var. *sulcata).* CONRAD 1857, **18**, 152, pl. V, fig. 8 *(I. cripsii).* Conrad's pl. V, fig. 8=Roemer's pl. VII, fig. 2.

Austin chalk: Ford of Guadalupe River near New Braunfels, and San Antonio-New Braunfels road crossing of Cibolo Creek (type localities).

Inoceramus texanus CONRAD 1857, **18**, 152, pl. V, fig. 7.

"Elevated, suboval, compressed, equilateral; hinge, and lateral, and basal margins regularly rounded; folds robust, prominent, unequal; summit not prominent."

Horizon (?): Jacun, three miles above Laredo (type locality, Conrad **18**, p. 143).

INOCERAMUS UMBONATUS MEEK AND HAYDEN. HILL 1889, **52**, p. 9.

Austin chalk: Austin.

Inoceramus undulato-plicatus ROEMER 1852, **78**, 59, pl. VII, fig. 1. DEUSSEN 1924, **33**, pl. VII, fig. 3.

Medium to large size; form inflated in umbonal region, thinned towards margins; margin forms nearly a right angle at beak, otherwise contour is oval. Several broad, low, wavy folds radiate from mid-line to either side, and terminate at the undulate margins. Group of *I. digitatus* Sowerby (Coniacian, Western Europe).

Austin chalk: Waterfall of Guadalupe River near New Braunfels (type locality). Widespread in Central Texas and northeastern Mexico.

Inoceramus sp. aff. opalensis Böse 1923, Inst. Geol. Mex. Bol. 42, 184, pl. XIII, figs. 1–3.

Eagle Ford: Langtry. **Turonian:** Near Opal, Zacatecas.

Inoceramus sp. aff. **concentricus** Parkinson. Woods 1911, A monograph of the Cretaceous lamellibranchia of England. Paleontogr. Soc. (London), 1910, p. 265, pl. XLV, fig. 11; pl. XLVI, figs. 1–10; pl. XLVII, figs. 1–2. Woods 1921, The evolution of *Inoceramus* in the Cretaceous period. Q.J.G.S., LXVIII, p. 2, text figs. 5–9. Böse 1928, **10**, 190, pl. XVIII, fig. 6....**Plate VII, figure 3**

Shell quite thin; form tall, gibbous, generally ovate in outline; beaks narrow and produced, the left one prominently incurved over the smaller and shorter right valve. Hinge line short, slightly oblique. Irregular faint concentric folds, no radial plications.

Upper Edwards (sandy limestone phase above *Toucasia* reef): Two miles southwest of Round Rock.

Comanche Peak: Three miles southeast of Leander. Lower Goodland: White settlement road, 16 miles west of Fort Worth (Dr. Scott).

ACTINOCERAMUS Meek 1876, 70, 39

Subovate, gibbous, inequivalve; hinge line short, oblique; beaks pointed, terminal, the left one more prominent and incurved; a few coarse radial plicae. Genotype: *I. sulcatus* Parkinson. Horizon: Middle Albian.

Actinoceramus subsulcatiformis Böse 1928, **10,** 189, pl. XVIII, figs. 1–5..**Plate VII, figure 2**

Small species, one-half inch tall; incurved beak; strong radial plicae near margin, smooth in umbonal region; shell thin.

Upper Edwards: About a mile east of Valley Mills (type locality). Most writers consider *Actinoceramus* as a subgenus of *Inoceramus.* Compare Woods 1911, Paleontogr. Soc., 268, pl. XLVII, figs. 3–4. Woods 1912, Q.J.G.S., XLVIII, pp. 3–4, text figs. 10–18 (on page 3).

A closely similar species is *Inoceramus praedigitatus* Airaghi, 1904, Boll. Soc. Geol. Ital., XXIII, 183, pl. IV, figs. 13–14, and text figure 1 (on page 183), from the Albian, type locality Perte du Rhône. This is an inequivalve species of about the same shape and size as the Texan species but with 7–8 radial folds which extend entirely to the beak region and there fuse into one prominent fold; hinge line with 4–5 subquadrate pits.

PTERIIDAE Meek

PTERIA Scopoli *(Avicula)*

Shell aviculoid, two-winged, oblique, more or less inequivalve, adult teeth obscure.

Shell distinctly oblique, elongate, more than twice as long as tall
- Smooth, except for growth lines.................................**P. planiuscula**
- Radial ribs present
  - Ribs numerous, prominent.................................**P. convexo-plana**
  - Ribs few, faint.................................**P. leveretti**

Shell less than twice as long as tall
- Subequivalve
  - Subquadrate; anterior ear short; scar not prominent
    - Beaks subterminal.................................**P. aguilerae**
    - Beaks subcentral.................................P. n. sp.
    - Beaks anterior to center; shell slightly taller than long ....**P. salinensis**
  - Longer than tall; gibbous; anterior ear and muscle scars prominent ....**P. pedernalis**
- Inequivalve
  - Cast gibbous, large, subcircular.................................**P. iridescens**
  - Cast thinner, small
    - Outline subcircular; ribs present.................................**P. dispar**
    - Outline like *P. pedernalis*; ribs faint or absent ....**P. singleyi**

Pteria pedernalis (Roemer) 1849, **77**, 400. Roemer 1852, **78**, 61, pl. VIII, figs. 1 a–b *(Avicula)*. Böse 1910, **8**, 84, pl. XII, figs. 4–9 *(Avicula)*.................................**Plate II, figure 6**

Form large, inflated, especially in umbonal region, subequivalve, anterior ear prominently produced, hinge line long and straight; anterior border nearly vertical, basal and posterior margins rounded, contour rather elongate oval. Shell thin, with numerous subequal flattened growth lamellae, demarcated by fine concentric growth lines.

Fredericksburg: At Fredericksburg (type locality); La Encantada, Chihuahua; Arivechi, Sonora. Walnut: Austin (Bull Creek road).

Comanche Peak: Three miles southeast of Leander.

Pteria convexo-plana (Roemer) 1849, **77**, 400. Roemer 1852, **78**, 61, pl. VII, figs. 9 a–d *(Avicula)*.

Small to medium-sized, elongate, axis oblique to hinge line; has numerous radial ribs (cast smooth); posterior ear oblique-angled, not distinctly separated from rest of shell.

Fredericksburg: At Fredericksburg (type locality).

Pteria salinensis WHITE (?) 1883, **106**, 15, pl. XVI, figs. 2a–6. CRAGIN 1893, **21**, 211.

Lower Woodbine: Tarrant County, Walnut Creek, 3.5 miles east of Mansfield (type locality).

Pteria (?) stabilitatis WHITE 1883, **106**, 15, pl. XVII, fig. 3 a.

An aviculid shell adherent by its entire right valve; hinge line straight, shorter than shell; ears obsolete; cartilage pit small. White thinks it may be a new genus.

[Upper] Cretaceous: Collin County (type locality).

Pteria iridescens (SHUMARD) 1862, **90**, 203–204 *(Avicula).*

Cast large, subcircular, inequivalve, gibbous, cardinal margin straight, as long as shell, other margins circular in outline; muscle scars numerous; no surface ornamentation recorded. Length of type 66 mm.; thickness 37 mm. Differs from *Pteria pedernalis* in its unequal valves, greater proportionate width and smaller muscle scars.

[Upper] Cretaceous: Lamar County, head of Pine Creek.

PTERIA AGUILERAE (BÖSE) 1920, Univ. Texas Bull. 1856, 227, pl. XX, figs. 1, 2, 11, 12 *(Avicula).*

Outline roughly subquadrate; species relatively taller and thinner than *Pteria pedernalis.*

Salmurian: Cerro del Macho, Hacienda de Mohóvano, Coahuila-Chihuahua; near Piedra de Lumbre, Coahuila.

PTERIA n. sp.

Has subcentral beaks.

Salmurian: Near Piedra de Lumbre, Coahuila.

Pteria planiuscula (ROEMER) 1849, **77**, 401; ROEMER 1852, **78**, 62, pl. VII, fig. 7 *(Avicula).*

Medium-sized, smooth except for growth lines, elongate-oval, axis of shell oblique to hinge margin; posterior ear acute-angled, separated from body by a depression.

Austin chalk (?): Falls of Guadalupe River near New Braunfels (type locality).

Pteria leveretti (CRAGIN) 1893, **21**, 171, pl. XLI, fig. 3 *(Avicula).*

Body of shell elongate, exclusive of wing about four times as long as tall, pointed anteriorly, truncated posteriorly; large triangular wing; shell ornamented with fine growth lines, crossed by narrow radial lines, producing a somewhat cancellated ornamentation.

Kiamichi: Denton Creek, near Wise-Denton County line (type locality).

Walnut-Comanche Peak: Near Benbrook.

Pteria singleyi (CRAGIN) 1893, **21**, 172 *(Avicula)*.

General outline of *P. pedernalis*, but is strongly inequivalve, much smaller and more compressed, with the margin prominent but much narrower, than in that species.

Glen Rose: Travis County, Santa Monica Springs (holotype).

Pteria dispar (CRAGIN) 1894, **23**, 52 *(Avicula)*.

Small, semicircular, compressed, very inequivalve; left valve feebly arched, with smaller right valve nearly flat; anterior ears sharply delimited, nearly equilateral triangles with radial ribs, posterior ear small, narrow; left valve with large flattened radial ribs and narrow interspaces; right valve centrally has feeble, tuberculate radial ribs.

Grayson: One-half to three-fourths mile southeast of Union Station, Denison, in a side branch of Pawpaw Creek (holotype).

Superfamily OSTRACEA

OSTREIDAE Lamarck[14]

OSTREA LINNAEUS (including *Liostrea* Douvillé)

Ostrea s. s. (genotype: *O. edulis)* has the superior valve flat and lamellar, the inferior valve plicate. *Liostrea* (genotype: *O. sublamellosa)* has subequal lamellose valves. These animals make considerable structural adaptations to their environment, and such "variations" are not to be taken as justifying taxonomic (genetic) partitions.

In practice, fragments of *Ostreidae* may frequently be recognized by the lamellae into which the shell splits.

Ostrea anomiaeformis ROEMER 1849, **77**, 394; ROEMER 1852, **78**, 75, pl. IX, figs. 7 a–e.

Shell small, larger valve inflated in beak region, otherwise rounded; smaller valve subcircular, with elevated submarginal beak.

Eagle Ford: Ford and waterfall of Guadalupe River near New Braunfels (type locality); Austin (Hill 1889, **52**, p. 3).

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[14]Literature: Coquand, H., 1869: Monographie du genre Ostrea, terrain crétacé. Marseille. Douvillé, H., 1910: Observations sur les ostreidés, origine et classification. Bull. Soc. Géol. France (4), X, 634–659. Gillet, S., 1924: Etudes sur les lamellibranches néocomiens. Soc. Géol France. Mém. 3, (n.s.), pp. 66–73. Jaworski, E., 1913: Ein Beitrag zur Stammesgeschichte der Austern. Zts. ind. Abs. Ver. Lehre, Bd. 9, Heft 3, 182–215. Lang, W. D., 1923: Evolution: a resultant. Proc. Geol. Assoc. XXXIV, pt. 1, pp. 7–12. White, C. A., 1883: A Review of the fossil Ostreidae of North America [etc.]. U. S. Geol. Surv., 4th Ann. Rept., 273–430. Jackson, R. T., 1888: The development of oysters with remarks on allied genera. Proc. Boston Soc. Nat. Hist., XXIII.

Ostrea bella CONRAD 1857, **18,** 156, pl. X, figs. 4 a–b. CRAGIN 1893, **21,** 199.

Shell oblong-ovate, slightly curved, narrowed towards beak. Larger valve inflated, rounded, undulated, with radical ribs crossed by remote, imbricated growth rings; smaller valve flattened, concave towards beak, marked by minute obsolete radial lines.

"Cretaceous: West Texas."

Taylor: Two miles south of Presidio del Norte (Cragin 1893, **21,** 199).

Ostrea camelina CRAGIN 1893, **21,** 199. HILL 1888, **51,** pl. VII, figs. 28–29.

Shell large, lower valve deeply concave with a hump in beak region and a posterior radial sulcus; upper valve flat; beaks narrow and pointed.

Glen Rose and **Travis Peak:** Burnet, Travis, Hood and Erath counties.

Ostrea carica CRAGIN 1893, **21,** 200, pl. XLV, fig. 11.

Shell medium-sized, single or colonial, thin, smooth; beaks small, depressed, directed backwards; valves generally ovate in outline, narrowed towards beaks; upper valve nearly flat.

Woodbine: Denton County (Timber Creek); Tarrant County (Bear Creek) (type localities).

Ostrea congesta CONRAD 1843, Rept. Hydrog. Basin Upper Miss. River (Nicollet), I, Appendix C, p. 169. SHUMARD 1860, **89,** 609.

Eagle Ford: Grayson County, near Sherman (Post Oak Creek).

Ostrea cortex CONRAD 1857, **18,** 157, pl. XI, figs. 4 a–d. CONRAD 1859, 1869, **117,** p. 64. DEUSSEN 1924, **33,** pl. XII, fig. 2.

"Elongated, pointed towards the apex; inferior valve ventricose, very thick, with very prominent, concentric, imbricated laminae; cardinal fosset long and profound, somewhat curved, with a rounded ridge on each side."

Upper Cretaceous (?): "Dry Creek, Mexico."

Ostrea crenulimargo ROEMER 1852, **78,** 76, pl. IX, figs. 6 a–b. COQUAND 1869, **117,** 55–56, pl. XXV, figs. 7–8. CRAGIN 1893, **21,** 201, pl. XLV, fig. 6. WHITE 1884, **107,** 294, pl. XXXIII, figs. 8–9. GILLET 1924, **47,** p. 68 *(Ostrea);* p. 232 *(Liostrea).*

Thin, subtriangular, smooth, with 5–8 plications; beaks short and blunt. A variety *stonewallensis* CRAGIN 1893, **21,** 202, pl. XLV, figs. 1–5, is larger and more elevated, with 6–9 plications, with its umbonal convexity more prominent, and its beaks more recurved.

Fredericksburg: At Fredericksburg (type locality); Forestburg, Montague County.

Ostrea franklini COQUAND 1869, **117**, 53, pl. XXIII, figs. 8–10. HILL 1893, **55**, 23. CRAGIN 1893, **21**, 203.

Trinity division (Glen Rose): Iredell, Bosque County.

Ostrea franklini var. **ragsdalei** HILL 1893, **55**, 23, pl. I, fig. 6.

Shell elongate, acuminate, with several low, broad, radial costae interrupted by prominent growth rings; beak of larger valve prolonged, ribbed, subcylindrical.

Glen Rose: Glen Rose (type locality).

Ostrea lyoni SHUMARD 1862, **90**, 200. CRAGIN 1893, **21**, 204.

Shell thin, of variable outline, ovate-oblong or subcircular, lower valve strongly convex, upper valve less so; surface marked with growth lines; beak acute, straight, or turned to one side.

Upper Cretaceous: Red River County, Pine Bluff.
Woodbine?: Fannin County.

Ostrea owenana SHUMARD 1862, **90**, 200. DEUSSEN 1924, **33**, pl. XI, figs. 3–3 a. STEPHENSON 1923, **96**, 159.

Shell large (4 inches), upper valve elevated, rather thin, convex, narrowed towards beak; hinge area large, triangular and deeply excavated in middle. Valve with prominent convexity near middle and back of that a prominent sinus; basal margin is correspondingly undulate; lower valve thicker and less undulate. The thinness of shell is a feature of this species.

Navarro: Chatfield Point (type locality).

Ostrea aff. **pratti** STEPHENSON 1923, **96.**

In most respects resembles this species, but has plication more prominently developed. Compare also Ostrea subspatulata FORBES (WHITE 1884, **107**, 301, pl. XXXVII, figs. 1–2), and *O. owenana* SHUMARD.

Rattlesnake: Terlingua quadrangle, widespread and abundant marker.

Ostrea perversa CRAGIN 1893, **21**, 205, pl. XXVIII, figs. 1–6.

Shell large, thin, subequivalve, smooth, outline generally ovate-oblong, narrowed towards beaks, some shells with axis curved.

Del Rio: Austin (Shoal Creek).
"Washita limestone": Johnson County (Nolands River), Denton County (Denton Creek near Justin), Grayson County (Cedar Mills).

Ostrea planovata SHUMARD 1862, **90**, 201. WHITE 1884, **107**, 299.

Shell small, thin, irregularly ovate, narrow near beak, surface marked with fine growth lines. Shumard recorded the formation at Dresden as "Austin limestone."

Navarro: Navarro County, Dresden (type locality).

Ostrea plumosa MORTON 1833. CRAGIN 1893, **21,** 206. STEPHENSON 1923, **96,** 147, pl. XXXVIII, figs. 14–17; pl. XXXIX, figs. 11–15.

Ovate to triangular, some individuals with narrowed beaks. Left valve generally attached, right valve compressed to ventricose, with fine concentric growth lines and radiating, fine, unequal, bifurcating costae.

Austin chalk: Dallas County.

Taylor: Two miles west of Taylor; Travis, Hays and Comal counties.

Brownstown marl: Paris.

San Miguel: Five miles southeast of Spofford.

Escondido: Sixteen miles southeast of Eagle Pass.

Ostrea soleniscus MEEK. CRAGIN 1893, **21,** 206, pl. XXXV, fig. 3. WHITE 1883, **106,** 9, pl. II, figs. 2 a–b. WHITE 1884, **107,** 300, pl. XLII, fig. 1.

Shell long, slender, smooth; beak of left valve narrow, produced and generally closely recurved, externally with delicate plications.

Woodbine: Denton County; Tarrant County.

Ostrea saltillensis BÖSE 1913, Inst. Geol. Mex., Bol. 30, 46, pl. VIII, figs. 1–3. STEPHENSON 1923, **96,** p. 147.

San Miguel beds: "Southwest Texas."

Cardenas beds: Cárdenas, San Luis Potosí; Tula, Tamaulipas; numerous other localities in northern Mexico.

Ostrea subspatulata FORBES, Q.J.G.S., Vol. I, pp. 61–62, text figs. on pp. 61, 62. CONRAD 1857, **18,** 155, pl. X, figs. 3 a–b. STEPHENSON 1923, **96,** p. 159.

The *Ostrea* aff. *pratti,* above mentioned, from north of Terlingua, may be this species.

Upper Cretaceous?: Brewster County. Tascalingo [Terlingua].

Ostrea tecticosta GABB 1860. STEPHENSON 1923, **96,** 143, pl. XXXVIII, figs. 1–9.

Outline irregular, roughly triangular, broad ventrally, narrowly pointed near beak, some shells with axis curved. Left valve with growth lines and imbricated lamellae, and with several radiating bifurcating costae; right valve with growth lines and imbricating lamellae.

Lower Navarro *(Exogyra costata* zone): Kaufman County, four miles east of Crandall, in cut of Texas & New Orleans Railway (7550).

Ostrea vellicata CONRAD 1857, **18**, 156, pl. XI, figs. 2 a–b.

"Subovate, inferior valve convex, with very irregular, laminated, concentric lines, imbricated; surface as if pinched into cavities at places; beak subrostrated, thick; margins of the lower valve thickened, muscular impression comparatively near the base; hinge area broad."

Lower Cretaceous: Rio Grande, between El Paso and Frontera (type locality).

ALECTRYONIA FISCHER DE WALDHEIM

Valves rather flat or broadly curved, hinge line straight, radial folds or plications present: *Alectryonia* s. s. (type: *A. cristagalli* Lamarck). The genus includes the subgenus or section *Arctostrea* Pervinquière (type: *A. rectangularis* Roemer), elongated recurved shells with an elevated median keel from which compressed, single or bifurcated, ribs run off to the zig-zag shell margin; some forms are low, flattened, with wing-like expansions (*macroptera*-type).

A. Large flattened shells:

Alectryonia (?) **subovata** SHUMARD 1854, **87**, 179, pl. V, fig. 2. COQUAND 1869, **117**, 48, pl. XVII, fig. 4. WHITE 1884, **107**, p. 301. CRAGIN 1893, **21**, p. 207.

Large massive shell, mainly oblong-ovate, beaks straight or recurved; shells nearly smooth except for growth lines and usually 6–8 coarse, radial folds. Apparently is relatively more elongated than *A. marcoui.*

Fredericksburg division: North-Central Texas.

Washita division: Central Texas; Trans-Pecos Texas; Fort Washita, Bryan County, Oklahoma (holotype).

Alectryonia alternans CRAGIN 1893, **21**, p. 198.

Mainly clustered shells, somewhat like *Ostrea subovata* but shorter, ovate to rhomboidal, with 8–12 sharp plications.

Glen Rose (100 feet below main *Exogyra texana* bed): Travis County, Sandy Creek.

Alectryonia marcoui (BÖSE) 1910, **8**, 105, pl. XVI, fig. 15; pl. XVII, fig. 1. MARCOU 1858, **68**, 43, pl. IV, fig. 4 *(Ostrea marshi).*

Large, massive, subovate shell, smooth except for growth lines and 3–8 broad, radial folds, which are more prominent near the shell margin. This species is very close to *A. subovata.*

Fredericksburg and Washita (subd. 3, 5, 6): El Paso section.
Washita: North-Central Texas.
Weno to Main Street: Tarrant County.

Alectryonia sp. aff. **diluviana** LINNAEUS. CRAGIN 1893, **21**, p. 203. HILL 1901, **57**. DEUSSEN 1924, **33**, pl. X, fig. 1.

Large, inequivalve shell, thickened along inferior margin, with radiating sharply rounded plicae which form interlocking zig-zag folds at shell margin.

Austin chalk: Austin.

B. Small, oval or falciform shells, plicate

Alectryonia falcata (MORTON) 1827. HILL 1889, **52**, p. 6 (?). STEPHENSON 1923, **96**, 154, pl. XXXIX, figs. 1–10.

Shell long, relatively narrow, strongly curved backward; beak near center of hinge; attachment scar small. Surface with 5–10 or more strong plications, originating along central line of shell and passing obliquely backward and downward to the zig-zag margin.

Taylor: San Marcos, 2¼ miles south of town; 2½ miles east of San Marcos; 2¾ miles south of San Marcos.

Upson: Maverick County, 3½ miles northwest of Paloma; 2½ miles southeast of Spofford.

Navarro: Manor (?).

Alectryonia lugubris (CONRAD) 1857, **18**, 156, pl. X, fig. 5. COQUAND 1869, **117**, 66, pl. XXXVI, figs. 22–23. CRAGIN 1893, **21**, 204. WHITE 1884, **107**, 297, pl. XLI, fig. 3. HILL 1901, **57**, pl. XLV, fig. 2........................**Plate XVI, figure 5; plate XXIV, figures 8–9**

Many writers consider *Ostrea bellaplicata* SHUMARD to be a synonym of this species. "Suboval, superior valve flat, inferior valve slightly ventricose showing a mark of attachment on the umbo. A small species, constant in character and easily recognized." Outside the attachment scar it has numerous small, subequal, radial ribs.

[Upper Cretaceous]: "East of Red River [Canadian], New Mexico, Santa Fe road."

Navarro: Two miles north of Corsicana (Cragin).

Turonian: Northern Mexico (Böse).

Alectryonia quadriplicata (SHUMARD) 1860, **89**, p. 608. WHITE 1879, **104**, 275, pl. V, fig. 6 a; pl. VIII, figs. 3 a–b. WHITE 1884, **107**, 299, pl. XLIII, figs. 5–7. BÖSE 1910, **8**, 101, pl. XVI, figs. 1–12. ADKINS AND WINTON 1920, **3**, 60, pl. XVI, figs. 6–10..**Plate XVI, figure 1**

Small shell with falcate contour, axis curved, beak obtusely rounded; has about four conspicuous, distant, thin, radial folds, taller near margin where they form pointed prolongations.

Washita: Ten miles above mouth of Kiamesha Creek, and bluffs of Red River in Lamar County (type localities, the latter one questionable).

Upper Fort Worth to **mid Main Street:** North-Central Texas.

Weno-Pawpaw (subd. 6): El Paso section.

Alectryonia sp. SHATTUCK 1903, **86**, p. 21.

Buda: Austin (Shoal Creek).

Sub-genus ARCTOSTREA Pervinquière

Alectryonia (Arctostrea) sp. aff. **carinata** LAMARCK. PERVINQUIÈRE 1910, Pal. Univ., fiches 197–197 a–197 b (types). BÖSE 1910, **8**, 104, pl. XVI, figs. 13–14. WHITNEY 1911, **111**, 12, pl. I, figs. 1–2. ADKINS AND WINTON 1920, **3**, 59, pl. XVI, figs. 2–5 .... **Plate XVI, figure 3**

Shell elongate, curved, with a prominent carina, from which thin, elevated, acute-topped straight or curved, subparallel ribs run to the zig-zag shell margin. There are at least two species, one large with elevated cross-section and numerous parallel ribs, and the other with a low triangular cross-section and spreading ribs.

Washita division (most abundant at top of **Denton** and top of **Weno**): North-Central Texas, South-Central Texas, Trans-Pecos Texas, widespread.

Top of **Fredericksburg:** Black Mountain, Hudspeth County.

GRYPHAEOSTREA Conrad, in Meek 1876, 70, p. 11

"Shell thin, elongated, straight, narrow; lower valve rather deep and smooth; upper valve flat or slightly concave, and ornamented with distant, regular, thin, concentric laminae; beak of lower valve contorted or turned to one side; cartilage-pit narrow, oblique."

Genotype: *G. vomer* MORTON.

Gryphaeostrea vomer (MORTON). MEEK 1876, **70**, p. 11, and footnote, p. 11. BOYLE 1893, U. S. Geol. Surv. Bull. 102, p. 142. DANE AND STEPHENSON 1928, **118**, p. 53.

Taylor (Marlin chalk): Falls (or Limestone) County.

GRYPHEA LAMARCK

Adults not attached; right valve flat, opercular, small and generally fitting within the other valve, hinge line straight; large (left) valve arched, beak incurved (rarely somewhat bent to one side), some species with prominent radial sinus, some with lateral winglike expansions.

Genotype: *G. arcuata*. Jurassic of Europe; Cretaceous (especially Lower Cretaceous) of Texas.

Gryphea had an extensive development in the European Lias (*Liogryphaea* Fischer) and disappeared in Europe at the end of the Jurassic. But in Texas during the Lower Cretaceous the genus underwent an enormous provincial development, with the species below listed. There is a recent species *(G. angulata* Lamarck). If *G. arcuata,* the first species figured, by de Blainville, be taken as the genotype, it is possible that the Texan species may eventually be assigned to another genus. The Texan Grypheas are extremely variable, and although a key could be constructed to give the main differential features of the typical forms of all the species, no such key would cover all the variations found in the field; therefore no key has been included. Extensive field experience and long familiarity, aided by a set of figures showing the commoner variations,[15] are the best means of identifying these fossils, and some variants will even then be found to be undeterminable.

Gryphea wardi Hill and Vaughan 1898, **58,** 49, pl. I, figs. 1–16.

Earliest reported species in Texas; small, many individuals distorted by large attachment scar; some have obscure radial plicae; no sinus; beak not incurved.

Glen Rose: Travis and Hays counties (type localities).

Gryphea marcoui Hill and Vaughan 1898, **58,** 50, pls. II–V .... **Plate II, figure 3**

Typically elongated, nearly symmetrical shells, with greatly inrolled, nearly straight beak; radial sinus prominent. The beak is more incurved, and the shell more straight-sided and elongate and less flared basally, than in *G. mucronata.* Some individuals are quite slender. *G. washitaensis* is much less slender, and has a pronounced marginal flare. *G. navia* is more massive and has an outcurved beak. *G. corrugata* is more broadly triangular and basally more flared.

Walnut, Comanche Peak: North-Central Texas: "Big Springs on Colorado River"; Austin; Fort Stockton.

Edwards: Edwards County.

Gryphea navia Hall 1856, Rept. Expl. Surv. R. R. from Miss. River to Pacific, III, pt. IV, 100, pl. I, figs. 7–10. Hill and Vaughan 1898, **58,** pls. XVII–XVIII. Marcou 1858, Proc. Bost. Soc. Nat. Hist., VIII, 95 *(Gryphea roemeri).* Böse 1910, **8,** 106, pl. XVII, figs. 2–9; pl. XVIII, figs. 1–5, 10 .... **Plate XII, figure 9**

Typically rather massive, medium-sized shells, some with thick, imbricated shell layers; have prominent sulcus and pointed distal flare of shell margin; beak conspicuously bent to one side, but not elevated; a prominent sharply rounded radial carina runs from beak to basal margin, and is paralleled by a prominent radial sinus.

Kiamichi: Southern Oklahoma, North-Central Texas, northern

[15]Hill and Vaughan, 1898. The lower Cretaceous Grypheas of the Texas region. U. S. Geol. Surv. Bull. 151.

Trans-Pecos Texas. It is rare in South-Central Texas and in southern Trans-Pecos Texas.

Gryphea corrugata SAY 1823, Acct. Exped. Pittsburg to Rocky Mtns., II, 410–411. MORTON 1834, Syn. Org. Rem. Cret. Group U. S., 55, pl. XV, fig. 9 *(Gryphea pitcheri)*. HILL AND VAUGHAN 1898, **58**, 53, pls. V–XV, XVIII, XIX. MARCOU 1889, The original locality of the *Gryphea pitcheri* MORTON. Am. Geol., 188–193.

A highly variable species, typically medium-sized, with anterior flare and a variable, mainly weak sinus; beak not greatly incurved, bent slightly to the side. Many individuals are deformed by large attachment scar.

Kiamichi, Duck Creek: North-Central Texas, northern Trans-Pecos Texas.

Gryphea corrugata var. *hilli* CRAGIN, in TWENHOFEL 1924, **99**, 71, pl. XXIII, figs. 3–4. HILL AND VAUGHAN 1898, **58**, 56–57, pl. VIII, figs. 8–9, 11, 13–14.

This variety seems indistinguishable from the type *G. corrugata* Say.

Champion shell bed: Champion Draw, Kansas.

Gryphea corrugata var. **belviderensis** HILL AND VAUGHAN 1898, **58,** 56–57, pls. IX–X.

Large shells, more pointed apically, beak less incurved, and external radial sinus less conspicuous than in *G. tucumcari.*

Comanchean: Belvidere, Kansas (type locality).

Gryphea tucumcari MARCOU 1851, Resume of geol. recon. [etc.], in: WHIPPLE, Rept. Explor. Railr. Route from Miss. River to Pacific, House Doc. 129, pp. 44–48. MARCOU 1858, **68**, 43, pl. IV, figs. 1–3. HILL AND VAUGHAN 1898, **58**, 53, pls. XIII, XIV, XVI, figs. 1–3. BÖSE 1910, **8**, 109, pl. XVIII, figs. 6–9, 11–12; pl. XIX, figs. 1–14. ADKINS 1927, **2**, pp. 40, 44, 50, pl. IV, fig. 1........**Plate VI, figure 1**

Shell large, rather thin, elevated, rounded, excavated, flared basally; shallow sinus; beak short, straight.

Kiamichi, Duck Creek: Near Tucumcari (type locality; holotype British Museum Natural History, South Kensington, BM 12676; replica in Bureau of Economic Geology); Fort Stockton; Kent; El Paso section, Cerro de Muleros (subd. 1–3); widespread in northern Trans-Pecos Texas, where it is a provincial fossil; so far, unknown in Central Texas.

Gryphea washitaensis HILL 1889. Check list of the invertebrate fossils from the Cretaceous formations of Texas [etc.], p. 11. HILL

1889, **52**, p. 4. HILL AND VAUGHAN 1898, **58**, 59, pls. XIX–XXIII. BÖSE 1910, **8**, 110, pl. XX, figs. 1–13. ADKINS AND WINTON 1920, **3**, 62, pl. XV, figs. 5–12.

Larger valve typically thin, beak only slightly incurved, not turned to the side; lateral expansions of shell margin flared, especially posteriorly, with the larger flare limited from rest of shell by a shallow sinus-like radial depression.

Kiamichi to Main Street: Central Texas, northern Trans-Pecos Texas; Fort Washita, Bryan County, Oklahoma (type locality).

Gryphea gibberosa CRAGIN 1893, **21**, 189. HILL AND VAUGHAN 1898, **58**, 62, pl. XXIII, figs. 1–2 (as senile stage of *G. washitaensis).*

Larger valve elongate oval, smaller valve subrectangular; shell thick, with imbricated layers; hinge line straight; no wings. The larger valve has an indistinct radial sinus. This form has been considered identical with *G. washitaensis*, but its range does not appear to be identical with the range of that species, and it differs in form from the largest individuals of *G. washitaensis* ordinarily found.

Denton: Travis County, 2 miles west of Austin; **basal Fort Worth,** at Round Rock (type localities).

Fort Worth: International & Great Northern cut, West Sixth Street, Austin; near Mount Bonnell, Austin; near Fort Worth; near Denison.

Gryphea mucronata GABB 1869, Geol. Surv. Calif., II, 274–275. ROEMER 1852, **78**, 73, pl. IX, figs. 1 a–c *(G. pitcheri).* HILL AND VAUGHAN 1898, **58**, 63, pls. XXIV–XXX. ADKINS AND WINTON 1920, **3**, 63, pl. XV, figs. 1–4............................**Plate XXII, figure 4**

Shell variable, typical form elongate oval, rather thick, external radial sinus slightly developed, beak prominently incurved and straight. Some individuals are thick, but are less massive than *G. navia*, and have the beak straight instead of deflected; generally they differ from *G. marcoui* in being larger and heavier, and somewhat more flared basally.

Grayson, Del Rio, Buda: Widespread in Central and Trans-Pecos Texas. In the Grayson and Del Rio, they are sparse at the base of the formation (abundant *Exogyra arietina)* and plentiful at the top (sparse *E. arietina);* in the Buda they are generally sparse, except perhaps at the very base.

Gryphea aucella ROEMER 1849, **77**, 395. ROEMER 1852, **78**, 74, pl. IX, figs. 4 a–b. HILL 1901, **57**, pl. XLV, figs. 4–4 a. DEUSSEN 1924, **33**, pl. VII, figs. 2–2 a.

Typically medium-sized solid shells, with strong, rounded posterior marginal expansion, and bluntly rounded beak, not much inrolled. Smaller valve flattish, elongated antero-posteriorly to cover body cavity and flare, dorsal margin nearly straight, ventral margin nearly semicircular.

Austin chalk: Ford of Guadalupe River near New Braunfels (type locality); widespread in Central Texas.

Gryphea cfr. **newberryi** STANTON 1893, U. S. Geol. Surv. Bull. 106.

Taylor: Davis Mountains north of Hovey. Terlingua quadrangle, west and southwest of Payne's water hole, and elsewhere.

PYCNODONTA FISCHER DE WALDHEIM[16]

Beak subcentral, less inrolled than in *Gryphea;* superior border of valve forms broad wings; cardinal border bears crenulations; right valve rather flat.

Genotype: *G. vesiculosa* Sowerby (Albian). Cretaceous.

Pycnodonta vesicularis (LAMARCK). STEPHENSON 1923, **96**, 161, pls. XLII–XLIV. BÖSE 1906, Inst. Geol. Mexico, Bol. 24 (Cárdenas), pl. IV, figs. 1–3; pl. VII, fig. 2; pl. IX, fig. 4; pl. XII, fig. 6. WOODS 1913, Paleontogr. Soc., Vol. II, pt. 9, 360–366 .... **Plate XXXVII, figure 4**

Shell generally subcircular to broadly subelliptical in outline. Left valve compressed to strongly convex, usually with an oblique radial sulcus which divides off from the rest of the shell a convex, postero-dorsal, wing-like portion. Right valve flat to strongly concave, and overlapped by margins of the left valve. Beak of left valve subcentral, incurved, of variable prominence; beak of right valve small, non-projecting. Hinge small, subtriangular, ligament pit shallow, narrow, subequilateral. Surfaces of both valves relatively smooth except for growth lines.

Escondido: Anacacho Mountains; Medina County (Rothe's ranch).

Cardenas beds: Near Cárdenas, San Luis Potosí, Mexico; Tula, Tamaulipas, and numerous other localities in northeastern Mexico.

EXOGYRA SAY[17] "RAM'S HORN"

Large (left, inferior) valve curved in a flattened to elevated spire; smaller valve operculum-like, rather flattened, with a distinct spiral beak. Ornamentation varied (smooth, imbricate, costate).

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[16]Literature: Pervinquière, 1914, Etudes de paléontologie tunisienne, Vol. II. Douvillé, H., 1910, Bull. Soc. Géol. France (4), X, 634, 637. Gillet, S., 1924, Soc. Géol. France, Mém. 3, p. 71.

[17]Literature: Böse, E., 1919: On a new *Exogyra* from the Del Rio clay [etc.], Univ Texas Bull. 1902. Jourdy, E., 1924: Histoire naturelle des Exogyres. Ann. Paléont., XIII, fasc. 1–2. Stephenson, L. W., 1914: Cretaceous deposits of the eastern Gulf region, and species of *Exogyra* from the eastern Gulf region and the Carolinas. U. S. Geol. Surv., Prof. Paper 81.

Inferior valve with two ligamental grooves separated by a ridge; other valve with one groove.

Stratigraphic range: Toarcian (Jurassic)-Maestrichtian.

Genotype: *E. costata* Say (Campanian, New Jersey).

Three sections of the genus have been proposed:

Aetostreon Bayle: Small valve flat, smooth; larger valve convex, not plicate, shaped according to the substratum.

Ceratostreon Bayle: With spiral beaks on both valves; both valves generally plicate; angulated carina near convex margin of shell. *(E. texana; E. weatherfordensis; ?E. americana.)*

Rhynchostreon Bayle: Ovate forms, smooth or with sparse or fine costation.

Pervinquière and Jourdy have attempted to construct more elaborate phylogenetic lines in the genus, on the basis of form and ornamentation.

A. Large, smooth, massive species

Exogyra quitmanensis Cragin 1893, **21,** 183, pl. XXXI. Baker 1927, Univ. Texas Bull. 2745, pp. 22, 24, 25, 26.

More elongate than *Exogyra ponderosa;* somewhat similar to *Exogyra whitneyi.*

Trinity (Finlay, with *Orbitulina texana):* Foothills south of Quitman Mountains (type locality); northern Quitman Mountains, one mile south of Quitman Gap; southern Quitman Mountains, summit of Hot Springs road; top of Bluff Mesa, near Sierra Blanca; one mile southwest of Eagle Spring; east side of Van Horn Mountains.

Exogyra whitneyi Böse 1919, **9,** p. 10. Böse 1910, **8,** 115, pl. XXIII, fig. 17; pl. XXIV, fig. 6; pl. XXV, fig. 8; pl. XXVI, figs. 4–11 (as *E. ponderosa* var. *clarki)*..............................**Plate XXII, figure 8**

Differs from *Exogyra ponderosa* in having weak ribs in younger stages, and in being generally more elongate; and usually in having the region beneath the beak, between the hinge and the body cavity, considerably excavated.

Main Street and **Grayson** equivalents (subd. 7–8): El Paso section, Cerro de Muleros (type locality).

Del Rio: Between Dryden and Sanderson.

This species and the preceding one seem to be provincial fossils for West Texas.

Exogyra americana MARCOU (not DESHAYES) 1858, **68,** 37, pl. III, fig. 1 (as *Gryphea sinuata* var. *americana).* ADKINS AND WINTON 1920, **3,** 66, pl. XIV, figs. 1–2. WHITE 1879, **104,** 278, pl. I, figs. 1 a–b. WHITE 1884, **107,** 307, pl. LIV, figs. 1–2 *(Exogyra walkeri)* .... **Plate XV, figure 4**

Shell flattened, beak depressed, left valve and body cavity thicker near beak, thinned to opposite margin; left valve with rounded shoulder along thicker side; right valve rather flat and operculiform, fitting into larger valve.

Fort Worth, Duck Creek: Grayson County, near Preston (type locality; holotype British Museum Natural History, South Kensington, BM 12670; replica in Bureau of Economic Geology); Fort Worth; Gainesville; west of Aquilla; west of Waco; Bell County; Austin; Fort Stockton; Kent.

This fossil is a widespread and valuable marker, generally indicating the Fort Worth level but not strictly confined to that level.

Exogyra ponderosa ROEMER 1852, **78,** 71, pl. IX, figs. 2 a–b. STEPHENSON 1924, **96,** 46, pl. XIII, figs. 5–7; pl. XIV, figs. 1–3. HILL 1901, **57,** pl. XLV, fig. 1 .... **Plate XXXVI, figure 1**

Shell large, thick, outline generally subcircular (some individuals more elongated), left valve strongly convex, beak generally low, with small attachment scar; hinge with broad, deeply impressed ligamental groove, paralleled on upper side by faint, shallow, narrow groove; posterior to ligamental groove is a broad, shallow, pitted or striated depression. Costae faint or irregular in initial or medial portions of shell, or absent. Right valve flat or slightly concave, subcircular or subovate in outline, with nearly flat, spiral twist, the beak being well within the margin.

Austin chalk (lower part of *Exogyra ponderosa* zone): Dallas, Travis, Hays, Bexar, Medina, Uvalde, Kinney counties.

Brownstown marl: Red River, Lamar counties.

Annona chalk: Red River County.

Taylor: Delta, Travis, Hays, Comal, Guadalupe, Bexar counties.

Anacacho: Medina, Uvalde, Kinney counties.

Upson: Kinney, Maverick counties.

San Miguel: Maverick County.

In northern Mexico, at numerous localities: Esperanzas (Coahuila), near Ojinaga (Chihuahua), and others.

BÖSE 1919, **9,** considers the form in the upper Austin chalk to be distinct from *Exogyra ponderosa.*

Exogyra ponderosa var. **erraticostata** STEPHENSON 1914, **94,** 49, pl. XV, fig. 4; pl. XVI, figs. 1–2. STEPHENSON 1923, **96,** 171, pl. XLVII, fig. 1.

Differs from typical *Exogyra ponderosa* in the ornamentation of the left valve: for about 2 cm. from the beak there are small, regular costae as in some individuals of *E. ponderosa,* but at a greater distance there are weak, irregular, sharp to round, fairly coarse, discontinuous costae, which vary in size, shape and distribution.

Austin chalk (lower part of *Exogyra ponderosa* zone): Seven miles northeast of Dallas; Travis County, Onion Creek, one-half mile below the Lockhart road crossing, and Onion Creek, one-half mile above Bluff Springs; Maverick County, Tequisquite Creek, a few hundred yards below Eagle Pass-Del Rio road.

Brownstown marl (upper part of *Exogyra ponderosa* zone): Manchester road, 4 miles north of Clarksville, Red River County.

Exogyra ferox CRAGIN 1893, **21**, 185, pl. XXXII, fig. 1; pl. XXXIII, fig. 5; pl. XXXIV, fig. 1; pl. XXXVI, fig. 6. BÖSE 1919, **9**, p. 11.

Shell large (155 mm. high), massive, elongated; beak of lower (left) valve outcurved, in some individuals free. The species is more elongate relatively than *Exogyra whitneyi* and larger than *Exogyra cartledgei.*

Woodbine: Northwest Fannin County (type locality).

B. Medium to small, smooth species

Exogyra plexa CRAGIN (part) 1893, **21**, 187, pl. XXX, figs. 3, 5, 6 (not fig. 4). BÖSE 1919, **9**, pp. 7–8, pl. I, figs. 3–4. ADKINS AND WINTON 1920, **3**, 65, pl. XIII, fig. 7.

Shell small, with pronounced rounded carina and numerous fine costellae, especially in the beak region; no plications.

Upper Goodland: Three miles east of Benbrook; **Duck Creek,** north of Denison (type localities; types in University of Texas).

Goodland (below upper *Salenia* zone): Tarrant County.

Kiamichi (ledge 16): Tarrant County.

Basal Duck Creek: Grayson County, at Duck Creek type locality, north of Denison.

Exogyra arietina ROEMER 1852, **78**, 68, pl. VIII, fig. 10. BÖSE 1919, **9**, 19, pl. IV, figs. 1–18; pl. V, figs. 1–23. "RAM'S HORN"............ ....**Plate XV, figure 1; plate XXII, figures 1–3**

Beak region and young shells (after about 3 mm. in length) with fine, elevated longitudinal costellae, which in later stages are interrupted by the growth lines; adult stage devoid of costellae. Shell elliptically coiled, exceptionally extended straight in most mature stage; has one or two prominent lateral radial sinuses. Spire usually slightly but distinctly elevated, but exceptionally it is tall (two or more turns). Interior of left valve deeply excavated. Right valve opercular, oval, broadly sinuous, notched at point of incoiling of beak, has coarse, oval growth lamellae.

Del Rio, Grayson: North-Central Texas, South-Central Texas, Trans-Pecos Texas, widespread and abundant (zone of abundance in basal Grayson-Del Rio, sparser at top); type locality 30 miles up the Brazos from Torrey's Trading House *(i.e.* southern Hill County, west of Aquilla), five (?) cotypes in University of Bonn.

An individual, doubtless ancestral, practically indistinguishable from *Exogyra arietina,* was found in the upper Weno, three miles southeast of Fort Worth. The species has remoter affinities with the smooth *Exogyra plexa* in the Goodland-Kiamichi.

Exogyra sp.

Medium-sized, smooth species, with flared basal margin and free, very tapering beak.

Upper Del Rio: Austin (Shoal Creek).

Exogyra laeviuscula ROEMER 1849, **77**, 398. ROEMER 1852, **78**, 70, pl. IX, figs. 3 a–c. CONRAD 1857, **18**, 154, pl. VII, figs. 4 a–b. HILL 1901, **57**, pl. XLV, fig. 3. DEUSSEN 1924, **33**, pl. X, figs. 2–2 a. WHITE 1884, **107**, 305, pl. LII, figs. 3–5.

Medium-sized shell, squarish to oval in contour, smooth except for growth lines; left valve ventricose, flared terminally, rapidly expanding from a small, narrow beak which is more elevated than in most forms of *E. ponderosa* or of *E. columbella.* Right valve ovate, nearly flat.

Austin chalk: Central Texas, widespread; near New Braunfels (type locality), New Mexico, and Nuevo Leon (White).

C. Medium to small, costate or plicate species

Exogyra hilli CRAGIN 1893, **21**, 186. HILL 1889, **51**, pl. V, figs. 1–10; pl. VII, fig. 30.

Small (28 mm. tall), plicate, arcuate, narrow especially behind, carinate, anterior slope with 5–8 folds. Right valve flattish, concave anteriorly, thickened posteriorly.

Travis Peak: Travis County (Camp Creek, Cow Creek); Burnet County (Hickory Creek); Pike County, Arkansas.

Exogyra paupercula CRAGIN 1893, **21**, pl. XXX, figs. 7–8.

Shell small, elongate, rectangular in outline, left valve excavated, with 2–4 radial folds; beak low or free. Right valve smaller, thin, subovate, anterior margin straight, beak depressed.

Glen Rose: Erath County, 3 to 4 miles south of Dublin (type locality).

Exogyra texana ROEMER 1852, **78,** 68, pl. X, figs. 1 a–e. HILL 1901, **57,** pl. XXVII, figs. 1 a–b. BÖSE 1910, **8,** 112, pl. XX, figs. 14–16; pl. XXI, figs. 1–11; pl. XXII, figs. 1–9. BÖSE 1919, **9,** p. 5, pl. I, figs. 1–2. ADKINS AND WINTON 1920, **3,** 65, pl. XIII, figs. 11–14 ....**Plate II, figures 1–2; plate XV, figure 5**

Elongate oval, plicate, beaks depressed. Left valve with strong carina on one edge, the opposite edge thin. The steep, short slope below the carina has numerous crenulate plications; the broader slope has simple or bifurcated, partly imbricated plications. Right valve ovate, with depressed beak. Some varieties are more spinose or imbricated. *Fossil pearls* were found in this oyster in Coke County (ADKINS AND WINTON 1920, **3,** 64), Plate II, figure 1.

Fredericksburg: Fredericksburg, San Saba Valley, and Waco Camp (type localities); widespread in Central and West Texas.

Upper and middle Glen Rose: Travis, Hays counties.

Exogyra weatherfordensis CRAGIN 1893, **21,** 188, pl. XLV, figs. 7–10. BÖSE 1919, **9,** 5, pl. I, figs. 1–2. ADKINS AND WINTON 1920, **3,** 65, pl. XIII, figs. 11–14.

Shell smaller and more elongate than *Exogyra texana,* lower valve carinated, posterior slope with numerous plications, anterior slope with 6–12 oblique, subtriangular plications. Upper valve flat, with concentric, imbricated lines; anterior margin thickened and milled.

Glen Rose: One-fourth mile west of Weatherford; and four miles west of Montell, Uvalde County (type localities; horizon?).

Fredericksburg (common in Walnut and Comanche Peak): North-Central Texas, widespread and abundant.

Exogyra n. sp. aff. **plexa** CRAGIN 1893, **21,** 187, pl. XXX, fig. 4. BÖSE 1919, **9,** 8, pl. I, figs. 5–6. ADKINS AND WINTON 1920, **3,** 65, pl. XIII, figs. 8–10.

Form somewhat as in *Exogyra plexa* CRAGIN (restricted), but with several prominent plications running from carina to posterior shell margin.

Goodland: Three miles west of Benbrook; Duck Creek, north of Denison (Cragin's type localities); Texas & Pacific Railway, 3–5 miles west of Fort Worth.

Kiamichi: Little Mineral Creek, north of Pottsboro; Tarrant County, several localities west and northwest of Fort Worth.

Exogyra drakei CRAGIN 1893, **21,** 184, pl. XXIX, figs. 8–11.

Elongate-subovate, narrow depressed beaks; left valve deeply excavated, with an obscure carina, and 10–20 obscure, radial plications, imbricated at ends. Right valve flat or convex, smooth except for projecting growth lines.

Del Rio: McLennan County, near Bosqueville (two cotypes); on Denton Creek, one mile east of Roanoke.

Exogyra cartledgei BÖSE 1919, **9,** 17, pl. I, figs. 7–13; pl. II, figs. 1–4; pl. III, figs. 1–8........ **Plate XXII, figures 5–7**

Adult shell thick, elongate, generally twisted or oblique in body portion, beak depressed or else coiling outwards and free; beak loosely coiled leaving large area above hinge line. Left valve with rounded carina, from which coarse, subequal ribs pass out over anterior and posterior slopes. Right valve operculiform, slightly twisted, beak submarginal, forming marginal notch.

Uppermost Del Rio: Terlingua, Reed Plateau (type locality); several localities in northern Coahuila (everywhere at same level); Georgetown, Round Rock (one individual at each locality). This fossil has remarkable zonal relations: at the type locality, east face of the Reed Plateau, it occurs only in a zone of about three feet thickness almost at the top of the Del Rio, and there is present in vast quantity; such search as has been made failed to reveal it in situ at any other level; the Del Rio outcrop in Coahuila, thinning southwards towards Remolino and Albercas where it finally disappears, contains *E. cartledgei* at numerous localities everywhere in a very thin zone at the top; and at the same horizon at Georgetown and Round Rock, single individuals were found. This oyster, so far as known, has perhaps the most restricted range of any Texan Cretaceous fossil.

Exogyra n. sp. 1.

Buda: Bell County, four miles southeast of Belton(type locality); Williamson County; Travis County; Bosqueville, McLennan County.

Exogyra n. sp. 2.

Austin chalk: Big Walnut Creek, below Sprinkle road, Travis County (type locality).

Exogyra columbella MEEK 1876, **71,** 124–125, pl. I, figs. 3 a–d. WHITE 1884, **107,** 304, pl. LV, figs. 5–6. CRAGIN 1893, **21,** 184. BÖSE 1919, **9,** pl. 12. HILL 1901, **57.**

Lower valve deeply excavated, covered with subequal, wide, flattened ribs. Differs from *Exogyra laeviuscula* in its smaller and lower spire, and in having ribs.

Woodbine: Grayson County (Big Mineral Creek; Moss Springs); Denton County (Timber Creek); type localities in New Mexico and Utah, horizon not stated. Other non-ribbed species have been loosely referred to this species.

D. Large, costate or plicate species

Exogyra clarki SHATTUCK 1903, **86,** 22, pls. X–XI.

Large species, relatively thin-shelled at margin, outline elongate oval, narrower towards beak; spiral low, making distinct notch on margin of left valve. Imbricated growth lamellae, crossed, especially in central and in umbonal regions, by short, narrow, interrupted, radial ribs.

Buda: Austin, Shoal Creek (type locality).

Exogyra costata SAY 1820, Am. Jour. Sci. (1), 2, p. 43. STEPHENSON 1923, **96,** 173, pl. XLVII, figs. 2–5; pl. XLVIII. BÖSE 1906, Inst. Geol. Mex., Bol. 24, 51, pl. VI, fig. 3; pl. VII, fig. 1; pl. VIII, figs. 2–3; pl. IX, fig. 3. HILL 1902, **57,** pl. XLVII, figs. 1–1 a. DEUSSEN 1924, **33,** pl. XII, fig. 1.................**Plate XXXVII, figure 2**

Shell thick, subcircular to subovate; left valve strongly convex, with umbonal ridge extending from beak to posterior shell margin. Surface bears rather regular, subequal costae, semicircular to squarish in outline, most of them prominent, bifurcating from umbonal ridge, obsolete near margin in some old shells; costae may bear slight nodular protuberances. Upper valve disk-shaped, rather flat, fitting within the larger valve.

Type locality: In New Jersey, exact horizon unknown.

Navarro: Bowie, Kaufman, Travis, Guadalupe counties; widespread in Central Texas.

Escondido: Medina, Uvalde, Maverick counties.

Cardenas beds: Localities 1 to 7 kilometers east of Cárdenas, San Luis Potosí; Tula, Tamaulipas (extremely abundant, associated with *Pycondonta "vesicularis," Ostrea saltillensis* and gastropods); numerous localities in northern Mexico.

Exogyra costata var. **spinosa** STEPHENSON 1923, **96,** 179, pl. XLIX, figs. 1–6; pl. L, figs. 1–4. STEPHENSON 1914, **94,** pl. XVII, fig. 2; pl. XIX, figs. 1–2.

Differs from typical *Exogyra costata* in "the prominent development of concentric, imbricating growth lamellae, which along the crests of the costae project outward in spine-like folds with the convex side of the folds turned upwards. The folds vary in prominence, but reach maximum extensions of 6 or 8 mm. from the crests of the ridges; they are easily broken, so that even the best specimens are imperfect."

Taylor (upper part of *Exogyra ponderosa* zone): Hays County.

Anacacho (upper part of *Exogyra ponderosa* zone): Medina, Kinney counties.

San Miguel (upper part of *Exogyra ponderosa* zone): Kinney, Maverick counties.

Exogyra cancellata STEPHENSON 1923, **96,** 182, pl. L, figs. 5–6; pl. LI, figs. 1–2. STEPHENSON 1914, **94,** 53, pl. XX, figs. 2–4; pl. XXI, figs. 1–2.

Shell somewhat ovate, beak incurved and depressed. Left valve with low, bifurcating, nodular costae, the nodes being produced by concentric depressions, resulting in a checkered or cancellated ornamentation. Costae in some individuals are weakly developed.

Lower Navarro: Delta, Hunt, Kaufman counties.
Cardenas beds: Ciudad Maiz, San Luis Potosí.

Doubtful or invalid species:

Exogyra squammata HILL AND VAUGHAN. GILLET 1924, **47,** p. 70 (?=*Exogyra squammata* D'ORBIGNY 1842, Foss. Col., pl. XIX, figs. 12–15; COQUAND 1869, **117,** 178, pl. LXX, figs. 3–6).

Exogyra haarmani BÖSE 1920, Univ. Texas Bull. 1856, 230, pl. XVIII, figs. 4–8.

Upper Cenomanian (with *Metoicoceras* aff. *whitei, Metoicoceras* n. sp): Cerro del Macho, Hda. Mohóvano, Coah.-Chih.

Exogyra potosinus CASTILLO AND AGUILERA.

Upper Jurassic ? (Malone beds): East of Torcer, Hudspeth County (Cragin).

Exogyra aff. couloni D'ORBIGNY.

Lower Neocomian: Miquehuana, San Luis Potosí.

Exogyra (two species).

Lower Neocomian, basalmost Cretaceous: Huizachal, southwest of Ciudad Victoria, Tamaulipas.

Superfamily TRIGONIACEA

TRIGONIIDAE Lamarck

TRIGONIA BRUGUIERE[18]

Surface sculptured with nodulose ribs or rows of pustules, the posterior dorsal area usually discrepant with the rest. Beaks opisthogyrous, nearly terminal; teeth striated;

[18]Literature: Agassiz, L., 1840: Etudes critiques sur les mollusques fossiles, Trigonies, pt. 1. Bigot, A., 1893: Mémoire sur les Trigonies. Mém. Soc. Linn. de Normandie, Caen, XVII, fasc. 2. Cossman, M., 1912: Evolution des Trigonies. Ann. Paléont., VII, fasc. 2. Deecke, W., 1925: Uber die Trigonien. Pal. Zts., VII, Heft 2, 65–101. Deecke, W., Trigoniidae mesozoicae. Fossilium catalogus. No. 30. Gillet, S., 1924: Soc. Géol. France, Mém. 3, 77–98. Gillet, S., 1920: Revision du groupe de *Trigonia quadrata* Agassiz. Bull Soc. Géol. France, XX, 553. Litschkow, B., 1912–1913: Sur les Trigonies. Kiev. (Includes catalog of species of the genus

adductor scars strong, with buttressing ridges. Liassic to Recent (abundant in Jurassic and Cretaceous).

The described Texan species fall into the following sections:

Clavellatae: Area limited by two nodose keels, and mostly has also a median keel. Escutcheon not ornamented. Ribs irregularly concentric or oblique, resolved into rows of nodes. Mainly Cretaceous. *T. proscabra.*

Undulate: Like *Clavellatae,* and with plain escutcheon, but the ribs have posteriorly a sharp V-shaped or right-angled bend. Mainly Cretaceous. *T. goodelli, T. calderoni.*

Glabrae: Oval or elongate oval; area obscurely limited and marked by fine striations. Weak concentric, nodose ribs, restricted to anterior half of shell, some species nearly smooth. *T. concentrica.*

Quadratae: Form subquadrate; body and the poorly defined area covered with irregularly concentric rows of nodes. Mainly Cretaceous. *T. taffi.*

Scabrae: Shell somewhat crescentic, dorsal margin concave, ventral margin very convex, beaks prominent, shell narrow and produced behind, area narrow or nearly absent, obscurely defined. Ribs concave forwards, narrow, sharp, mostly tuberculate. Exclusively Cretaceous. *T. praestriata, T. stolleyi, T. crenulata* Roemer, *T. guadalupae, T. emoryi, T. clavigera, T. eufaulensis.*

Costatae: Area sharply delimited, with radial ribs; body with prominently raised, smooth, concentric ribs. Predominantly Jurassic, a few Cretaceous species. *T. munita, T. rudicosta, T. conferticostata.*

Pseudoquadratae: Area and escutcheon ornamented with concentric ridges; body has sparse, coarse, nodose, radial ribs; ribs of area prolonged beyond limiting keel of area; section close to *Clavellatae;* type *T. transitoria* Steinmann (South America). Limited to basalmost Cretaceous. *T. vyschetzkii.*

A. Malone species:

Trigonia vyschetzkii CRAGIN.

Trigonia vyschetzkii CRAGIN 1893, **21**, 215. CRAGIN 1897, Jour. Geol., V, 816–817. CRAGIN 1905, **27**, 56, pl. VIII, figs. 1–2; pl. IX, figs. 1–3.

Trigonia vyschetzu GILLET 1924, **47**, p. 96.

Trigonia vyschetzhu GILLET 1924, **47**, p. 96.

Trigonia volutzi GILLET 1924, **47**, p. 97.

Trigonia vyschetzi GILLET 1924, **47**, p. 284.

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by sections, pp. 120–160.) Litschkow, B., 1912: Mesozoic Trigoniae. Mem. Soc. Natur. Kiew., Vol. XXII. Lycett, J., 1872–1873: A monograph of the British fossil Trigoniae. Paleontogr. Soc. London. Steinmann, Gustav., 1882: Die Gruppe der Trigoniae pseudo-quadratae N. Jahrb., I, 219–227. Woods, Henry, 1899–1912: A monograph of the Cretaceous Lamellibranchia of England. Paleontogr. Soc. London.

Section *Pseudoquadratae;* form thick, subequivalve, rounded-quadrangular in general outline, postero-dorsal margin long, rather straight, area posterior to beak large, obscurely bounded by rounded ridge over which the several finer ribs of the posterior area pass onto the sides of the shell; sides with a few (10 or more) coarse ribs, each a little narrower than the concave-bottomed interspaces, and bearing on summit several coarse, rounded low tubercles.

Basal Cretaceous: Malone Hills, and Theta subdivision of Trio section, 1.5 miles east of Torcer station (type locality; abundant).

Trigonia goodelli CRAGIN 1897, Jour. Geol., 5, 816; 1905, **27**, 58, pl. X, figs. 1–2. GILLET 1924, **47**, p. 284 *(Trigonia goodeli)*.

Section *Undulatae*.

Basal Cretaceous: Malone.

Trigonia calderoni CASTILLO AND AGUILERA. CRAGIN 1905, **27**, 59, pl. IX, figs. 4–5.

Section *Undulatae*.

Basal Cretaceous: Malone.

Trigonia proscabra CRAGIN 1905, **27**, 60, pl. X, figs. 3–6. GILLET 1924, **47**, p. 284.

Section *Clavellatae* (with ornamented escutcheon as in *Scabrae)*.

Basal Cretaceous: Malone.

Trigonia praestriata CRAGIN 1905, **27**, 61, pl. X, fig. 7. GILLET 1924, **47**, pp. 90, 284.

Section *Scabrae*.

Basal Cretaceous: Malone.

Trigonia munita CRAGIN 1905, **27**, 62, pl. X, figs. 8–11.

Section *Costatae*.

Basal Cretaceous: Malone.

Trigonia rudicostata CRAGIN 1905, **27**, 63, pl. XI, figs. 1–2.

Section *Costatae*.

Basal Cretaceous: Malone.

Trigonia conferticostata CRAGIN 1905, **27**, 63, pl. XI, fig. 3.

Section *Costatae*.

Basal Cretaceous: Malone.

Trigonia steeruwitzi CRAGIN. GILLET 1924, **47**, p. 216. *(Nomen nudum.)*

B. Trinity division

Trigonia taffi CRAGIN 1893, **21,** 214. CRAGIN 1905 **27,** pp. 10–11, 19, 97.

Section *Quadratae;* form large, rounded-subquadrate, compressed; area ornamented with numerous, narrow, parallel, abruptly raised bands, separated by interspaces three times as broad, and beaded or granulate near the beak. Body ornamented with rows, concave forwards, of small, closely set, rounded tubercles.

Glen Rose: Bluff Mesa, south of Sierra Blanca; 1 mile northeast of Malone[19] (type localities).

Trigonia concentrica CRAGIN 1893, **21,** 213, **pl.** XLI, fig. 4.

Cast small (50 mm. long); outline semilunar, beaks tall, subterminal, cast produced posteriorly. Cragin compared the ornament to that of *T. longa* Agassiz and *T. sinuata* Parkinson (section *Glabrae).* "Anterior part of shell ornamented with concentric ribs which are very fine and distinct upon the beaks, just posterior to which they give place to a few more or less distinct tubercles, the posterior part of the shell being ornamented with unequally prominent growth lines only."

Travis Peak: Travis County, Cow Creek and Post Oak Creek (type localities).

Trigonia stolleyi HILL 1893, **55,** 26, pl. III, figs. 3, 5.

Section *Scabrae;* semilunar in general outline, beaks subterminal; posterior portion truncated and apparently not produced; about 22 narrow, high, slightly wavy ribs with tops notched, giving serrate effect; interspaces unusually wide. Differs from *T. emoryi* in having fewer ribs, which are less distinctly tuberculate.

Glen Rose: Near Glen Rose, plant beds of the Paluxy River (type locality).

Trigonia crenulata LAMARCK. ROEMER 1852, **78,** 51, pl. VII, fig. 6. HILL 1893, **55,** 27, pl. III, fig. 4.

Böse considered it as possibly identical with *T. emoryi*; the cast figured by Hill belongs to the section *Scabrae,* but apparently has sparser ribs than *T. emoryi.*

Glen Rose?: Travis County, Colorado River bluffs near Bull Creek.

Trigonia (?) **lerchi** (HILL) 1893, **55,** 30, pl. IV, fig. 3 *(Pholadomya?)* GILLET 1924, **47,** pp. 83, 233 *(Trigonia leerchi).*

Indeterminate cast; Gillet considers it a *Trigonia.*

Basal Cretaceous conglomerate: Burnet County, on Sycamore Creek near crossing of Burnet-Travis Peak road (type locality).

[19]Malone locality erroneous (CRAGIN 1905, **27,** p. 10, footnote *b.)*

C. Fredericksburg Species

Trigonia emoryi CONRAD 1857, **18**, 148, pl. 3, fig. 2. GILLET 1924, **47**, 90. SHATTUCK 1903, **86**, 23, pl. VIII, figs. 6–8. BÖSE 1910, **8**, 121, pl. XXIV, figs. 1–5; pl. XXV, figs. 1, 3, 5; pl. XXVI, fig. 1.

Section *Scabrae;* beak prominent, dorsal margin concave, ventral margin strongly convex, shell elongate posteriorly, inflated, equivalve. Valve has 33 or more narrow, tall, equally spaced ribs directed backwards from dorsal mid-line, thence forwards making a backwardly directed V on the edge of the escutcheon, thence over the sides with a forward directed concavity. The ribs bear numerous, small, elevated nodes.

Cretaceous: Between El Paso and Frontera (type locality).

Fredericksburg division: Widespread and abundant in Central Texas.

Washita division: Central Texas.

Buda: Austin (Shoal Creek, Barton Creek), Buda (Onion Creek).

Trigonia guadalupae BÖSE 1910, **8**, 124, pl. XXIII, figs. 11–16.

Shell small to medium size, thick; beaks prominent, rather pointed; dorsal margin concave; ventral margin prominently convex; 17–22 strongly elevated, narrow ribs with well separated, conical tubercles on the summits; area anterior to beaks short, subvertical; area posterior to beaks long, crescentic, limited on each side by double ridge, bears several ridges directed obliquely backwards.

Fredericksburg (with *Oxytropidoceras chihuahuense):* La Encantada, Chihuahua (type locality).

Weno: Near Fort Worth.

D. Washita species

Trigonia clavigera CRAGIN 1893, **21**, 212, pl. XLVI, figs. 12–13.. **Plate XVI, figure 4**

Section *Scabrae;* general form of *Trigonia emoryi*, but has about 28 ribs which bear erect, compressed, triangular, or wedge-fronted, obtuse, more or less distinctly knob-ended spines, of which there are 8–10 large ones and about as many smaller ones on each of the longer ribs.

Upper Washita: Cooke County, Brown's Ferry (type locality).

E. Austin chalk species

TRIGONIA ALIFORMIS GOLDFUSS. GIEBEL 1853, **45**. ROEMER 1849, **77**, 404.

Austin chalk: New Braunfels.

TRIGONIA THORACICA MORTON. ROEMER 1852, **78,** 52.
Austin chalk: Between New Braunfels and Seguin.

F. Navarro species

Trigonia sp. HILL 1889, **52,** p. 11.
Navarro: North of Webberville.

Trigonia eufaulensis GABB. STEPHENSON 1923, **96,** 189, pl. 54, figs. 1–6. WADE 1926, **103,** 61, pl. 20, figs. 3–4.

Section *Scabrae;* shell small to medium, equivalve; dorsal margin moderately concave; basal margin prominently convex, rather zig-zag by the ends of the costae; posteriorly narrowed; area posterior to beaks with numerous short ribs running perpendicular to shell margin and turning suddenly posterior at the impressed edge of the escutcheon; body ornamented with 15–18 prominently elevated ribs with a sharp anterior and more gentle posterior slope; ribs prominently concave anteriorly, some overhang anteriorly. They are mainly surmounted by small nodules or transversely raised areas.

Navarro: Kaufman County, near Kaufman (U.S.N.M. cat. no. 20995).

Trigonia securiformis CRAGIN 1893, **21,** 214, pl. XLVI, fig. 6= **Protocardia.**

Trigonia texana CONRAD 1857, **18,** 148=**Arctica.**

Superfamily PECTINACEA

PECTINIDAE Lamarck[20]

PECTEN MULLER. Scallop

"Free and auriculate, and without internal lirae" (Dall).

Many writers, among them Dall and Gillet, consider *Pecten* in a very broad sense, and relegate to sub-genera or sections such groups as *Chlamys* and *Neithea,* which are claimed to be founded on superficial shell characters having few corresponding anatomical differences, and therefore not properly regarded as of generic value. Böhm assigns generic rank to *Neithea.*

[20]Literature: Böhm, Joh., 1919: Zur systematischen Stellung der Gattung *Neithea* Drouet. Jahrb. preuss. Geol. Landesanst., XL, Teil II, Heft 1, 129–147. Böhm, Joh., 1920: Uber *Pecten septemplicatus* auct., *ibid.,* pp. 156–160. Choffat, P., Espèces nouvelles ou peu connues. Serv. Géol. Port., Lisbon. Gillet, S., 1924: Revision du sous-genre *Neithea* Drouet. Bull. Soc. Géol. France (4), XXI. Kniker, Hedwig, T., 1919 (dated 1918): Comanchean and Cretaceous Pectinidae of Texas. Univ. Texas Bull. 1817. Philippi, E., 1900: Zur Stammesgeschichte der Pectiniden. Zts. deuts. geol. Ges., L., 619.

A. Shell elongate to circular, flattened, smooth or with numerous, subequal ribs; ears prominent, unequal, triangular

Pecten (Chlamys) stantoni HILL 1893, **55**, 24, pl. II, figs. 3–3 a. STANTON, Geol. Bisbee Quadrangle.

Shell small, ears rugose, right one with deep fold. Surface of larger valve marked by strong, flattened, double ribs, each with a depression along its entire length, alternating with small, single ribs, and both kinds of ribs crossed by minute, concentric lines.

Glen Rose: Near Glen Rose, in "plant bed" of Paluxy River.
Trinity division: Bisbee, Arizona.

Pecten (Chlamys?) bonnellensis KNIKER 1919, **62**, 13, pl. I, figs. 1–2.

Left valve with about 20 primary ribs, and with simple secondary ribs intercalated in increasing number toward the shell margin (3 to 6 at margin). Ribs with numerous fine spines.

"Georgetown" (probably Upper): Austin, Mount Bonnell (type locality).

Main Street: Southern Denton County.

Pecten (Chlamys?) chihuahensis BÖSE 1910, **8**, 93, pl. XV, fig. 1.

Apparently somewhat broader than *P. bonnellensis*, and has more prominent primary ribs. Shell medium-sized, suboval, ears unequal. About 20 principal ribs, which branch towards the undulated shell margin; no spines on ribs.

Fort Worth-Denton (subd. 5, with *Pervinquieria trinodosa*): El Paso section.

Pecten (Camptonectes?) manchacensis KNIKER 1919, **62**, 14, pl. I, figs. 3–4.

Shell small, orbicular, anterior ear long and ascending. Right valve ornamented with delicate, minute, concentric folds; no ribs.

Lower Buda: Austin, Manchaca (type localities).

Pecten (Camptonectes?) siederensis KNIKER 1919, **62**, 15, pl. I, figs. 5–6.

Shell medium-sized, suborbicular, ears subequal. Right valve convex, extremely thin, surface smooth except for delicate growth lines and some short, irregular, microscopic, falciform, radial lines.

Upper Buda: Travis County, Sieder Springs (type locality).

Pecten (Camptonectes?) bensoni KNIKER 1919, **62**, 16, pl. I, figs. 7–13.

Shell medium-sized, subcircular, anterior ear more projecting. Right valve ornamented with radiating, diverging, dichotomous furrows, separated by broader, rounded, low folds, and with strong concentric ridges. Stephenson considers this species as perhaps identical with *Pecten bellisculptus* Conrad (**96**, p. 194).

Austin chalk: Austin (type locality); Travis Heights; Waller Creek.

Pecten bellisculptus (CONRAD). STEPHENSON 1923, **96**, 193, pl. LIV, figs. 10–11.

Subcircular to broadly ovate, valves convex, depressed, subequal; beaks small, depressed, angle of beak about 100°; posterior ear of right valve triangular, delimited from body by a sulcus. Surface has fine concentric growth lines, and numerous, crowded, radiating bifurcating ribs which, though depressed, are distinct and are readily seen macroscopically; the ribs are separated by much narrower depressions.

Austin chalk (questionably): Eastern part of South Austin.

San Miguel: Tank east of Uvalde road, 17 miles northeast of Eagle Pass.

Pecten simplicius CONRAD 1860. STEPHENSON 1923, **96**, 199, pl. LV, figs. 6–11.

Shell small, thin, general contour of *Pecten bensoni*, subcircular-subovate, subequilateral, both valves depressed and convex. Both ears separated from body by sulci, anterior ears larger. Beak small, beak angle about 95°. Surface shiny, smooth except for growth rings and extremely fine, scattered radiating ribs.

Navarro: Near Kaufman; near Chatfield; San Marcos River, one-half mile below Martindale, Caldwell County.

Pecten mississippiensis CONRAD 1860. STEPHENSON 1923, **96**, 201, pl. LV, figs. 12–15.

Species medium-sized (up to 50 mm.), shell thin, tall ovate; ears triangular, delimited by sulci; beak small, raised; beak angle 90°–95°. Left valve flatter than right, marked by 5 prominent, narrow distant, radiating ridges, with 2 to 4 much less prominent radial ribs in each interspace; right valve has 4 or 5 broadly rounded, shallow, unequal, radiating folds. Both valves have fine, closely and evenly spaced, concentric growth lamellae with ragged edges.

Navarro: Near Kaufman; near Chatfield.

Pecten cleburnensis ADKINS AND WINTON 1920, **3**, 71, pl. XII, fig. 1.

Elongate-oval, inequivalve; right valve has numerous, fine, subequal, radiating, straight costellae at the shell margin.

Washita (Main Street?): Cleburne (type locality).

Pecten (Camptonectes?) inconspicuus CRAGIN 1895, **23**, p. 51. ADKINS 1920, **1**, 123, pl. XI, fig. 4.

Shell subcircular, nearly smooth, anterior and posterior dorsal margins straight; posterior ear larger. Right valve has fine growth lines and a few scattered imbricated growth rings, and scattered, fine radial striae.

Pawpaw: Pawpaw Creek, Denison (type locality).
Weno: Gainesville.

B. All ribs fine, subequal, and similar

Pecten (Neithea) bellula CRAGIN 1893, **21**, p. 216. KNIKER 1919, **62**, 22, pl. III, figs. 3–11. ADKINS AND WINTON 1920, **3**, 69, pl. XI, figs. 3–7..**Plate XVII, figure 5**

Shell elevated, ears small, triangular, unequal. Right valve has numerous simple ribs, subequal in size except that every sixth or seventh rib is slightly more prominent and makes a projection on the scalloped shell margin.

Fort Worth, upper Duck Creek: One-half mile above Texas & Pacific bridge across Sycamore Creek, east of Fort Worth; and International & Great Northern cut on West Sixth Street, Austin (type localities); North-Central Texas, widespread.

C. With 4–6 prominent ribs

Pecten (Neithea) wrighti SHUMARD 1860, **89**, p. 607. CRAGIN 1893, **21**, 217, pl. XXXII, figs. 2–3. KNIKER 1919, **62**, 23, pl. IV, figs. 1–3. ADKINS AND WINTON 1920, **3**, 69, pl. XI, figs. 8–10..**Plate XVII, figure 6**

Shell elevated, anterior ear prominent and pointed, posterior ear reduced. Right valve has four thick, radial ribs, each with prominent costellae along summit. Interspaces contain variable, small, radial costellae. The shell is covered by numerous, fine, distinct growth lines. Left valve almost flat, with costae corresponding to those of right valve, and with similar ornamentation.

Upper Duck Creek, lower Fort Worth: Denison, Fort Worth, Waco, Austin; near Roanoke; Devil's Ridge, near Sierra Blanca.
Main Street: Fort Worth (rare).

Pecten (Neithea) whitneyi KNIKER 1919, **62**, 39, pl. VII, figs. 13–17. WHITNEY 1911, **111**, 13, pl. I, fig. 4.

Four prominent radial ribs, and a smaller posterior one. Differs from *Pecten wrighti* in being narrower, more nearly equilateral, and more convex; in having ribs of right valve bluntly pointed at summit, and the interspaces narrow and angular at bottom, instead of flattened.

Lower Buda: Austin, Manchaca (type localities).

D. With 5–8 coarse ribs, and irregular, finer ribs

Pecten (Neithea) duplicicosta ROEMER 1849, **77,** 398; ROEMER 1852, **78,** 65, pl. VIII, figs. 2 a–b.

Shell broad, basally circular in outline, ears prominent. Right valve elevated, elongated, with 6 primary ribs forming projections on the shell margin; 3 or more secondaries per interspace. Ribs are relatively low, flattened, and irregularly spaced.

Edwards: Austin; Central Texas (widespread); Pedernales River float (type locality).

Pecten (Neithea) roemeri HILL 1889, **53,** pl. I. SHATTUCK 1903, **86,** 15, pls. II–IV; pl. V, fig. 1. KNIKER 1919, **62,** 43, pl. IX, figs. 1–3; pl. X, fig. 1.

Large species, outline suboctahedral, right valve elevated, ears prominent with subequal, radial costellae; posterior ear larger. Right valve with 6 irregular, unequal, prominent radial folds; the folds and depressions contain irregular, unequal costae and costellae. The species is larger, more elevated and more ornately ribbed than *P. duplicicosta.*

Upper Buda: Austin (type locality).

E. Primary, secondary, and tertiary ribs present

Pecten (Neithea) occidentalis CONRAD 1855, **17,** 269; CONRAD 1857, **18,** 150, pl. V, figs. 1 a–c.

Pecten quadricostatus var. ROEMER 1852, **78,** 64, pl. VIII, figs. 4 a–c.

Vola fredericksburgensis CRAGIN 1895, **23,** p. 52; TWENHOFEL 1924, **99,** 78, pl. XXII, fig. 5.

Not *Vola occidentalis* CRAGIN 1895, Am. Geol., XVI, 375.

Species founded on Roemer's figure and description. Has 1 tertiary rib on each side of each primary (except first and last, where only on inner side), and more or less fused with the primary; 2 secondaries per interspace. The Glen Rose specimens are rather elongated.

Fredericksburg (?Walnut): Fredericksburg (type locality).

Walnut: Austin (common).

Glen Rose: Central Texas (widespread).

Cretaceous: Between El Paso and Frontera; Leon Springs (Pecos County).

Pecten (Neithea) irregularis BÖSE 1910, **8,** 97, pl. XV, figs. 10–18. KNIKER 1919, **62,** 18, pl. II, figs. 1–6..........**Plate XVII, figure 8**

Vola occidentalis CRAGIN 1895, Am. Geol., XVI, 375.

Tertiary ribs irregularly disposed; the most common arrangements seem to vary with locality. Differs from *P. occidentalis* in that some primary ribs do not have a tertiary on each side, and also in the form of the shell. These differences may not be of specific value.

Kiamichi: North-Central Texas (common).

Goodland (abundant near middle): North-Central Texas.

Walnut (shell conglomerate): North-Central Texas (rare); near Austin.

Upper Fredericksburg: El Paso section (type locality).

Glen Rose: Near Austin (?).

F. No tertiaries; primaries and secondaries present

Pecten (Neithea) texanus ROEMER 1852, **78**, 65, pl. VIII, figs. 3 a–b. CONRAD 1857, **18**, 151, pl. V, figs. 2 a–b. BÖSE 1910, **8**, 93, pl. XV, fig. 3. KNIKER 1919, **62**, 25, pl. IV, figs. 4–7; pl. V, fig. 1 .... **Plate XVII, figures 2, 4**

Ribs subequal in size, flat-topped, with narrow interspaces; primaries long, project beyond margin.

Washita: North-Central Texas (especially in Grayson marl).

Georgetown: Near Austin.

Del Rio: Hill County, west of Aquilla (at type locality of *Turrilites brazoensis* Roemer).

In float: New Braunfels-San Antonio road crossing of Cibolo Creek (type locality).

Pecten (Neithea) texanus var. **elongatus** BÖSE 1910, **8**, 95, pl. XV, figs. 2, 4, 6. KNIKER 1919, **62**, 28, pl. V, figs. 2–3.

Taller shell than *P. texanus*, with smaller beak angle; has ribs of right valve, especially the primaries, more prominent.

Lower Buda: Austin.

Del Rio: Austin, San Marcos.

Washita: El Paso section (type locality).

Pecten (Neithea) subalpinus BÖSE 1910, **8**, 96, pl. XV, figs. 5, 7–9. KNIKER 1919, **62**, 28, pl. V, fig. 4 .... **Plate XVII, figures 1, 3**

As at present defined the species is quite variable: ribs mostly high, narrow, rounded on top, intervening depressions with slightly flattened bottoms. The ribs are generally narrower and less flattened than in *P. texanus* and the form is generally more elongated.

Washita division: Central and West Texas, widespread; El Paso section (type locality).

Del Rio: Austin, San Marcos.

Buda: Austin, Manchaca, Buda, San Marcos.

Pecten (Neithea) georgetownensis KNIKER 1919, **62**, 31, pl. VI, figs. 1–3. ADKINS AND WINTON 1920, **3**, 70, pl. XII, figs. 5–6 .... **Plate XVII, figure 7**

Subequilateral, elongated, elevated species. Ribs of right or both valves split by one or more narrow, radial furrows.

Lower Weno: Fort Worth.
Georgetown: Austin (type locality).

Pecten (Neithea) georgetownensis var. **subirregularis** KNIKER, 1919, **62**, 33, pl. VI, figs. 4–5.

General form of *P. georgetownensis*, but ribs not split.

Georgetown: Austin (type locality).

Pecten (Neithea) subalpinus var. **linki** KNIKER 1919, **62**, 30, pl. V, figs. 5–6.

Ribs generally lower and broader than in *Pecten subalpinus* BÖSE.

Georgetown: Austin (type locality).

Pecten (Neithea) theodori KNIKER 1919, **62**, 34, pl. VI, figs. 6–9.

Typical form similar to *P. subalpinus*, but some individuals have split ribs.

Georgetown: Austin (type locality).

Pecten (Neithea) altana KNIKER 1919, **62**, 36, pl. VII, figs. 1–3.

Primaries of same size as secondaries but longer; ribs high, narrow, and flattened on top, about twice as wide as the interspaces.

Georgetown: Austin (type locality).

Pecten (Neithea) budensis KNIKER 1919, **62**, 36, pl. VII, figs. 4–12.

Shell medium to large, equilateral, somewhat elongated. Right valve with 6 prominent trifid ribs, and in each interspace 2 smaller ribs. There are prominent growth lines on the body of the shell and on the ears.

Buda: Austin, Round Rock, Manchaca (type localities).

Pecten (Neithea) austinensis KNIKER 1919, **62**, 46, pl. IX, figs. 4–6; pl. X, fig. 2.

Medium-sized, heavy, subtrigonal shell. Six primary ribs, elevated above others; in each interspace are 2 closely spaced ribs.

Austin chalk: Austin (type locality).

G. Ribs similar, subequal, coarse

Pecten (Neithea) simondsi KNIKER 1919, **62**, 41, pl. VIII, figs. 1–10.

Shell small, right valve with 19 prominent, flattened, radial ribs, of which every fourth one is slightly raised; interspaces deep and narrower than the ribs. Ribs scaly on umbonal and medial portions of shell.

Buda: Austin, Manchaca, Round Rock (type localities).

Pecten (Neithea) boesi KNIKER 1919, **62,** 42, pl. VIII, figs. 11–19.

Shell small, differs from *P. simondsi* in having 21 ribs on the right valve; in the shape of the ribs, which are subtriangular, slightly flattened on top, and considerably higher; and in having concentric ridges but not scales, on the umbo.

Buda: Austin, Round Rock (type localities).

H. Primaries prominent; three or more secondaries per interspace

Pecten (Neithea) hartmani KNIKER 1919, **62,** 48, pl. X, figs. 3–6, 12.

Has 21 ribs; primaries strong; 3 secondaries per interspace.

Upper Austin chalk: Travis county, Walnut Creek at Sprinkle (type locality).

Pecten (Neithea) casteeli KNIKER 1919, **62,** 51, pl. X, figs. 7–11.

Has 26 ribs; primaries distinctly elevated; 4 ribs per interspace, of which the two middle ones are stronger than the others in some individuals.

Austin chalk: Austin (type locality).

SPONDYLIDAE Fleming

Monomyarian, inequivalve, nearly equilateral; isodont crura in adult.

PLICATULA LAMARCK. "CAT'S PAW"

Subovate, flattened or with one valve inflated, initially attached; fine or coarse radial ribs; small area, long crural teeth. Trias to Recent.

Plicatula incongrua CONRAD 1857, **18,** 153, pl. VI, figs. 10 a–b. CRAGIN 1893, **21,** 209, pl. XLVI, figs. 9–10.

Plicatula subgurgitis BÖSE 1910, **8,** 100, pl. XV, figs. 21–23.

Plicatula senescens CRAGIN 1894, Am. Geol., XIV, 2, pl. I, figs. 17–18.

Left valve rather flat; right valve inflated at least near beaks. Shape variable, oval to elongated. Ribs variable, generally a few coarse ones; finer intercalated ones common. Some individuals have larger attachment scars, which obscure the ornamentation.

Washita division: Abundant.

Fredericksburg division: Occasional.

Plicatula dentonensis CRAGIN 1893, **21,** 209, pl. XLVI, figs. 7–8.

Valves more flattened than in *P. incongrua,* and nearly equal. Numerous fine radial striae or costellae, some spinose.

Denton, and **Upper Fort Worth:** North-Central Texas. Abundant at Texas & Pacific station, Fort Worth; Denton Creek, near Roanoke.

SPONDYLUS LINNAEUS

Shells inflated, inequivalve, with radial ribs, and with spines; short, thick crural teeth. Attached valve usually thicker, with prolonged beak; free valve with incurved beak.

Free valve with subequal ribs
  No spines .... **S. texanus**
  Faint or prominent spines present
    Free valve with pointed spines; attached with transversely elongated spines .... **S. hilli**
    Spine bases faint .... S. sp. SHATTUCK
Free valve with ribs of two sizes
  Spines faint, mainly on umbonal region .... **S. cragini**
  Spines strong, on both valves .... **S. guadalupae**

Spondylus hilli CRAGIN 1893, **21**, 211, pl. XXXIII, figs. 1–3.

Larger, less compressed, and more broadly ovate than *Spondylus guadalupae.* Free valve convex, with numerous, subequal ribs and with scattered, low to pointed spines; attached valve thick in beak region, with prolonged beak (large attachment scar), numerous subequal ribs, and several rows of concentrically flattened spines.

Georgetown: About 1.5 miles east of Georgetown, on the San Gabriel River (type locality).

Spondylus cragini WHITNEY 1911, **111**, 13, pl. II, figs. 7–8.

Attached valve larger, has numerous faint costae and thin lamellae, interiorly has fine radiating costae separated by fine grooves; free valve convex, ornamented with many irregular, wavy, radiating costae, of which eight are stronger than the others; in the intervals between them are 3–7 radiating costae of varying prominence. Ribs bear small spines, limited in adult to strong ribs in umbonal region.

Buda: On Shoal Creek at Thirtieth Street, Austin (type locality).

Spondylus texanus WHITNEY 1911, **111**, 14, pl. II, figs. 1–3.

Free valve small (about 25 mm. tall), subtrigonal, anterior and posterior margins rather straight, basal margin evenly rounded; bears 50 or more fine, subequal ribs, some of them branching; no spines noted.

Buda: Shoal Creek at Thirtieth Street, Austin (type locality).

Spondylus sp. SHATTUCK 1903, **86**, p. 20, pl. VIII, figs. 1–3.

Size medium (40 mm. tall), umbos prominent; about 60 mostly subequal prominent ribs, a little narrower than the interspaces, bearing at intervals bosses which are probably remnants of spine-bases. Shattuck mentions some juvenile individuals in which every sixth rib is stronger and spine-bearing.

Buda: Austin, on Shoal Creek.

Spondylus guadalupae ROEMER 1849, **77**, 300; 1852, **78**, 62, pl. VIII, figs. 9 a–b.

Shell of medium size, beak of attached valve very prolonged. Each valve has 10–12 ribs bearing prominent, long, curved, flattened spines, and between the spined ribs 3–6 mainly non-spinose, low, subequal ribs.

Austin chalk: Waterfall of Guadalupe River, near New Braunfels, and Cibolo Creek crossing of New Braunfels-San Antonio road (type localities); Austin, Travis Heights and elsewhere in Travis County.

Position uncertain:

CHONDRODONTA STANTON

Ostreiform shape of shell (through fixation and habit of growth); smooth or with radial plications. Each valve bears a long narrow chondrophore, the space between being probably filled with the resilium. Cretaceous.

Genotype: *Ostrea munsoni* HILL (EDWARDS=Albian, Texas).

Chondrodonta munsoni (HILL) 1893, Proc. Biol. Soc. Washington, VII, 105, pl. XII. STANTON 1901, **93**, 303, pl. XXV, figs. 1–5. GILLET 1924, p. 30.

Shell with numerous fine radial plications, some branched.

Edwards: Belton (type locality); Barton Creek, Austin; Colorado River Dam, near Austin; Big Springs; Double Mountain, Stonewall County; "Cooper Mountain, Kent County"; Kickapoo Springs; High Bridge of Pecos River; Bluff Creek, near Crawford.

Chondrodonta glabra STANTON 1901, **93**, 306, pl. XXVI, figs. 1–3.

Smooth species, with few growth lines.

Upper Glen Rose?: One mile east of Kerrville.

Stanton has placed this genus in the superfamily Pectinacea; Douvillé and Gillet place it in the Pinnidae on account of the position of the anterior adductor muscle. It is confined to the rudistid-reef facies.

LIMIDAE d'Orbigny

LIMA BRUGUIERE

Elongate shells, umbo prominent, hinge line short, ears unequal; prominent radial ribs.

The subgenus *Plagiostoma* Sowerby differs from *Lima* s. s. in having the form oblique; fine numerous radial ribs; ears like *Lima* in being very unequal, anterior one short, the posterior one long.

Lima (Mantellum) bravoensis BÖSE 1910, **8**, 88, pl. XIV, figs. 4–6.

Similar to *Lima wacoensis* but is shorter and has differently shaped ribs. Umbonal angle about 90°; anterior area has 6–7 fine riblets; main body has 21 somewhat rounded ribs.

Upper Fredericksburg (with *Exogyra texana):* El Paso section opposite the smelter on the New Mexico side, between the two railroad bridges (type locality; holotype at Instituto Geológico de México).

Lima (Mantellum) mexicana BÖSE 1910, **8**, 92, pl. XIV, figs. 14–15.

Differs from *Lima wacoensis* in being thicker, more oblique, less elongate, and in having a distinct posterior area. Ears unequal; areas smooth; body has about 25 sharp-topped ribs (more rounded at each end of shell); intervals between ribs narrow in center of shell, same size as ribs elsewhere.

Fort Worth-Pawpaw (subd. 5–6): El Paso section, near initial boundary monument (type locality; two cotypes).

Lima wacoensis ROEMER 1849, **77**, 399; 1852, **78**, 63, pl. VIII, figs. 7 a–b. SHATTUCK 1903, **86**, 18, pl. V, fig. 10. CONRAD 1857, **18**, 151, pl. V, figs. 4 a–b. (?) BÖSE 1910, **8**, 90, pl. XIV, figs. 7–13 .... **Plate XVIII, figure 4**

Shell subquadrate-rounded in outline, rather elongate along axis; about 24 principal radiating ribs, rather sharp-topped with flat sides sloping evenly to a definite narrow depression in the relatively broad interspace. The specimen figured by Conrad has only about 20 narrow-topped, remotely spaced ribs.

Georgtown: Waco Camp, 8 miles west of New Braunfels (type locality); widespread in Central and West Texas in the Fredericksburg and Washita divisions.

Lima leonensis CONRAD 1857, **18**, 151, pl. V, figs. 3 a–c.

Shell subrectangular-rounded, with about the same proportions as *L. wacoensis;* about 19 straight radiating, narrow-topped ribs with broad interspaces; ears less prominent and more unequal than in other species.

Lower Washita: Leon Springs, near Fort Stockton (type locality).

LIMA KIMBALLI GABB 1872, p. 26.

Nugal, Mexico.

Lima (Plagiostoma) n. sp.

Edwards: Bluff Creek, west of Crawford; Santa Fe quarry, 5 miles west of Belton.

Lima generosa CRAGIN 1893, **21**, 193.

Shell rotund, compressed, pectiniform, large (height 62 mm.), about 20 narrow, low, radial ribs with radial lines between, ribs bear small imbrications.

Fort Worth: San Gabriel River southeast of Georgetown (with *Macraster elegans)*.

Lima semilaevis CRAGIN 1893, **21**, 194.

Shell inequilateral, triangular-ovate, with dorsal sides, straight and vertical portion forming a semicircle, posterior ear well developed; numerous fine crowded striae near peak and about 12 coarse remote ribs on anterior margin; posterior margin almost smooth.

Denton: Brown's Ferry, Cooke County (type locality).

Lima shumardi SHATTUCK 1903, **86**, 17, pl. V, fig. 11.

Subrectangular in outline, distinctly less elongate than *L. wacoensis*; about 30 sharp-topped ribs.

Buda?: Probably at Austin (type locality).

Lima sp. SHATTUCK 1903, **86**, 18, pl. V, fig. 9.

Fairly large species; about 20 narrow ribs with wide, shallow interspaces.

Buda: At Buda (Onion Creek).

Lima crenulicosta ROEMER 1849, **77**, 399; 1852, **78**, 63, pl. VIII, fig. 8 a–c.

Small to medium-sized species, much more rounded and more inflated than other species; about 25 round-topped ribs, which are a little narrower than the interspaces.

Austin?: Waterfall, New Braunfels (type locality).

Lima acutilineata (CONRAD). STEPHENSON 1923, **96**, 215, pl. LVIII, figs. 4–9.

Shell subovate, elongate, very oblique, equivalve, very inequilateral, moderately convex. Beaks small, incurved, approximate; both ears small; byssal notch well defined. Numerous, acute radiating ribs with broad interspaces.

Navarro *(Exogyra costata* zone): Two miles northwest of Webberville (U.S.N.M. cat. no. 21192). San Marcos River, one-half mile below Martindale, Caldwell County (7621). West-facing bluff of Guadalupe River Valley, 2 miles above McQueeney, Guadalupe County (7637).
Escondido *(Exogyra costata* zone): Lower crossing of Medina River at Castroville, Medina County (7665, 7796).

Ctenostreon (?) n. sp.

In 1919, I found a species which probably belongs to this genus.

Fort Worth: About 4 miles southwest of Fort Worth.

Vola (?) catherina CRAGIN 1893, **21.**

This species has not been rediscovered; specimens at Breslau which look like it, belong apparently to a subgenus of *Lima*.

Georgetown: Austin, one-eighth mile southwest of Barton Springs (type locality).

ANOMIA MULLER

Shell thin, sessile by the calcified byssus passing through a sinus or perforation in the right valve, conforming to the subadjacent surface; the left valve more convex, with 4 muscular scars on a central area; a chondrophore in the lower valve. Jurassic-Recent.

Anomia sp. aff. **micronema** MEEK AND HAYDEN. HILL 1889, **62**, p. 7.

Uppermost Cretaceous: Eagle Pass.

Anomia argentaria MORTON. HILL 1889, **52**, p. 7. STEPHENSON 1923, **96**, 226, pl. LX, figs. 10–14. WADE 1926, **103**, 68, pl. XXII, figs. 10–13.

Differs from *Anomia tellinoides* in being more nearly circular, in having much more prominent radial striae, beak located below margin, hinge developed behind and in front of beak, postero-dorsal margin not concave.

Taylor: Delta, Hays, Comal counties.

Upson clay: Maverick County.

Navarro: Delta, Kaufman, Guadalupe counties.

Anomia sp. HILL 1889, **52**, p. 7.

Trinity division: Arkansas, Texas.

Anomia (?) anomiaeformis ROEMER 1849, **77**, 394; ROEMER 1852, **78**, 75, pl. IX, figs. 7 a–d *(Ostrea)*. HILL 1889, **52**, p. 3.

One valve circular in basal outline, but inflated and with central projecting beak; other valve subcircular, opercular, with submarginal beak and subcentral muscle scar; both valves have fine, radial striae; hinge not described. Genus?

Austin chalk: New Braunfels, ford and waterfall (type locality); Austin.

Also in the **Eagle Ford** formation (?).

Anomia geniculata WHITNEY 1911, **111**, 14, pl. II, figs. 4–5.

Shell small, subovate, acuminate; left valve convex, geniculate, ornamented with 8 strong, radiating costae, terminating in hollow, lamellar spines, at the geniculation. Below the geniculation the surface is marked by heavy lines of growth, with only a trace of the costae. Right valve ornamented with five or more radiating costae extending to the margin and bearing four concentric rows of spines.

Buda: Austin, Shoal Creek (type locality).

Anomia tellinoides MORTON. STEPHENSON 1923, **96**, 223, pl. LX, figs. 1–7. WADE 1926, **103**, 69, pl. XXIII, figs. 3–4.

Broadly subovate, some individuals subtriangular; beak small, nearer posterior margin, projecting above dorsal margin, hinge endentulous, developed only in front of beak; radial striae weak or absent.

Lower Navarro (lower part of *Exogyra costata* zone): "Bed of a small creek 2 miles west of Casper, Delta County, south of the Texas & Midland Railroad (7511)."

PARANOMIA CONRAD 1860

Inequivalve, irregular, flattened; valves imperforate in adult; hinge of left valve with central triangular concavity, right valve with byssal plug. Cretaceous.

Paranomia scabra (MORTON) 1834. STEPHENSON 1923, **96**, 234, pl. LXI, figs. 1–4 (synonymy). WADE 1926, **103**, 67, pl. XXI, figs. 3–9.

Shell ovate, radially ribbed or with fine, hollow spines. Young byssiferous, adult free. Two ovate adductor scars in upper central portion of each valve. "The uppermost adductor scar on the right valve is connected by a line or scar to the closed foramen beneath the obscure triangular cardinal plate, showing that in the young stage of the shell this adductor passed through this foramen and was attached to the foreign object on which the larva developed. As the shell grew into adult stages this muscle left the foreign object, became attached to the lower valve, and migrated into a central position in the adult. The line or narrow scar connecting this upper adductor scar and the foramen scar is the path of migration." (Wade).

Taylor (upper part of *Ex. ponderosa* zone): "Bank of a small branch 2½ miles south of San Marcos (7617)."

Upson clay (upper part of *Ex. ponderosa* zone): "Gulleys in west-facing slops of Imperialist Creek, 3½ miles northwest of Paloma siding, Maverick County (8256)."

Superfamily MYTILACEA Férussac

MYTILIDAE Fleming

MYTILUS LINNAEUS

Mytilus semiplicatus ROEMER 1849, **77**, 402; 1852, **78**, 55, pl. VII, fig. 3.

Large species, tall dorso-ventrally, somewhat elongated along the (oblique) axis, postero dorso-margin short, straight, beak pointed; ventral outline elongate-oval; with several remote concentric growth rings, and, on the posterior slope numerous fine, low, straight, rounded, radial ribs, prominent at margin and more obscure towards the beak.

Taylor?: Three miles below New Braunfels, towards Seguin (type locality).

Mytilus tenuitesta ROEMER 1849, **77,** 403; 1852, **78,** 55, pl. VII, figs. 13 a–b.

Species more slender and elongate along axis, and with dorsal margin proportionately longer than in *M. semiplicatus;* smaller than that species, and lacks ribs.

Fredericksburg: At Fredericksburg (type locality).

MODIOLA LAMARCK

Form subovate, thick .... **M. granulato-cancellata**
Form elongate
  Shell smooth or nearly so
    Faint concentric folds, may be obsolete centrally .... **M. austinensis**
    Smooth, except for fine concentric growth lines and a few radial lines .... **M. branneri**
  Shell with ribs
    Radial ribs .... **M. pedernalis; M. filisculpta**
    Concentric ribs .... **M. concentrice-costellata**
    Concentric and radial ribs .... **M. jurafacies**

Modiola parva HILL 1888, **51.**

Trinity division: West of Weatherford; and Murfreesboro, Arkansas.

Modiola branneri HILL 1893, **55,** 24, pl. V, figs. 8–10. HILL 1888, **51,** 133, pl. II, figs. 18–19.

Small, elongate-subtriangular, greatly thickened in umbonal region; umbones pronounced and rapidly narrowing to a rounded point; anterior portion somewhat flattened; posterior portion attenuated, thin, and strongly curving in outline; surface smooth, lustrous, marked by fine lines of concentric growth and faint radiating striae.

Glen Rose: Glen Rose, in "plant bed" of Paluxy River (type locality).

Modiola jurafacies CRAGIN 1893, **21,** 195.

Species with angulated umbonal slope; sublinear concentric costellae, and dorsally a few oblique radial folds.

Edwards (?): Brazos River bluffs near railway bridge east of Granbury (type locality).

Modiola stonewallensis CRAGIN 1893, **21**, 196.

Large, umbonal shoulder prominent and obtusely angulated, beaks compressed, elevated; ornamentation, dorsally and posteriorly consists of remote, delicate, subequal imbrications or raised lines, anteriorly of crowded fine raised lines.

Lower Cretaceous: Double Mountain; a mountain south of Double Mountain Fork; Gail, Borden County.

Denton: Cooke County (Brown's Ferry, Red River).

Modiola concentrice-costellata ROEMER 1849, **77**, 403; 1852, **78**, 54, pl. VII, figs. 10 a–c .... **Plate I, figure 5**

Elongate subrectangular species, with oblique ridge slightly curved with axis of shell; no radial ribs; numerous, crowded, round-topped, concentric ribs with narrow interspaces.

Fredericksburg: Fredericksburg and San Saba Valley (type localities).

Walnut: Austin (Bull Creek road).

Modiola pedernalis ROEMER 1849, **77**, 403; 1852, **78**, 53, pl. VII, figs. 11 a–b.

Elongate, subrectangular, rounded species, more narrowed toward beak; numerous radiating, curved, branched, narrow and prominent ribs. The ribs are wider than the interspaces. Concentric growth striae, scattered ones being more prominent.

Fredericksburg: Fredericksburg and San Saba Valley (type localities).

Modiola austinensis WHITNEY 1911, **111**, 15, pl. II, fig. 6.

"Shell elongate, subcuneate, arcuate, inflated anteriorly, compressed posteriorly; beaks subterminal, twisted forward; umbonal ridge prominent, sloping abruptly to the anterior; surface ornamented with concentric lines of growth, crossed by numerous fine striae radiating from the beak, and covering the entire shell."

Buda: Austin (Shoal Creek), type locality.

Modiola (?) sp. SHATTUCK 1903, **86**, 23, pl. VIII, figs. 4–5.

Indeterminate cast: May be an *Inoceramus*.

Buda: Buda (Onion Creek).

Modiola filisculpta CRAGIN, **21**, 1893, 194.

Shell large (72 mm. long); elongate, ovate-cuneate; prominent rounded umbonal ridge; numerous fine, crowded, radial costellae, obsolete anterior to the umbonal ridge.

Woodbine: Denton County (Timber Creek), and northern Fannin County (type localities).

Modiola granulato-cancellata ROEMER 1852, **78**, 54, pl. VII, figs. 12 a–c.

Subovate, inflated species, axis oblique, hinge line nearly straight, beaks prominent, incurved, approximated; numerous, fine, radial ribs, some branched, cut by concentric furrows into fine even granulations on crests of rib. This species is much more inflated from side to side, and much less elongate, than *M. concentrice-costellata* or *M. pedernalis*.

Austin chalk: Ravine between New Braunfels and Seguin (type locality).

Modiola sp. ROEMER 1852, **78**, p. 54.

Austin chalk?: Waterfall, New Braunfels.

CRENELLA Brown

Crenella serica CONRAD 1860. STEPHENSON 1923, **96**, 241, pl. LXII, figs. 1–2.

Navarro *(Ex. costata* zone): Two miles northwest of Webberville.

Order ANOMALODESMACEA

Superfamily ANATINACEA

PHOLADOMYACIDAE Gray

PHOLADOMYA SOWERBY

Ornamentation cancellated............**P. lincecumi; P. (?) postextenta**
Concentric folds ....**P. knowltoni**
Radial ribs
  Ribs granulated, 18 or more............**P. sancti-sabae; P. shattucki**
  Ribs non-granulated
    About 6 remote ribs ....**P. pedernalis**
    About 13–14 narrow ribs with wide interspaces.........**P. texana**

A. Malone species:

Pholadomya tosta CRAGIN 1905, **27**, 79, pl. XV, figs. 2–3.
Pholadomya marcoui CRAGIN 1905, **27**, 80, pl. XVI, figs. 1–2.
Pholadomya praeposita CRAGIN 1905, **27**, 82, pl. XVI, figs. 3–4.
Pholadomya aff. **paucicosta** F. A. ROEMER 1836. CRAGIN 1905, **27**, 81, pl. XVI, figs. 5–6.

B. Higher Cretaceous species:

Pholadomya (?) **knowltoni** HILL 1893, **55**, 30, pl. II, figs. 1–2.

Form elongate, rounded anteriorly, flared and truncate posteriorly, with a medium elevated, rounded ridge running backwards from the beaks. Beaks nearly in contact. Irregular concentric plicae and a few faint radial depressions and folds.

Glen Rose: Austin (Bull Creek) (type locality).

Pholadomya sancti-sabae ROEMER 1849, **77**, 405. ROEMER 1852, **78**, 48, pl. VI, figs. 7 a–b *(Cardium)*. BÖSE 1910, **8**, 138, pl. 30, fig. 1.

Shell generally ovate in outline but with the umbonal region prominently elevated and rounded, form thinner and more flared posteriorly. Central part of shell has 22 or more fine radial ribs composed of fine subequal tubercles; posteriorly the shell is smooth except for rather coarse growth lines.

Fredericksburg: New Braunfels (type locality).

Walnut: Austin (Bull Creek road).

Kiamichi: Grayson County, at Duck Creek type locality; Fort Worth.

PHOLADOMYA BELVIDERENSIS TWENHOFEL 1924, **99**, 79, pl. XX, fig. 7.

Mentor, and **Champion shell bed:** Southern Kansas.

Pholadomya pedernalis ROEMER 1849, **77**, 408; 1852, **78**, 45, pl. VI, figs. 4 a–b.

Form more elongate than in *P. sancti-sabae* and with beaks more anterior. Central part of shell with 5 or more distinct narrow radial ribs. Posteriorly the shell is smooth except for rather coarse growth lines.

Fredericksburg: Fredericksburg (type locality).

Pholadomya texana CONRAD 1857, **18**, 152, pl. XIX, fig. 3.

Cast; 13–14 distant, narrow, prominently elevated, undulated or irregular ribs with wide, concave interspaces; coarse, irregular growth lines, some prominent ones at rather regular, widely spaced intervals.

Fredericksburg: "Turkey Creek, Leon and Eagle Pass roads."

Pholadomya shattucki BÖSE 1910, **8**, 137, pl. XXIX, figs. 7–9.

Pholadomya roemeri SHATTUCK (not WHITFIELD 1885), 1903, **86**, 28, pl. XV, figs. 3–6.

Shell large, very globose, inflated anteriorly, becoming less so posteriorly where it is prolonged into a thin, broadly rounded expansion. Central part of shell with 25 or more rather fine radiating costae which bear numerous fine tubercles.

Buda: Austin (Shoal Creek); Buda (Onion Creek), type localities, widespread in Central Texas; Fort Worth-Denton (subd. 5); El Paso section.

Pholadomya (?) **postextenta** CRAGIN 1893, **21**, 209, pl. XLI, fig. 1.

Form thin, very elongate-ovate, with numerous radial and concentric ribs in middle part of shell, forming a cancellated ornamentation; casts; generic determination uncertain.

Denison beds: One-half mile northwest of Denison, at Mineral Springs.

Pholadomya ingens CRAGIN 1893, **21**, 208.

Large species (length about 100 mm.), ventricose, subovate in outline, narrowed posteriorly; 18 or more narrow, compressed radial ribs with wide, concave interspaces.

Austin chalk (?Anacacho): Hondo Creek, 4 miles from Hondo (type locality).

Pholadomya lincecumi SHUMARD 1862, **90**, p. 199.

Small, thin shell, gibbous and broadly rounded anteriorly, narrowed and gaping posteriorly. Surface with about 30 radial raised lines crossed by narrow concentric, sinuate folds and by fine growth lines, thus producing a cancellated ornamentation.

Navarro: Corsicana (type locality).

Pholadomya lerchi HILL: See **Trigonia lerchi.**

HOMOMYA AGASSIZ

Shell relatively tall, rounded........................**H. alta**
Shell elongate, subrectangular
  Length about one and one-half times the height, the two long margins not parallel........................**H. budaensis**
  Length about twice the height, the two long margins parallel ....**H. vulgaris**
Shell not very elongate, length about one to one and one-half times the height
  Beak sub-terminal
    Contour trapezoidal........................**H. jurafacies**
    Contour rounded-rectangular
      Taller, least inflated, more regularly rectangular........................**H.** aff. **ligeriensis**
      Lower, very inflated, form oblique........................**H. bravoensis**
  Beak not terminal
    Contour quadrate-trapezoidal; form obese........................**H. solida**
    Contour elongate-ovate; form less thick........................**H. austinensis**

Homomya jurafacies CRAGIN 1893, **21**, 191, pl. XXXIX, figs. 1–2.

Somewhat elongate trapezoidal in outline, form thick, robust. Beaks subterminal, small, strongly incurved but not touching. Casts. Length, height, and thickness in proportion 1.5:1:1.

Glen Rose: Burnet and Bosque counties.

Homomya solida CRAGIN 1893, **21,** 191, pl. XXXIX, figs. 3–4.

Somewhat trapezoidal in outline, thick. Length, height, and thickness in proportion 11:9:8. Umbonal region elevated narrow, projecting from rest of shell, beaks subterminal.

Glen Rose: Parker, Hood, Erath, and Travis counties.

Homomya alta ROEMER 1849, **77,** 408. ROEMER 1852, **78,** 45, pl. VI, fig. 11.

Shell about equally long and tall, anterior, ventral and posterior margins form a long oval; umbonal region rounded, prominently projecting; concentric costae, subequal rounded.

Fredericksburg: Fredericksburg (type locality).

Homomya washita CRAGIN 1894, **23,** p. 59.

Form curved, oblong, beaks nearly terminal; length, height and thickness in proportion 3:2:2.3. Concentric growth lines, some more prominent.

Grayson: One-half mile southeast of Union Station, Denison, in abandoned cut of D. B. & N. O. Railway (type locality).

Main Street: Denison (Pawpaw Creek).

Homomya austinensis SHATTUCK 1903, **86,** 28, pl. XVI, figs. 1–3.

Species somewhat oval in outline, beaks nearer anterior end; length, height, and thickness in proportion 9:6:5. Moderate sized concentric ribs.

Buda: Austin, Shoal Creek (type locality).

Homomya vulgaris SHATTUCK 1903, **86,** 29, pl. XVI, figs. 4–5.

Outline elongate-rectangular; length, height, and thickness in the proportion of 6:3:2, dorsal and ventral margins subparallel. Prominent, unequal concentric costae. Beaks elevated near anterior end.

Buda: Austin (Shoal Creek, Bouldin Creek); Buda (Onion Creek).

Homomya budaensis WHITNEY 1911, **111,** 15, pl. III, figs. 1–2; pl. IV, figs. 1–2.

Outline roughly rectangular but with dorsal and ventral sides not parallel; beaks near anterior end. Length about twice the height. Unequal prominent concentric ribs.

Buda: Austin (Shoal Creek) (type locality).

Homomya bravoensis BÖSE 1910, **8,** 136, pl. XXIX, figs. 5–6.

Form roughly elongate rectangular, rounded, oblique, quite inflated, beaks subterminal, proportionately less tall and more inflated than *H.* aff. *ligeriensis;* reduced concentric lines.

Fredericksburg (with *Exogyra texana)*: Cerro de Muleros, El Paso section, subd. 2–3 (type locality).

Edwards: Two miles west of Round Rock.

Homomya aff. **ligeriensis** (D'ORBIGNY). BÖSE 1910, **8**, 137, pl. XXIX, figs. 1–4.

Form subrectangular, beaks nearly terminal; prominent, somewhat irregular concentric lines.

Kiamichi-Pawpaw (subd. 4–5–6): El Paso section.

Edwards: Two miles west of Round Rock (horizon of *Inoceramus* aff. *concentricus)*. A species similar to this is common and widespread in the upper Fredericksburg division in Central Texas. It is probably a new species.

ANATINA LAMARCK

Narrow, central, vertical sinus present; anterior portion of shell with concentric folds; posterior portion smooth, constricted .... **A. obliquiplicata**

No prominent vertical (radial) sinus

Form compressed (L/T=7) .... **A. sulcatina**

Form thicker (L/T=3–4)

Subrectangular; short (L/H=1.7) .... **A. (?) pliculifera**

Elongate oval (L/H=2–2.5)

Very elongate (L/H=2.5) .... **A. texana** CRAGIN

Shorter (L/H=2)

Beaks subcentral; few concentric ribs .... **A. shattucki**

Beaks anterior; numerous concentric ribs .... **A. austinensis**

Anatina obliquiplicata CRAGIN 1905, **27**, 85, pl. XVI, figs. 7–8.

Shell elongate, rounded anteriorly, narrowed posteriorly with a median radial depression, anterior to which are several coarse concentric plications; posteriorly nearly smooth.

Basal Cretaceous: Malone (type locality).

Anatina (?) **pliculifera** CRAGIN 1905, **27**, 86, pl. XV, figs. 9–10.

Form roughly rectangular, length and height in proportion 5:3. A few coarse, subequal concentric plications. Quadrate in contour.

Basal Cretaceous: Malone (type locality).

Anatina texana CRAGIN 1893, **21**, 168, pl. XLI, fig. 5.

Form elongate oval, length and height in proportion 2.5:1. Umbonal region broadly rounded, projecting. Shell with 15 or more low concentric plications fainter in beak region. Height 55 mm., length 131 mm., thickness 35 mm.

Comanche Peak: San Gabriel River, 2 miles above Georgetown.

Anatina shattucki new name.

Anatina texana SHATTUCK 1903, **86**, 30, pl. XVIII, fig. 3 (not CRAGIN 1893).

Form rather oval, compressed; length nearly twice height; 8 or more unequal, rounded concentric plications, rather quadrate in outline.

Buda: Austin (Shoal Creek) (type locality).

Anatina austinensis SHATTUCK 1903, **86**, 29, pl. XVIII, figs. 1–2.

Form elongate-oval, ventral margin fairly straight; length, height, and thickness in proportion 3:1.5:1. About 16 subequal, rounded, concentric ribs, subquadrate in contour.

Buda: Austin (Shoal Creek).

Anatina sulcatina SHUMARD 1862, **90**, 204–205.

Shell large, ovate, thin, inequivalve, very inequilateral; width greater than length; anterior end broadly rounded, posterior end short, contracted, narrowly rounded; beaks small, only slightly elevated, posterior to middle; narrow sulcus from beak to pallial margin. Surface in 20–25 rounded concentric folds, which become indistinct posteriorly; numerous fine growth lines. Length 87 mm., width 37 mm., thickness 13 mm.

Navarro: Chatfield Point (type locality).

Anatina tosta CRAGIN 1893 = **Pholadomya.**

Superfamily CHAMACEA

DICERATIDAE Dall

REQUIENIA MATHERON

Smooth, very inequivalve, attached by the spirally twisted beak of the left valve; right valve opercular, flat, spiral; teeth feeble; posterior adductor scar buttressed. Restricted to the rudistid-reef facies. Lower Cretaceous.

Requienia patagiata WHITE 1884. See **Toucasia patagiata** WHITE.

Requienia texana (ROEMER). *(Caprotina.)* See **Toucasia texana** (ROEMER).

Requienia bicornis MEEK (?). 1876, **71.**

Fredericksburg? Fort Lancaster (Crockett County, east of Sheffield).

Requienia sp.

Trinity: Nine miles south of Van Horn wells (Chispa sheet).

TOUCASIA MUNIER-CHALMAS

Differs from *Requienia* in having both valves keeled.

Toucasia patagiata (WHITE) 1884.

Requienia patagiata WHITE 1884, **108,** 6, pl. I, figs. 1–8; pl. II, figs. 1–4. ROEMER 1888, **80,** 12, pl. I, fig. 16; pl. III, figs. 5 a–c. SCOTT 1926, **85,** p. 173 *(Toucasia)*. HILL 1889, **52,** p. 12.

Left valve larger than right, tall, spiral, with two or three volutions, with wrinkled keel; upper surface above keel flattened, lower surface convex. Right valve similar but shorter and with less acute and less wrinkled keel, about two volutions, spire more flattened. Hinge strong, the principal tooth of the right valve being large and prominent. Surface marked by irregular growth lines.

Edwards: Barton Creek, Austin (type locality); Austin, Deep Eddy Bluff and numerous other localities; Crawford (Bluff Creek); Oglesby; 4 miles west of Belton.

Toucasia texana (ROEMER) 1852.

Caprotina texana ROEMER 1852, **78,** 80, pl. V, figs. 2 a–c.

Requienia texana WHITE 1884, **108,** 7, pl. II, figs. 5–7. HILL 1889, **52,** p. 12. SCOTT 1926, **85,** p. 173 *(Toucasia)*.

Left valve large, about 2 to 3 volutions, spire flattened, rapidly enlarging. Keel not wrinkled or fringed, with a broad, flat spiral surface above, and a flattened shape similar to that of larger valve.

Edwards: Austin.

Toucasia sp.

Trinity: Nine miles south of Van Horn wells (Chispa sheet).

MONOPLEURIDAE Fischer

MONOPLEURA MATHERON

Attached by conical or twisted right (larger) valve; left valve smaller, conical or flat-operculate; posterior adductor scar buttressed; dentition inverse. Lower Cretaceous (confined to the rudistid-reef facies).

Monopleura marcida WHITE 1884, **108,** 8, pls. III–IV. ROEMER 1888, **80,** 10–11, pl. III, figs. 1 a–d. HILL 1889, **52,** p. 12. SCOTT 1926, **85,** p. 174..**Plate II, figure 4**

Right valve fairly thin, long, slender, twisted or distorted, rather subelliptical in cross-section; ligamental groove extends along its whole length. Left valve flattened, operculiform, marked with concentric growth-lines and irregular radial lines. Tooth of right valve prominent: hinge plate and two teeth of left valve rather strong.

Radiating lines of left valve more pronounced. and right valve much flatter and more operculiform than in *M. pinguiscula.*

Edwards: Austin (type locality); Barton Creek, 2 miles above mouth; Deep Eddy Bluff; Crawford; Belton; Oglesby.

Monopleura pinguiscula WHITE 1884, **108**, 8–9, pl. V. ROEMER 1888, **80**, 11, pl. III, figs. 2 a–c. HILL 1889, **52**, p. 12. SCOTT 1926, **85**, p. 174.

Right valve long, conical, curved, often twisted, cross-section subelliptical, body-cavity large and deep, surface with annular growth-lines and some faint longitudinal lines; ligamental groove prominent, extending along whole length of valve; attachment scar variable. Left (smaller) valve strongly convex, rather thick, its umbonal portion being prominent, strongly incurved and projecting beyond hinge line. Hinge strong; tooth of right valve large and prominent; teeth of left valve located upon a strong plate.

Edwards: Austin (type locality), and Barton Creek, 2 miles above mouth.

Monopleura subtriquetra ROEMER 1852, **78**, 81, pl. V, figs. 5 a–b. SCOTT 1926, **85**, 174. HILL 1893, **56**, 103.

Cross-section of large valve oval to trapezoidal, increasing rapidly in size, curved, ligamental groove prominent, well marked concentric growth-striae and in terminal portion fine, numerous longitudinal lines. Smaller valve not figured.

Fredericksburg: (?) San Saba Valley, and upper course of Pedernales River.

Monopleura texana ROEMER 1852, **78**, 81, pl. V, figs. 3 a–b. HILL 1893, **56**, 103. SCOTT 1926, **85**, 174.

Large valve with an exceptionally depressed spiral, rapidly expanding, about one (?) volution. Small valve ovate-triangular, suboperculiform. Generic determination uncertain.

Fredericksburg: Waco Camp, on the Guadalupe River west of New Braunfels.

CAPRINIDAE d'Orbigny

Shell very inequivalve, thick, inverse. Right valve attached, conical or spiral, with strong tooth between two cavities. Left valve free, twisted or spiral, two teeth with a cavity between. Three shell layers: outer one prismatic, inner one thinner and porcellanous; middle layer in one or both valves with a system of numerous longitudinal canals.

PLAGIOPTYCHUS MATHERON

Right valve conical or twisted, attached; left (free) valve convex, with incurved beak, with canals in middle layer.

Plagioptychus (?) cordatus ROEMER 1888, **80**, 13, pl. II, figs. 2 a–c. HILL 1893, **56**, p. 103.

Subequivalve, outline of valves cordate, beaks twisted. Right valve attached by beak; left valve sharply keeled with beak inrolled under that of right valve. Surface smooth. Generic determination uncertain.

Edwards: Austin (Barton Creek, 2 miles above mouth) (type locality); Bluff Creek, near Crawford.

CAPRINULA D'ORBIGNY

Right valve attached, elongated, conical or incurved; left (free) valve smaller, gyrate; both valves with large inner and small outer canals; hinge as in *Caprina.*

Caprinula anguis (ROEMER) 1888, **80**, 9, pl. I, figs. 7 a–b; pl. II, figs. 2 a–d *(Ichthyosarcolites).* DOUVILLÉ, H., 1900: Sur quelques rudistes américains. Bull. Soc. Géol. France, XXVIII, p. 220, figs. 16–17 *(Caprinula).* SCOTT 1926, **85**, p. 172. ADKINS 1924, Univ. Texas Bull. 2340, p. 36.

Edwards: Austin, Barton Creek, 2 miles above mouth (type locality); Crawford.

Caprinula (?) crassifibra (ROEMER) 1852, **78**, 79, pl. V, fig. 6.

Edwards: Central Texas.

Caprinula (?) guadalupae (ROEMER) 1852, **78**.

Edwards: Central Texas.

Caprinula (?) planata (CONRAD) 1857, **18**.

Fredericksburg: West Texas.

Caprinula (?) occidentalis (CONRAD) 1857, **18**.

Fredericksburg: West Texas.

CAPRINELLA D'ORBIGNY

Caprinella sp. aff. **coraloidea** HALL AND MEEK. WADE 1926, **103**, 82, pl. XXV, figs. 13–14.

Austin chalk: Travis county, Richard Schmidt quarry, near Pilot Knob.

Superfamily RUDISTACEAE

RADIOLITIDAE Gray

EORADIOLITES DOUVILLÉ

Eoradiolites davidsoni (HILL).

Radiolites davidsoni HILL 1893, **56**, 106, pl. XIII, and text fig. 1 (on page 107).

Radiolites davidsoni DOUVILLÉ 1900, Bull. Soc. Géol. France, XXVIII, 218, figs. 13–15.

Praeradiolites davidsoni DOUVILLÉ 1902, Classification des radiolites. Soc. Géol. France, Mém., p. 465.

Agria davidsoni TOUCAS 1907, Soc. Géol. France, Vol. XIV, Mém. 36, p. 24, pl. XI.

Agria davidsoni SCOTT 1926, **85**, p. 172.

Eoradiolites davidsoni H. DOUVILLÉ 1910, Études Sur les Rudistes. Soc. Géol. France, Mém., 41 (Paléontologie, tome XVIII).

Eoradiolites davidsoni H. DOUVILLÉ 1912, **38**, 245.

Eoradiolites davidsoni ADKINS 1924, Univ. Texas Bull. 2340, p. 36.

Edwards: Belton; Central Texas.

SAUVAGESIA

Sauvagesia texana (ROEMER) 1852.

Hippurites texanus ROEMER 1852, **78**, 76, pl. V, figs. 1 a–e.

Radiolites texanus HILL 1893, **56**, p. 103. HILL 1889, **52**, p. 13.

Sauvagesia texana TOUCAS 1909, Soc. Géol. France, Mém. 36, pt. 3, 82, pl. XVI. SCOTT 1926, **85**, p. 172.

Float: In Guadalupe River at New Braunfels (type locality).

Edwards: Near Austin.

DURANIA

Durania (?) sabinae ROEMER 1849, **77**, p. 410; 1852, **78**, p. 77 (Radiolites).

Limy casts of interior of a radiolite species.

Edwards(?): Sabine Creek, crossing of New Braunfels-Fredericksburg road.

Durania austinensis (ROEMER) 1852.

Radiolites austinensis ROEMER 1852, **78**, 77, pl. VI, figs. 1 a–d. HILL 1889, **52**, p. 13. HILL 1901, **57**, pl. XLIV, fig. 1. BÖSE 1906, Inst. Geol. Mex., Bol. 24 (Cárdenas), 57, pl. XI, fig. 1; pl. XIII, fig. 8; pl. XIV, fig. 1. UDDEN 1907, **100**, p. 39.

Sauvagesia austinensis TOUCAS 1909, Soc. Géol. France, Mém. 36, pt. 3, p. 96. SCOTT 1926, **85**, p. 175.

Durania austinensis H. DOUVILLÉ.

Durania austinensis ADKINS 1924, Univ. Texas. Bull. 2340, p. 82.

Austin chalk: At Austin (type locality).

Taylor: Travis, McLennan, and Bell counties.

Radiolites rugosa GIEBEL 1852, **45**, 365, pl. 7, fig. 1. PRATHER 1901, **75**, 85–87. ADKINS 1924, Univ. Texas Bull. 2340, p. 38.

Giebel's figures do not make clear the proper generic assignment of this species.

Type locality: Probably "Cibolo, 8 miles from Comanche Spring."

Edwards(?): Near Waco (Prather).

Radiolites cf. **socialis** D'ORBIGNY. UDDEN 1907, **100**, p. 39.

Terlingua beds: Brewster County, north of Laguna and west of Emory Peak.

Superfamily LUCINACEA

LUCINIDAE Fleming

PHACOIDES BLAINVILLE

Lucina s. s. (Tertiary and Recent) is smooth, has the teeth obsolete, and the radial sulcus absent; the genus (or subgenus) *Phacoides* has low concentric ribs, sulcus absent, dentition complete, some Texas species equilateral and others not. Cretaceous-Tertiary. Unfortunately, the facts concerning the dentition of Texan species have not been published.

Phacoides (?) **potosina** (CASTILLO AND AGUILERA) 1895, Com. Geol. Mex., Bol. I, 6, pl. IV, figs. 2, 3, 6; pl. V, figs. 11–14 *(Lucina)*; CRAGIN 1903, **27**, 72, pl. XIII, figs. 4–5 *(Lucina)*.

Inequilateral, thick, longer than tall, a few low, subequally spaced concentric ribs; small species (?).

Basal Cretaceous: Malone.

Phacoides (?) **potosinus** var. **metrica** (CRAGIN) 1903, **27**, 73, pl. XIII, figs. 6–10 *(Lucina)*.

Cragin's fig. 6 is nearly equilateral, and taller than wide, while his fig. 9 is inequilateral and longer than tall; probably different species.

Basal Cretaceous: Malone.

Phacoides (?) **planiuscula** (CRAGIN) 1903, **27**, 75, pl. XIII, fig. 3 *(Lucina)*.

Inequilateral, longer than tall; concentric ribbing obsolete except on anterior and posterior margins.

Basal Cretaceous: Malone.

Phacoides acute-lineolatus (ROEMER) 1888, **80**, 14, pl. III, figs. 4 a–b *(Lucina)*.

Subquadrate, slightly longer than tall, inequilateral; prominent concentric ribs separated by deep, broad grooves.

Edwards: Austin, Barton Creek, 2 miles above mouth (type locality); Deep Eddy Bluff.

Phacoides (?) **sublenticularis** (SHUMARD) 1860, **89**, 602 *(Lucina)*.

Length 47 mm., width 43 mm., subcircular, inequilateral; numerous, fine, concentric, unequal lines of growth.

Eagle Ford (septaria): Lamar and Fannin counties, bluffs of Red River.

Lucina (?) parvilineata SHUMARD 1862, **90,** p. 204 *(Lucina).*

Shell broadly ovate or subcircular, a little longer than wide, compressed; valves gently convex, inferior margin rounded. Beaks small, moderately elevated, directed backwards, and situated nearer the anterior end. Surface bears crowded concentric striae, and on the anterior and posterior slopes radiating lines. Length 19 mm., width 17 mm., thickness 6 mm.

Navarro: Near Corsicana (type locality).

CORBIS CUVIER

Corbis (Mutiella) roblesi BÖSE 1910, **8,** 127, pl. XXVII, figs. 1–3.

Upper Fredericksburg (zone *Oxy. chihuahuense):* La Encantada, Chihuahua (type locality).

PACHYCARDIUM

Pachycardium spillmani (CONRAD) 1858. STEPHENSON 1923, **96,** 298, pl. LXXIII, figs. 3–5 (synonymy).

Taylor, Navarro: North-central and south-central Texas.

THRACIIDAE Dall

THRACIA LEACH

Thracia myaeformis WHITE 1880, **105,** 297, pl. VI, figs. 1–2. WHITE 1883, **106,** 23, pl. XVII, figs. 2 a–b.

Shell large (length 57 mm.), subequivalve, transversely elongate oval, wider and thicker anteriorly than posteriorly, both ends regularly rounded, beaks prominent, incurved, and directed a little forwards; pallial sinus large and subangular at its anterior end. Surface marked by growth lines, and by irregular concentric wrinkles.

Cretaceous: Bell County (type locality).

Superfamily POROMYACEA

POROMYACIDAE Dall

LIOPISTHA

MEEK 1864 (genotype: *Cardium elegantulum* ROEMER 1852).

Liopistha protexta (CONRAD) 1853. STEPHENSON 1923, **96,** 250, pl. LXV, fig. 3.

Shell subovate in outline, inequilateral, moderately ventricose. Beaks incurved, prominent, approximate, situated a little in advance of the mid-length. Anterior margin regularly rounded; ventral margin broadly and regularly rounded. Surface marked by about 30 prominent, subacute ribs; on a rather narrow area along the inner antero-dorsal slope the ribs become obsolete; the ribs appear to be obsolete or absent on the postero-dorsal slope. Size medium (length about 30 mm.).

Navarro *(Exogyra costata* zone): Kaufman County, field on Simpson's place, 2 miles southeast of Kaufman (7547); near Kaufman (U.S.N.M. Cat. No. 20991); Navarro County, concretions in field south of Chatfield (7569); near Chatfield (U.S.N.M. Cat. No. 21065); near Corsicana (U.S.N.M. Cat. No. 20932).

Liopistha elegantula (ROEMER) 1849, **77**, 405. ROEMER 1852, **78**, 48, pl. VI, figs. 5 a–c *(Cardium)*.

Proportionately longer than *L. protexta*, the basal margin is more broadly rounded, the umbo more projecting, the ribs are somewhat more widely spaced and are surmounted by numerous fine, subequal granules.

Austin chalk: Near New Braunfels, waterfall of Guadalupe River (type locality).

Liopistha (Cymella) bella (CONRAD) 1875. STEPHENSON 1923, **96**, 253, pl. LXV, figs. 4–8.

Shell subovate in outline, very thin, equivalve, inequilateral, moderately convex, becoming somewhat compressed posteriorly. Beaks prominent, strongly incurved, approximate, situated slightly in advance of the mid-length. Dorsal margins sloping from the summit at an angle of about 120 degrees, the anterior one being slightly steeper than the posterior one. Surface marked by 20–24 prominent, regularly spaced, concentric plications, which terminate at the margin of the lunule- and escutcheon-like areas. The surface is further partly ornamented by a group of 6–9 moderately distinct, acute ribs which trend downward from the beak to the central and posterior portions of the ventral margin; these modify the tops of the concentric ridges more than they do the bottoms of the intervening depressions. The number, spacing, and prominence of the radiating lines differ somewhat on different individuals; the lines located centrally in the group are more prominent than those towards the margins, where they become faint to obscure.

Navarro, San Miguel: Texas (form with more numerous radial costae, which are of the broad, round-crested type separated by narrow interspaces), Stephenson 1923, **96**, 254.

PACHYMYIDAE

PACHYMYA SOWERBY

Pachymya austinensis SHUMARD 1860, **89**, 604. WHITE 1879, **104**, 298, pl. V, figs. 7 a–b; pl. VIII, figs. 1 a–b. SHATTUCK 1903, **86**, 26. ADKINS AND WINTON 1920, **3**, 75, pl. XVII, fig. 10. WINTON 1925, **115**, 60, pl. XI, fig. 3 .... **Plate XV, figure 3**

Casts large, elongate, oval, somewhat compressed dorso-ventrally, both ends rounded, inequilateral, subequivalve, beaks nearly terminal; a prominent carina runs from beak obliquely downwards and backwards. Concentric growth lines; some casts show sparse, fine tubercles.

Washita division: Buda, at Austin, Shoal Creek (type locality); Salado, Bell County.

Upper Weno: Fort Worth (rare).

Basal Main Street: Fort Worth (abundant).

Pachymya austinensis var. **budaensis** WHITNEY 1911, **111**, 16, pls. V–VI.

"This shell is very closely related to *P. austinensis* SHUMARD and may be identical with it, but the Buda type is much higher posteriorly and not so greatly angulated on the umbonal slope."

Buda: Austin, Shoal Creek (type locality).

Order TELODESMACEA

Superfamily CYPRICARDIACEA

PLEUROPHORIDAE Dall *(Cyprinidae)*

ROUDAIRIA MUNIER-CHALMAS

Like *Trapezium*, but with a sharp keel and smooth area behind, anteriorly with concentric ridges; right posterior cardinal bifid. Upper Cretaceous.

Roudairia denisonensis CRAGIN 1894, **23**, p. 57.

This species has not been rediscovered; from the description it appears to be a *Protocardia*.

Grayson: One-half mile southeast of Union Station, Denison, in old D. B. & N. O. Railway cut (type locality).

Roudairia securiformis CRAGIN **Protocardia securiformis** (CRAGIN).

TRAPEZIUM HUMPH. emend. MEGERLE *(Cypricardia)*

Shell elongate, trapezoidal, concentrically (or more rarely radially) sculptured, many species with a posterior keel; three cardinal teeth in each valve, the posterior one of the right valve often bifid.

Trapezium compactum (WHITE) 1880, **105**, 297 *(Pachymya?)*. WHITE 1883, **106**, 22, pl. XVII, figs. 4 a–b. WHITNEY 1911, **11**, 17, pl. VII, figs. 1–3 *(Artica)*.

Small, inflated, elongate, subequivalve, beaks approximate, small, directed forwards and located anteriorly. Basal margin broadly convex, posterior end narrowly rounded; postero-dorsal margin forms an oblique downward and backward truncation of posterior part of shell. Umbonal ridges prominent, angular or subangular. Surface marked by concentric growth lines.

"Cretaceous": Bell County (type locality).

Buda: Austin, Shoal Creek.

ARCTICA SCHUM. *(Cyprina)*

Oval or rounded, inflated, concentrically striated; beaks prominent, curved, cardinals three in each valve, the left posterior often bifid, the middle left cardinal largest, the posterior one ridge-like. Jurassic, Cretaceous, Recent.

Arctica coteroi (CASTILLO AND AGUILERA). CRAGIN 1905, **27,** 77, pl. XIII, figs. 11–12.

Cast small, subequivalve, nearly equilateral, antero-dorsal margin concave, posterior margin convex, basal margin broadly rounded, cast about as tall as long; cast inflated, beaks small, close together.

Basal Cretaceous: Malone.

Arctica streeruwitzi (CRAGIN) 1893, **21,** 180, pl. XXXVI, figs. 3–5; pl. XL, fig. 2. CRAGIN 1905, **27,** 78, pl. XIV, figs. 1–2; pl. XV, fig. 1 *(Cyprina)*.

Form large, ovate, triangular; beaks small, incurved, close together. Shell ornamented with irregular, concentric striae, some of them coarser.

Basal Cretaceous: Malone.

Arctica roemeri (CRAGIN) 1893, **21,** 179, pl. XXXVIII, figs. 1–2.

Large cast, subequivalve, hinge line short, beaks small, incurved, close together; basal margin broadly rounded.

Glen Rose: Gillespie, Burnet, Erath, Hood, Parker, and Jack counties; western Travis County; Hood County, 2 miles east of Buckner.

Arctica texana (CONRAD) 1857, **18,** 148, pl. III, figs. 3 a–c *(Trigonia)*. CRAGIN 1893, **21,** pp. 178, 180 *(Cyprina)*.

Differs from *Arctica roemeri* in having the beak region much more projecting, the hinge line longer, the beaks widely separated instead of apposed, the profile much less evenly rounded in side and in top views.

Glen Rose: Gillespie, Lampasas, Bosque, Erath, and Parker counties.

Arctica sp. ROEMER 1849, **77,** 407. ROEMER 1852, **78,** 47.

Fredericksburg: Upper branch of Pedernales River.

Arctica mediale (CONRAD) 1857, **18,** 149, pl. IV, figs. 4 a–b *(Cardium)*.

Glen Rose: Central Texas. Type locality not stated.

VENIELLA Stoliczka

Left valve with the anterior cardinal strong and subtriangular.

Veniella conradi (Morton) 1833. Stephenson 1923, **86**, 257, pl. LXVI, figs. 1–5.

Shell thick in the adult, equivalve, inequilateral; the outline varies with the age of the individual, being subtrapezoidal in the young and becoming oblique and subtrigonal in the adult; moderately ventricose in the young, becoming strongly ventricose in the adult. Beak incurved, prosogyrate, situated a little in front of the mid-length in the young, but owing to the thickness of the shell and the increased obliquity becoming nearly terminal in the adult. A sharply defined, angular, umbonal ridge extends from the beak obliquely downward and backward to the lower posterior extremity. Hinge of left valve with two strong cardinal teeth, the anterior trigonal and bifid, the posterior long and narrow; and a short anterior lateral tooth, a long striated posterior lateral. Right valve with short, narrow anterior cardinal, strong oblique posterior cardinal, two short anterior laterals separated by deep socket with striated sides; long posterior socket. Surface marked by 6–8 distant, thin, elevated concentric lamellae, all but about three being on the beak region.

San Miguel (questionably): Del Rio road, 12.5 miles northwest of Eagle Pass.

Navarro *(Exogyra costata* zone): Kaufman County, near Kaufman (U.S.N.M. Cat. No. 21023); Navarro County, near Chatfield (U.S.N.M. Cat. No. 21052); near Corsicana (U.S.N.M. Cat. No. 20939); Travis County, 2 miles northwest of Webberville (U.S.N.M. Cat. No. 21182); Guadalupe County, Cibolo Creek, 1.5 miles west of Zuehl (7721), Stephenson 1923, **96**, 260–262.

Veniella lineata (Shumard) 1862, **90**, p. 201 *(Crassatella)*. Deussen 1924, **33**, pl. XI, figs. 2–2 a. Stephenson 1923, p. 263.

Shell somewhat trapeziform, gibbous, length about one-fourth greater than width; a carina extends from posterior side of beak to postero-inferior angle. Surface with 10–12 concentric lines separated by spaces with gradually widening intervals away from beak. Length (type) 39 mm., width 30 mm., thickness 25 mm.

Navarro: Near Corsicana (type locality).

Veniella laphami (Shumard) 1862, **90**, 204 *(Arctica?)*.

"Shell small, subtriangular, longer than wide, broad anteriorly and cuneate behind; umbonal region very gibbous; posterior slope falling abruptly to the margin and almost perpendicular to the sides; buccal side short, narrowly rounded; anal side long, truncate at extremity, declining in a very gentle curve from beak to posterior end; pallial margin gently convex; beaks near anterior margin, elevated, incurved, pointed." Length (type) 10 mm., width 8 mm., thickness 7 mm.

Upper Cretaceous: Fannin County, bluffs of Red River (type locality).

Veniella (Etea) carolinensis (CONRAD). STEPHENSON 1923, **96,** 264, pl. LXVI, figs. 9–12.

Shell moderately thin, elongate subovate in outline, equivalve, very inequilateral, moderately convex. Beaks incurved, prosogyrate, approximate, situated about one-third the length of the shell from the anterior extremity. Umbonal ridge oblique, angular, sharply defined from the beak to the lower posterior extremity; surface back of the umbonal ridge slightly concave. Surface smooth except for concentric growth lines and undulations.

Upson clay (upper part of *Exogyra ponderosa* zone), questionably: Maverick County, Imperialist Creek 2.5 miles west of Darling siding.

Superfamily ASTARTACEA

ASTARTIDAE d'Orbigny

ASTARTE SOWERBY

Triangular-rounded or oval, thick, rather compressed; smooth or concentrically sculptured; lunule impressed; right anterior cardinal strong; dentition variable, from lucinoid heterodont type to forms lacking lateral teeth. (The genotype, *Astarte scotica,* lacks lateral teeth.) The subgenus *Eriphyla* GABB (type *E. umbonata* GABB) has lateral teeth; compare MEEK 1876, **70,** pp. 121–126.

Astarte lineolata ROEMER 1849, **77,** 404; 1852, **78,** 51, pl. VII, figs. 8 a–c.

Shell small, beak region prominent; narrowly rounded; basal margin broadly curved. Surface ornamentation consists of 15 or more narrow, elevated, concentric ridges and about three low concentric ridges in the interval between two taller ridges.

Austin?: Ford of Guadalupe River, New Braunfels.

Astarte texana CONRAD 1857, **18,** 152, pl. V, fig. 9.

An indeterminate cast.

"**Cretaceous:** Western Texas."

Astarte washitensis SHUMARD 1854, **87,** 180, pl. III, fig. 3.

"Shell ovate, trigonal, a little longer than wide, compressed, inequilateral, marked with fine, concentric rounded striae; buccal side shorter than the anal, excavated; basal margin rounded, truncated posteriorly, beaks slightly prominent, excavated." Indeterminate cast.

Fredericksburg ? (HILL): Camp No. 4, Cross Timbers, North-Central Texas (type locality).

Astarte (Eriphyla) pikensis HILL 1888, **51**, 134, pl. II, figs. 13–17. HILL 1893, **55**, 16, 28, pl. IV, figs. 4–6 *(Eriphyla)*.

Small, triangular-subovate species, basal margin broadly rounded; ornamentation of numerous, narrowly raised, concentric ridges and wide interspaces. Distinct anterior and posterior lateral teeth present.

Glen Rose: Glen Rose, plant bed on Paluxy River.

Trinity division: Pike County, Arkansas.

Malone species: *Astarte breviacola, A. posticalva, A. craticula, A. (?) isodontoides, A. malonensis* CRAGIN 1903, **27**.

OPIS DEFRANCE

Trigonal, cordate, smooth or concentrically striate; beaks prominent, prosocoelous; lunule very deep, bordered by a keel; cardinal teeth long, narrow (2:1).

Opis texana CRAGIN 1893, **21**, p. 196.

Fredericksburg: Tom Green County (Twin Mountain).

CRASSATELLITIDAE Dall

CRASSATELLITES KRUGER *(Crassatella)*

Crassatellites (?) **parvula** SHUMARD *(Crassatella?)* 1862, **90**, p. 202.

Shell small, thick, subovate, triangular, very gibbous, rounded anteriorly, truncate posteriorly. Surface marked with irregular, concentric folds and fine growth lines. Length 10 mm., height 7.5 mm., thickness 7 mm.

Navarro?: Fannin County, on Red River (type locality).

Crassatellites subplana (CONRAD) 1853.

Navarro: Two miles north of Webberville ? (Hill).

REMONDIA GABB

Remondia GABB 1869, Paleont. Calif., II, 257–276. STANTON 1897, On the genus *Remondia* Gabb, a group of Cretaceous bivalve mollusks. Proc. U. S. National Museum, XIX, no. 1109, 299–301. *Stearnsia* WHITE 1887, On new generic forms of Cretaceous mollusca and their relation to other forms. Proc. Acad. Nat. Sci. Phila., 1887, 32–37, pl. II.

"Shell rather compressed, equivalve or nearly so, elongate subquadrate to triangular in outline; lunule and escutcheon well marked and deeply excavated; ligament partly internal; hinge with three cardinal teeth and an anterior lateral lamina in the right valve, and two cardinals with a posterior lateral lamina in the left; free margins smooth or crenulate within; sculpture consisting of strong concentric ridges and furrows which may become obsolete in later stages of growth; posterior end usually (always?) emarginate." Genotype: *Remondia furcata* GABB (Fredericksburg of Arivechi, Sonora).

Remondia robinsi (WHITE) 1887, **109**, 33–34, pl. II, figs. 7–9 *(Stearnsia robbinsi* on plate legend). STANTON 1897, **92**, 301, pl. XXVI, figs. 6–8. .WHITNEY 1911, **111**, 17, pl. VII, fig. 7 (?).

Shell small, compressed; antero-dorsal slope straight, angle at beak about 100°; tip not produced as in *R. acuminata;* there are about 11 coarse concentric ridges. The genotype differs from *R. robinsi* in being subquadrate instead of subtriangular, and in having many, fine concentric folds or striae.

Weno: Big Fossil Creek, 6 miles north of Fort Worth (type locality.

Buda (?): Austin (Shoal Creek).

Remondia acuminata (CRAGIN) 1893.

Astarte (?Stearnsia) acuminata CRAGIN 1893, **21**, 171, pl. XLI, fig. 2.

Remondia acuminata ADKINS AND WINTON 1920, **3**, 74, pl. XIX, figs. 13–15.

This species differs from *R. robbinsi* in having an acuminate tip and fewer, sparser, concentric ribs.

Weno: Fort Worth region. Type locality: Float, 3.5 miles east of Fort Worth (doubtless derived from Weno).

REMONDIA FERRISSI CRAGIN 1889, Bull. Washburn Coll. Lab. Nat. Hist., 2, no. 10, p. 68. CRAGIN 1894, **22**, 5. pl. I, fig. 1. TWENHOFEL 1924, **99**, p. 83.

Belvidere beds: Southern Kansas (type locality).

PTYCHOMYA[21]

Like *Crassatellites,* but with radial sculpture and three cardinals in each valve. Cretaceous.

Ptychomya stantoni CRAGIN 1905, **27**, 69, pl. XII, figs. 4–6. GILLET 1924, **47**, p. 284.

Basal Cretaceous (Theta beds): One and one-half miles east of Torcer (Malone) station.

[21]Cragin, 1905, **27**, pp. 69–71 (catalog of species).

Ptychomya ragsdalei (CRAGIN) 1895, **23**, p. 58 *(Pholadomya)*. CRAGIN 1905, **27**, p. 70. CRAGIN 1894, **24**, pp. 42, 47. SHATTUCK 1903, **86**, 24, pl. XII, figs. 1–2; pl. XIII, fig. 1.

Shell medium to large, subovate, depressed, inequilateral, hinge line broad and slightly curved; umbos low, directed forward; two cardinal teeth directed backward, one posterior lateral tooth. Central part of shell with 25–30 radial tuberculate ribs. Anterior part with numerous short ribs at an angle to the main ribs, the apex of the angle directed toward the beak. Postero-dorsal margin with a narrow zone containing short corrugated ribs.

Main Street: Denison, Pawpaw Creek (type locality); Cooke County.

Superfamily CARDITACEA

CARDITIDAE Gill

CARDITA BRUG

Beaks elevated; anal cardinal area very elongated; sculpture radial, ribs commonly imbricated at growth lines; cardinals long and oblique. GILLET considers *Cardita* and *Venericardia* to be identical. Trias to Recent.

Cardita wenoensis (ADKINS) 1920, **1**, 125, pl. VI, fig. 2 *(Venericardia)*.

Small, inflated species, equivalve and nearly equilateral. Numerous, narrow, raised, radial ribs.

Weno: Southeast of Fort Worth (type locality); Gainesville.

Cardita n. sp. (ADKINS).

Medium sized species, with numerous, narrow, raised, radial ribs.

Del Rio (top): Bosqueville, McLennan County.

CARDITA BELVIDERENSIS CRAGIN 1894, Am. Geol. IV, 5, pl. I, figs. 9–11. TWENHOFEL 1924, **99**, 62, pl. XIII, figs. 4–6.

Champion shell bed: Southern Kansas.

Cardita eminula CONRAD 1857, **18**, 150, pl. VI. fig. 8.

Small, tall, equivalve, species with apex slightly curved; basal margin nearly circular; with 16 or more broadly rounded, straight, radial ribs with narrow interspaces.

Lower Washita: Leon Springs, Pecos County (type locality).

Cardita subtetrica CONRAD 1857 **18**, 164, pl. XXI, fig. 5.

Medium-sized shell fragment, with numerous, straight subequal, radial ribs, rather flat on top, crossed by concentric growth lines which form transverse elevations on crossing the ribs.

Cretaceous: "Rio Bravo del Norte, Texas."

CARDITA POSODAE Böse 1910, **8**, 120. pl. XXV, figs. 4, 6–7; pl. XXVI, fig. 3.

Inflated subequivalve, subtriangular species with broadly rounded basal margin, anterior end sharply rounded, posterior end produced; ornamented with 15 or more narrow, raised radial ribs with broad flat interspaces.

Upper Fredericksburg (horizon of *Oxytropidoceras chihuahuense)*: La Encantada, Chihuahua (type locality).

CARDITA ARIVECHENSIS HEILPRIN 1890, Proc., Acad. Nat. Sci. Phila., p. 452. BÖSE 1910, **8**, 126. *Cardita alticosta* GABB 1869, Pal. Calif., II, 268, pl. XXXVI, fig. 16.

Differs from *C. posodae* in being less pentagonal and more obliquely triangular, somewhat heavier, and interspaces less flat.

Fredericksburg: Sierra de las Conchas, Arivechi, Sonora.

Superfamily CARDIACEA

CARDIIDAE Fischer

CARDIUM LINNAEUS

It has not been practicable, from the figures and descriptions, to give a proper generic assignment to the following species.

Cardium choctawense SHUMARD 1860, **89**, 599. WHITE 1883, **106**, 39, pl. XVIII, figs. 7 a–c.

Eagle Ford: Sherman (Post Oak Creek).

Cardium congestum CONRAD 1857, **18**, 149, pl. VI, figs. 5 a–d.

Locality: "Rio San Pedro."

Cardium (?) *sevierense* HILL 1888, **51**, 133, pl. II, fig. 20; pl. IV, figs. 3–3 a–3 b. HILL 1893, **55**, p. 29.

Trinity division: Arkansas.

Cardium mediale CONRAD 1857. See Arctica mediale.
Cardium sancti-sabae ROEMER 1852. See Pholadomya sancti-sabae.
Cardium elegantulum ROEMER 1852. See Liopistha elegantula.
Cardium lamarensis SHUMARD 1860. See Meretrix lamarensis.
Cardium subcongestum BÖSE 1910, **8**, 128, pl. XVI, figs. 6–13.

Upper Fredericksburg (zone of *Oxy. chihuahuense)*: La Encantada, Chihuahua (type locality).

Cardium munozi BÖSE 1910, **8**, 131, pl. XXVIII, figs. 2, 4–6.

Upper Fredericksburg (zone of *Oxy. chihuahuense)*: La Encantada, Chihuahua (type locality).

GRANOCARDIUM

Granocardium budaense SHATTUCK 1903, **86,** 25, pl. XIII, figs. 2–4.

Buda: Austin (Shoal Creek, Bouldin Creek); Buda (Onion Creek).

PROTOCARDIA BEYR

Radial ribs posteriorly, concentric ribs anteriorly.

Protocardia stonei CRAGIN 1893, **21,** p. 210.

Small (20 mm.), triangular, inequilateral; anterior side short, with concentric ribs; posterior side produced, angulated, with about 22 radial ribs.

Glen Rose: At Comanche Peak (Hood County).

Protocardia (?) **pendens** CRAGIN 1893, **21,** p. 210.

Radial ornamentation in medial portion; anterior and posterior portions unknown.

Glen Rose: Burnet County (Hickory Creek).

PROTOCARDIA HILLANA (SOWERBY). ROEMER 1852, **78,** 49, pl. VI, fig. 12. BÖSE 1910, **8,** 129, pl. 27, figs. 4, 5; pl. XXVIII, figs. 1, 3.

Cast with subequal concentric ribs on the ventral one-third, and a few fainter radial ribs posteriorly. *P. texana* Conrad differs in having concentric ribs also in the umbonal region; and in being more nearly equilateral.

Fredericksburg: Fredericksburg, and San Saba Valley. Subd. 3–6; El Paso section.

Protocardia texana (CONRAD) 1857, **18,** 150, pl. VI, figs. 6 a–c. SHATTUCK 1903, **86,** 25, pl. XIII, figs. 5–7.. **Plate II, figure 5; plate XVI, figure 2**

Inequivalve, sub-equilateral, postero-dorsal margin straight, other margins forming arc of a circle; prominent elevated round topped fairly fine concentric ribs, and posteriorly several fine straight radial ribs.

Fredericksburg (?): Between El Paso and Frontera (type locality); abundant and widespread in Central Texas.

Washita: Widespread in Central Texas.

Protocardia coloradoensis (SHUMARD) 1860, **89,** 599 *(Cardium).*

Triangular cast, apical angle 75°–80°; length and height about equal, inflated in umbonal region; anteriorly rounded, posteriorly truncated, postero-dorsal margin straight. Fine concentric striae anteriorly; radial striae posteriorly.

Fredericksburg (with *Exogyra texana* and *Engonoceras pierdenale):* Burnet, Travis, Bosque, Johnson, and McLennan counties.

Protocardia brazoensis (SHUMARD) 1860, **89**, 600 *(Cardium)*.

Cordate, subovate, very gibbous; length and height nearly equal; fine, equal, concentric striae, and posteriorly 18–25 radial striae.

Fredericksburg: Comanche Peak (Somervell County); Patrick's Creek (Parker County).

Protocardia filosa CONRAD 1857, **18**, 150, pl. VI, figs. 7 a–b.

Triangular elevated, central margin broadly rounded; a radial carina in posterior part; numerous, fine concentric ribs with narrow interspaces anteriorly; posteriorly with several fine, closely-spaced radial ribs.

Washita: Leon Springs (type locality); **Kiamichi,** 5 mile well, near Fort Stockton.

Fredericksburg: Fort Worth.

Walnut: Austin (Bull Creek road).

Protocardia subspinigera CRAGIN 1893, **21**, p. 210.

Like *P. hillana*, but more elongated; medium-sized, rounded, concentric costae; about 18 radial, spinose costae.

Denton: Cooke County, Brown's Ferry (type locality).

Protocardia multistriata SHUMARD 1854, **87**, 181, pl. IV, fig. 2. CONRAD 1857, **18**, 149, pl. VI, figs. 4 a–c. ADKINS 1920, **1**, 126, pl. X, figs. 21–26, 32.

Fine, subequal, closely spaced, concentric ribs; about 14 radial ribs.

Lower Cretaceous: Camp No. 4, Cross Timbers, Texas (type locality).

Weno: Gainesville.

Pawpaw: Tarrant County.

Protocardia vaughani SHATTUCK 1903, **86**, 26, pl. XIV, figs. 1–3.

Triangular-rounded in outline, equivalve, subequilateral, inflated. Shell and cast with many minute concentric striae, and numerous fine radial riblets, which are flattened, round-topped, and with narrow interspaces.

Buda?: Locality unknown.

PROTOCARDIA GRANULIFERA GABB 1869.

Lower Cretaceous: Sierra de las Conchas, Arivechi, Sonora.

Protocardia pedernalis (ROEMER) 1849, **77**, 406; ROEMER 1852, **78**, 49 (as *Cardium* sp.).

Casts with radial and concentric striae.

Frederickburg: Fredericksburg (type locality).

Protocardia transversalis (ROEMER) 1849, **77**, 406. ROEMER 1852, **78**, 50 (as *Cardium* sp.).

Casts with radial and concentric striae.

Frederickburg: Fredericksburg (type locality).

Protocardia securiformis (CRAGIN) 1893, **21**, 214, pl. XLVI, fig. 6 *(Trigonia)*. CRAGIN 1895, **23**, p. 57, footnote *(Trigonia)*. CRAGIN 1894, **22**, 7, pl. I, figs. 14–15 *(Roudairia quadrans)*.

Form compressed, tall, subtriangular, with high, narrow beaks. Ornamented over most of shell with numerous, rather coarse, rounded, raised, subequal concentric lines and posteriorly with 10–12 fine radial lines.

Comanche Peak: Big Springs (type locality).

Superfamily ISOCARDIACEA

ISOCARDIIDAE Gray

ISOCARDIA LAMARCK

Isocardia washita MARCOU 1858, **68**, 37, pl. III, figs. 2–2 a–2 b.

"Shell orbicular, slightly triangular, length and breadth nearly equal, entirely smooth, subequilateral, gibbous, umbones very depressed, narrow and curved forwards. The cast which I describe is destitute of muscular and pallial impressions."

Duck Creek?: Grayson County, "borders of Red River near Preston, Texas," (type locality; holotype BM. 12669, British Museum Natural History, South Kensington; plaster replica in Bureau of Economic Geology, Austin).

Isocardia humilis CRAGIN 1893, **21**, p. 193.

"Shell of medium size (35 mm.), rather ventricose, ovate-triangular, somewhat oblique; beaks unusually small and low for the genus, directed inward and slightly forward, rather closely approximated, placed nearer to the middle than to the anterior extremity; margins entire; shell apparently marked only with concentric growth-lines."

Eagle Ford: Grayson County, Rattlesnake Creek, three-fourths mile below the Bonham-Sherman road.

Isocardia medialis (CONRAD) 1857, **18**, 149, pl. IV, figs. 4 a–b *(Cardium)*. CRAGIN 1893, **21**, 178 *(Cyprina)*. GILLET 1924, **47**, 233 *(Anisocardia)*. SHATTUCK 1903, **86**, 27, pl. XIV, figs. 4–5 *(Isocardia)*. HILL 1893, **55**, 31, pl. II, figs. 4–5; pl. III, fig. 6 *(Isocardia)*.

Large species (60 mm. long); margins near beak nearly rectangular, otherwise outline subcircular; form medium to large subglobose; umbos prominent, produced, curved downward and forward; cast smooth, shell thick, decorated with fine concentric striae.

Type locality not stated.

Glen Rose: Widespread in Texas and Arkansas.

Goodland: North-Central Texas.

Buda: Travis and Hays counties.

SHATTUCK reports it from the **Comanche Peak** limestone.

CYPRINIDAE Lamarck

CYPRICARDIA Lamarck

Inequivalve, elongate, trapezoidal, with concentric sculpture; a postero-dorsal keel; three divergent cardinals, the hindmost frequently bifid, and a strong posterior lateral.

Cypricardia texana Roemer 1852, **78,** 50, pl. VI, figs. 6 a–c.

Small, elongated shell with prominent, posterior, median keel and prominent oblique carina running from beak to postero-ventral angle. Beaks anterior but not terminal. Weak concentric sculpture.

Fredericksburg: Fredericksburg (type locality).
Comanche Peak: Four miles southeast of Leander.

Superfamily VENERACEA

VENERIDAE Lamarck

CYPRIMERIA Conrad

Oval to subcircular shells, variably compressed, generally smooth; pallial sinus shallow; posterior lateral present; right valve with two cardinals, the hinder one bifid.

Cyprimeria texana (Roemer) 1852, **78,** 46, pl. VI, figs. 8 a–b *(Arcopagia).* Cragin 1893, **21,** p. 177........**Plate XVIII, figure 3**

Subcircular casts, maximum length 55 mm., height 53 mm., thickness 14 mm. (Cragin). Pallial line entire, no sinus. Length, height, and thickness have ratio of 1:.96:.26 (casts).

Fredericksburg: Fredericksburg (type locality); Gillespie, Stonewall, Lampasas, Williamson, Callahan, Grayson, Cooke, Denton, Tarrant, Johnson, McLennan, Bell, Travis counties; northern Trans-Pecos Texas. Widespread and common.

Cyprimeria crassa Meek. Cragin 1893, **21,** 176.

Length about 78 mm.; thicker and larger than *C. texana;* length, height, and thickness have ratio 1:.86:.30 (casts).

Eagle Ford: Denison (Hill 1889, **52,** p. 14).
Fredericksburg: Williamson, Bosque, McLennan, Mills, Runnels, Erath, Callahan, and Stonewall counties (Cragin).

Cyprimeria gigantea Cragin 1893, **21,** 176........**Plate XVIII, figure 2**

Large size (118 mm.), apparently inequivalve, beaks only slightly elevated; concentric markings on cast; length, height, and thickness have ratio 1:.92:.33 (casts).

Grayson: One mile east of Roanoke (type locality); Denison; Burleson.

Cyprimeria (?) **excavata** MORTON. CRAGIN 1893, **21**, p. 176.

Eagle Ford, top (horizon of *Schloenbachia graysonensis* and *Ostrea bellaplicata).*

CYPRIMERIA KIOWANA CRAGIN, in: TWENHOFEL 1924, **99**, 67, pl. X, fig. 1; pl. XIII, fig. 13.

Thicker than *C. texana* and about one and one-half times as large; larger and more convex than *C. crassa.*

Kiowa: Southern Kansas.

Cyprimeria washitaensis ADKINS 1920, **1**, 134, pl. IX, figs. 1–6.. **Plate XIX, figure 3**

Ovate, slightly elongate, beaks not very prominent; length, height, and thickness have ratio 1:.89:.29 (shells). Casts are not described, hence comparison with *C. texana* is difficult; the two species appear to differ in their internal characters, pallial line and muscle scars.

Weno: One mile north of Union Station, Denison (type locality); Gainesville brickyard.

Cyprimeria depressa (CONRAD) 1860. STEPHENSON 1923, **96**, 307, pl. 74, figs. 6–13 (synonymy).

Small shell, subovate, proportions of length to height variable, depressed convex, both valves bent markedly to the left posteriorly. Beaks very small, scarcely projecting, slightly prosogyrate, position variable but generally situated about two-fifths the length of shell from anterior end. Umbonal ridge lacking. Length 34 mm., height 28 mm. Hinge as usual in the genus; surface with fine growth lines, and basally in some shells with coarse concentric lines.

San Miguel: Kinney, Maverick counties (**96**, p. 310).

Cyprimeria sp. cf. **alta** CONRAD. WADE 1926, **103**, 91, pl. XXIX, figs. 2–4; pl. XXX, fig. 1.

Pallial sinus angularly incised; length, height, and thickness have ratio of 1:.88:.36 (shells).

Eagle Pass beds: At San Carlos.

APHRODINA CONRAD 1869

Aphrodina tippana (CONRAD). STEPHENSON 1923, **96**, 314, pl. LXXIX, figs. 1–6.

Subelliptical, longer than tall, moderately convex. Beaks prominent, incurved, approximate, prosogyrate, situated about three-tenths the length of shell from anterior end. Postero-dorsal margin broadly arched, antero-dorsal margin deeply excavated. Pallial sinus prominent. Length 52 mm., height 38 mm., thickness 27 mm.

Navarro *(Ex. costata* zone): Near Kaufman (U. S. N. M. Cat. No. 20976).

VENUS LINNAEUS

Venus malonensis CRAGIN 1893. See *Astarte malonensis.*

Venus (?) sublamellosus SHUMARD 1860, **89**, 598–599.

Small, compressed ovate species, a little longer than wide; beaks subcentral, incurved, approximate; pallial sinus large; surface with prominent, sharp, sublamellose, concentric striae; hinge unknown (may be *Cytherea).*

Eagle Ford, septaria (with *Scaphites vermiculus):* Five miles north of Sherman.

MERETRIX LAMARCK *(Cytherea)*

Differs from *Venus* in possessing lateral teeth.

Meretrix leonensis (CONRAD) 1857, **18**, 153, pl. VI, fig. 1 *(Cytherea).* WHITNEY 1911, **111**, 18, pl. VII, fig. 4 *(Meretrix leonensis?).*

"Oblong-subovate, ventricose, very inequilateral; posterior margin, from beak to extremity, slightly sinuous; extremity truncated or obtusely rounded, direct."

Lower Washita: Leon Springs (type locality).

Buda (?): Austin (Shoal Creek, Barton Creek, Bouldin Creek).

Meretrix texanus (CONRAD) 1857, **18**, 153, pl. VI, fig. 2 *(Cytherea).*

"Obliquely ovate, ventricose, very inequilateral, with prominent lines of growth; umbo large, umbonal slope subangulated; buccal margin obtusely rounded; base profoundly rounded, dorsal margin straight, very oblique." This species appears to be more massive than *M. leonensis* and to have the ventral margin more oval, less quadrate, with the two extremities less pointed.

Type locality: Between El Paso and Frontera.

MERETRIX BURKARTI (BÖSE) 1910, **8**, 132, pl. XXVIII, figs. 7–12 *(Cytherea).*

Shell small, rather thick, tall oval, subequivalve, inequilateral beaks prominent, almost touching; surface smooth.

Upper Fredericksburg (zone of *Oxy. chihuahuense):* Hacienda de Cañas, Chihuahua (type locality).

Meretrix lamarensis (SHUMARD) 1860, **89**, 600 *(Cytherea).* WHITE 1883, **106**, appendix, p. 39, pl. XVIII, figs. 4 a–b *(Cytherea).*

Shell small, elliptical, with tall, prominent, approximate, prosogyrate beaks; anterior end sharply rounded, posterior end broadly rounded, basal margin a broad curve; postero-dorsal margin arcuate, antero-dorsal margin excavated. Fine growth lines and, at intervals, a few coarser growth rings. Shell inflated, equivalve. Length, height, and thickness are 24, 18.5, and 11 mm. (1:.76:.46).

Eagle Ford, septaria: Lamar County, on Red River (type locality).

TAPES MEGERLE

Oval, elongate, with concentric ridges; divergent or bifid cardinals, no laterals; deep pallial sinus. Margin posterior to beak a gentle curve, anterior to beak rather sharply incised.

Tapes austinensis WHITNEY 1911, **111**, 19, pl. VII, figs. 8–9.

Small, ovate, broader posteriorly, with fine unequal, concentric growth lines; right valve with two bifid, divergent cardinals, no laterals (?).

Buda: Austin (Shoal Creek).

Tapes hilgardi SHUMARD 1860, **89**, 601. WHITE 1883, **106**, 22, pl. XVI, fig. 3 a.

Ovate, elongate, rather compressed, posterior and less tall; surface with coarse, concentric ridges; pallial sinus linguaeform; dentition not described.

Cretaceous (Fredericksburg): Bell County (White).

Eagle Ford: Lamar and Fannin counties, septaria in Red River bluffs (type locality).

TAPES GABBI BÖSE 1910, **8**, 134, pl. XXVIII, figs. 16–17; pl. XXIX, fig. 10. GABB 1869, Pal. Calif. II, 265, pl. XXXVI, fig. 13 (as T. hilgardi).

Large ovate species, notch in margin anterior to beak is faint. About 1.4 times as long as tall. Umbos more anterior than in *T. guadalupae.*

Vraconnian: Cerro de las Conchas, Arivechi, Sonora (type locality).

TAPES WHITEI BÖSE 1910, **8**, 133, pl. XXVIII, figs. 13–15. WHITE 1883, **106**, pl. XVI, figs. 3 b–c (not 3 a).

Subovate species, about 1.37 times as long as tall, anterior marginal notch shallow; anterior end narrowed and rather pointed, posterior end broadly rounded. Differs from *T. hilgardi* SHUMARD in the position of the umbos and in the outline.

Fredericksburg (with *Oxytropidoceras chihuahuense*)*:* La Encantada, Chihuahua (type locality).

TAPES ALDAMENSIS BÖSE 1910, **8**, 134, pl. XXXVIII, figs. 23–24.

Relatively tall, subovate species, about 1.36 times as long as tall; anterior marginal notch prominent. Differs from *T. gabbi* in shape of anterior marginal notch, and in having shell less produced anterior to the beak. Differs from *T. whitei* in the position of the umbos, and in its less oval outline.

Fredericksburg (with *Oxytropidoceras chihuahuense*): La Encantada, Chihuahua (type locality).

TAPES GUADALUPAE BÖSE 1910, **8**, 135, pl. XXVIII, fig. 25; pl. XXIX, fig. 11.

Fairly elongate species, about 1.45 times as long as tall; marginal notch anterior to beak is prominent; posterior end rather truncated.

Fredericksburg: (with *Oxytropidoceras chihuahuense*): La Encantada, Chihuahua (type locality).

TAPES CHIHUAHUENSIS BÖSE 1910, **8**, 135, pl. XXVIII, figs. 18–22.

Rather elongate oval, about 1.75 times as long as tall; anterodorsal margin prominently and broadly excavated.

Fredericksburg (with *Oxytropidoceras chihuahuense*): La Encantada, Chihuahua (type locality).

Superfamily TELLINACEA

TELLINIDAE (Lamarck) Stoliczka

TELLINA LINNAEUS

Pallial sinus deep and wide. Each valve with two cardinal teeth (one is sometimes nearly obsolete), lateral teeth variable or obsolescent. Genotype: *Tellina radiatus* LINNAEUS. Cretaceous-Recent.

Tellina subaequalis CRAGIN 1895, **23**, p. 60.

Indeterminate cast; no facts about dentition stated.

Pawpaw: Pawpaw Creek, Denison (type locality).

LINEARIA CONRAD 1860

Pallial sinus mostly narrow, rounded at end. Each valve with two cardinal teeth, slightly diverging, directed forwards and downwards. Lateral teeth long. Genotype: *L. metastriata* CONRAD. Cretaceous.

Linearia (?) irradians (ROEMER) 1852, **78**, 45, pl. VI, figs. 9 a–b (Solen). HILL 1889, **52**, p. 15.

Thin, subrectangular, elongate species with prominent, concentric growth lines and radial striae; dentition unknown.

Fredericksburg: Fredericksburg (type locality).

Linearia (?) cancellato-sculpta (ROEMER) 1852, **78**, 46, pl. VI, figs. 10 a–b *(Psammobia)*. HILL 1889, **52**, p. 15.

Thin, radially striated species, elongate ovate, shorter than *L.* (?) *irradians*. Dentition unknown.

Austin chalk: Waterfall at New Braunfels (type locality).

Linearia (?) **texana** (CONRAD) 1857, **18**, 164, pl. XXI, fig. 6 *(Capsa).*
Washita: Leon Springs, Pecos County (type locality).

SOLENIDAE

LEPTOSOLEN CONRAD

Leptosolen biplicatus CONRAD. STEPHENSON 1923, **96**, 332, pl. LXXXV, figs. 10–13. WADE 1926, **103**, 94, pl. XXXI, figs. 4, 7.

Subcylindrical in cross-section, elongate-rectangular in outline, with two oblique crests running from umbo.

Navarro *(Exogyra costata* zone): Near Kaufman (U-S.N.M. Cat. No. 20971); Simpson's Hill, public road, 2 miles southeast of Kaufman (7546); field on Simpson's place, 2 miles southwest of Kaufman (7547); near Corsicana (U.S.N.M. Cat. No. 20931).

Escondido: Gulley on east-facing slope of Medina River Valley, 1 mile south of Castroville, Medina County (7667).

Leptosolen conradi MEEK. TWENHOFEL 1924, **99**, 73, pl. XIV, figs. 2–4. Kansas.

Leptosolen otterensis CRAGIN. TWENHOFEL 1924, **99**, 73, pl. XIX, fig. 9. Kansas.

Superfamily MACTRACEA

MACTRIDAE Gray

MACTRA LINNAEUS

Mactra texana CONRAD 1856, **17**, p. 269.

Indeterminate cast; of Tertiary age if locality is correctly given.

Locality: Prairie between Laredo and Rio Grande City.

Mactra antiqua CRAGIN 1894, **22**, p. 9. TWENHOFEL 1924, **99**, p. 75.
Kiowa: Champion Draw, near Belvidere, Kansas.

Mactra siouxensis MEEK AND HAYDEN. TWENHOFEL 1924, **99**; 75, pl. XVII, figs. 5–7.
"Dakota": Two miles above mouth of Big Sioux River.

Mactra siousensis smolanensis TWENHOFEL 1924, **99**, 75, pl. VIII, fig. 10.
Mentor beds: Five miles west of Smolan, Kansas.

CYMBOPHORA GABB

Differs from *Mactra* "in having its cartilage-cavity spoon-shaped, with its prominent margins raised above the hinge plate, and the A-shaped cardinal tooth of the left valve more distinct from the margin of the cartilage-cavity" (MEEK). See also STEPHENSON 1923, **96,** 335–336. Genotype: *M. ashburneri* GABB (Cretaceous).

Cymbophora sp. aff. **trigonalis** STEPHENSON 1923, **96,** 336, pl. LXXXV, figs. 1–6 (especially page 337).

Navarro: Corsicana.
San Miguel: "Rio Grande region."

Cymbophora sp. STEPHENSON 1920, U. S. Geol. Surv., Prof. Paper 120-H, pp. 141, 143.

Weno, Pawpaw: Denison.

Cymbophora serpentinus BULLARD 1928, Univ. Texas Bull. 2710, p. 51 *(nomen nudum).*

Superfamily MYACEA

CORBULIDAE Fleming

CORBULA LAMARCK

Small, ovate, rostrate, very inequivalve, the right valve convex, larger, with a prominent tooth in front of the pit for the resilium, left valve with a flattened chondrophore, and usually a posterior tooth. Trias-Recent. Genotype: *Corbula sulcata* LAMARCK.

Corbula sp. HILL 1889, **52,** p. 16.

Cretaceous: Gillespie County.

Corbula crassicostata CRAGIN 1895, **24,** p. 61. TWENHOFEL 1924, **99,** 65, pl. XV, fig. 10.

Shell very gibbous (length 7 mm., height 7.5 mm., thickness 7 mm.). Outline triangular-ovate, dorsal margins nearly straight, subequal; basal margin nearly a semicircle. Beaks subcentral, a little anterior. Surface ornamentation consists of very coarse, flattish topped, concentric ribs separated by abrupt, deep, round-bottomed depression; in the basal part of the shell there is about one con-concentric rib per millimeter. Shell posteriorly gaping, with a short, conically inflated, gently truncated rostrum placed above the base of the shell.

Denison beds: Denison.
Kiowa shale, and **Champion shell bed:** Southern Kansas (type locality, Belvidere).

Corbula wenoensis ADKINS 1920, **1,** pl. X, figs. 1–4.

Small shell, elongate, inflated, with variably developed rostrum, mostly long. Antero-dorsal margin broadly arched, basal margin a long ellipse, rostrum narrow, located above base of shell. About 29 coarse concentric ribs basally, and some finer ones dorsally.

Weno (upper): North of Union Station, Denison (type locality); brickyards, Gainesville; rare south of Red River.

Corbula basiniformis ADKINS 1920, **1**, 130, pl. IX, figs. 7–24; pl. X, figs. 7–9.

Small shell, ovate triangular, anterior end and basal margin form a broad oval, posterior end cuneate, postero-dorsal margin almost straight, rostrum large, ending in an acute angle, situated somewhat above base of shell. Beaks prominent, less rounded than in *C. wenoensis*. Ornamentation consists on both valves of fine radial striae, and numerous, variable, mainly coarser concentric ribs, which are finer than in *C. wenoensis* or *C. littoralis*.

Weno: Cut of Frisco track, three-fourths mile north of Union Station, Denison (type locality); brickyard, Gainesville.

Corbula littoralis ADKINS 1920, **1**, 133, pl. X, fig. 5.

Small shell, more elongate than the last two described, with a short rostrum a little less than one-half the height of shell and situated only slightly above base of shell; ornamented with about 12 coarse concentric ribs basally and a few finer ones dorsally. Length (holotype) 18 mm., height 11.5 (?) mm.

Weno: Gainesville brickyard (type locality).

Corbula graysonensis SHUMARD 1860, **89**, p. 603.

Shell compressed, broad triangular; right valve the larger, more gibbous than the left, which it overlaps at the margins; anterior side shorter than the posterior, strongly rounded; posterior margin nearly straight, sloping from beak to anal extremity, which is angulated; pallial margin gently arched; beaks small, very slightly elevated, approximate, situated nearest the anterior margin; surface marked with fine, distinct concentric striae of growth. The species is more compressed than any species known to me from American Cretaceous strata (SHUMARD).

Length 13.5 mm., height 10 mm., thickness 6 mm.

Eagle Ford (with *Ostrea bellarugosa* and *Ostrea congesta*): Sherman, Post Oak Creek (type locality).

Corbula tuomeyi SHUMARD 1860, **89**, p. 604.

Shell small, inequivalve, ovate, subtrigonal; length greater than the height; valves convex, right more gibbous than the left; anterior side strongly and regularly rounded; anal side suddenly contracted and prolonged posteriorly, the extremity abruptly truncated; beaks moderately elevated, situated in advance of the middle of the shell; surface ornamented with fine, regular, distinct, concentric striae, which are continued upon the prolonged portion, being parallel with its inferior and posterior margins (SHUMARD).

Length 12.5 mm., height 8 mm., thickness of right valve 5 mm.

Eagle Ford, septaria: Four and one-half miles north of Sherman (type locality).

Corbula occidentalis CONRAD 1857, **18,** 150, pl. VI, fig. 9.

Small species (about 12 mm. long), elongate ovate, with tall beaks, form apparently inflated, posteriorly produced; 20 or more concentric ribs.

"**Eocene**" [Cretaceous?]: West Texas (type locality).

SAXICAVIDAE Gray

PANOPE MENARD DE LA GROYE *(Panopea)*

Lower Cretaceous Species

Panope inconstans CASTILLO AND AGUILERA 1895. CRAGIN 1905, **27,** 82, pl. XVII, figs. 1–5; pl. XVIII, figs. 1–3 *(Pleuromya).*

Basal Cretaceous?: Malone.

Panope henselli (HILL) 1893, **55,** 16, 31, pl. IV, figs. 1–2 *(Pleuromya).* GILLET 1924, **47,** p. 233 *(Panopea).*

Glen Rose: "Colorado River section."

Panope texana SHUMARD 1854, **87,** 181, pl. VI, fig. 1 *(Panopea).*

Shell oval, elongate, inflated anteriorly, compressed behind, beaks moderately prominent, basal edge rounded, buccal extremity wide, rounded; surface marked with irregular, concentric, slightly elevated ribs. Cast. Length 62.5 mm., height 35 mm., thickness 27.5 mm.

Lower Cretaceous: "Camp No. 4, Cross Timbers."

PANOPE REGULARIS D'ORBIGNY. ROEMER 1849, **77,** 407. ROEMER 1852, **78,** 35.

Fredericksburg?: Pedernales River.

Panope newberryi SHUMARD 1860, **89,** 605.

Shell oblong subovate, one-fourth to one-third longer than high, umbonal region gibbous; beaks small, strongly incurved, considerably anterior to middle; surface with fine growth lines and concentric wrinkles. Length 70 mm., width 45 mm., thickness 32 mm.

Edwards ("Caprotina limestone"): Parker County; and at Comanche Peak (type localities).

Upper Cretaceous Species

Panope subparallela SHUMARD 1860, **89**, 605.

Shell subovate, length twice the width, anteriorly rounded, posteriorly truncate, gaping; beaks low, anterior to middle.

Eagle Ford: Fannin County, near Red River (type locality).

Panope subplicata SHUMARD 1862, **90**, 199.

Shell subovate, nearly subquadrate, beaks nearer anterior end; anterior end rounded, gaping; posterior end truncate, gaping. Surface marked with fine growth lines and wrinkles.

Navarro, septaria: Chatfield Point (type locality).

GASTROCHAENIDAE Gray

FISTULANA Brug

Fistulana ruperti WHITNEY 1911, **111**, 19, pl. VII, figs. 5–6.

Shell elongate, suboval, broader anteriorly than posteriorly, substance thin; beaks nearly terminal; anterior margin broadly rounded; dorsal and ventral margins convex and diverging from the posterior; beyond the middle, the ventral margin turns abruptly to meet the anterior; ventral side gaping for a considerable part of its length; surface smooth, marked by fine lines of growth. Tube clavate and generally vertical in the rock.

Buda: Austin, Shoal Creek (type locality).

Superfamily ADESMACEA

TEREDINIDAE Scacchi

Shells equivalve, reduced; pallets variable (simple, spatuliform, and not articulated in *Teredo);* animal bores, mainly in wood; mantle secretes a calcareous lining to the burrow.

TEREDO Linnaeus

Teredo sp. ROEMER 1849, **77**, p. 408. ROEMER 1852, **78**, p. 44.

Eagle Ford: Ford of Guadalupe River, near New Braunfels

Teredo tibialis CONRAD (WHITFIELD). HILL 1889, **52**, p. 16.

Horizon and locality not stated: "Texas."

Class GASTROPODA

Sub-Class STREPTONEURA

Order ASPIDOBRANCHIA

PATELLIDAE Carpenter

PATELLA Linnaeus

Patella sp. Shattuck 1903, **36**, 30, pl. XIX, fig. 1.

Small conical shell with central erect apex. Circular striae crossed by fine, concentric lines.

Buda: Austin (Shoal Creek).

PLEUROTOMARIIDAE d'Orbigny

PLEUROTOMARIA Sowerby

Shell conical or turbinate, with strongly recurved growth-lines; outer lip with slit and slit-band.

Pleurotomaria austinensis Shumard 1862, **90,** 198.

"Shell large, depressed conical, spire short, very rapidly expanding from apex; volutions five, convex; last one subangulated below, and very gently convex beneath; an obscure, rounded revolving ridge near the suture, and a narrow carina (band of sinus) a little above the middle, carina quite prominent on the anterior half of the volution and becoming nearly obsolete before reaching the spiral turns; umbilicus deep, exhibiting the inner volutions, broad, nearly as wide as the diameter of the last volution at aperture; suture distinct.

"The only example we have found of this species is a cast, which on the anterior portion of the last volution exhibits traces of fine revolving striae.

"Diameter of base 2.5 inches; spiral angle 102°. Austin limestone near city of Austin."

Georgetown limestone: Austin (type locality); North-Central Texas, widely distributed; northern Trans-Pecos Texas. It is most abundant at the **Duck Creek-Fort Worth** level.

Pleurotomaria macilenta Cragin 1893, **21,** p. 228.

Apical angle 100° or more; whorls rather rounded and only faintly angulated; outer portion of volution with revolving lines.

"Fort Worth limestone" [Georgetown]: Travis, Williamson, Bell, and Gillespie counties.

Pleurotomaria robusta CRAGIN 1893, **21**, p. 228.

Apical angle 90° or less; peripheral and superior angulations distinct; outer portion of volution with revolving lines, lower portion with revolving and radial lines.

"Fort Worth limestone": Two miles south of Bosqueville; 2 miles east of Georgetown.

Pleurotomaria stantoni SHATTUCK 1903, **86**, 30, pl. XX.

Tall conical species; volution with about seven revolving, cord-like lines, and short, transverse ribs; ornamentation more rugged and ornate than in *P. austinensis.*

Buda: Travis County (Shoal Creek, Barton Creek); near Buda (Onion Creek).

Pleurotomaria sp. ROEMER 1852, **78**, p. 39.

Georgetown: Waco Camp, on the Guadalupe River, above New Braunfels.

TURBINIDAE Adams

TURBO LINNAEUS

Turbinate to conical shells, with nearly circular aperture; thick, calcareous operculum.

TURBO CHIHUAHUENSIS BÖSE 1910, **8**, 139, pl. XXX, figs. 2–4.

Volutions squarish in section, with three prominent, revolving ridges.

Upper Fredericksburg (zone of *Oxy. chihuahuense):* La Encantada, near Placer de Guadalupe, Chihuahua.

Turbo sp. ADKINS 1920, **1**, p. 49.

Weno: Near Fort Worth.

PHASIANELLIDAE

Phasianella perovata SHUMARD 1860, **89**, 597.

Glen Rose: At Comanche Peak; Parker County (type localities).

TROCHONEMATIDAE Zittel

AMBERLEYA MORRIS AND LYCETT

Amberleya graysonensis ADKINS 1920, **1**, 137, pl. VI, fig. 5.

Shell conical, turreted, apical angle about 63°; three or more volutions, last volution about two and one-half times the height of spire; volutions projecting, truncated, with anterior and posterior slope, and three equally spaced, beaded, revolving carinae. No umbilicus. Aperture apparently subquadrate, inner lip slightly callous, outer lip reflected (?).

Basal Weno: Two and one-half miles north of Denison, near Frisco track (type locality).

TROCHIDAE Adams

TROCHUS LINNAEUS

Trochus texanus ROEMER 1888, **80,** 15, pl. I, fig. 13. HILL 1893, **56,** p. 102. CRAGIN 1894, **22,** p. 11.

Conical species with straight sides, each volution with 5 rows of flat granules; lower margin of outer lip with a tooth.

Edwards: Austin, Barton Creek (type locality); Deep Eddy Bluff of Colorado River.

Trochus laticonicus ADKINS 1920, **1,** 138, pl. X, figs. 30–31.

About 10 revolving lines on side of volution above the keel.

Weno: Gainesville, brickyards (type locality).

Trochus sp. SHATTUCK 1903, **86,** 31, pl. XIX, figs. 2–3.

Differs from *T. laticonicus* in having a larger apical angle and straighter non-angulated sides.

Buda: Austin (Shoal Creek).

UMBONIIDAE Adams

HELICOCRYPTUS D'ORBIGNY

Small, smooth, planospiral shells; aperture oblique oval, inner lip calloused, outer lip simple.

Heliococryptus mexicanus BÖSE 1910, **8,** 140, pl. XLVI, figs. 1–5, 9–12; pl. XLVII, fig. 1. ADKINS 1920, **1,** 139......**Plate XXI, figure 7**

Smooth, planospiral shell; short ovate aperture.

Weno-Pawpaw (subd. 6): El Paso section; **Pawpaw,** in Tarrant County.

NERITIDAE Lamarck

NERITINA LAMARCK

Neritina apparata CRAGIN 1893, **21,** 227, pl. XLVI, fig. 14.

Low spire, body whorl large, ornamented with 13 or more radial ribs each composed of about three elongated nodes, the middle node being more faint.

Edwards: Big Springs (type locality).

Neritina sp. HILL 1893, **55**, p. 37.

Basal Glen Rose: Hood and Parker counties.

Neritina sp. BÖSE 1910, **8**, 141, pl. XXX, figs. 5–6.

Fredericksburg *(Exogyra texana* zone): Cerro de Muleros, near El Paso.

Neritina sp. ADKINS 1920, **1**, 139, pl. X, fig. 27.

Weno: Gainesville.

Order CTENOBRANCHIATA

EPITONIDAE Pilsbry

EPITONUM BOLTEN *(Scalaria)*

Epitonum texanum (ROEMER) 1852, **78**, 39–40, pl. IV, figs. 11 a–b *(Scalaria)*.

Austin chalk?: Waterfall of Guadalupe River, below New Braunfels. See: **Anchura.**

Epitonum forsheyi (SHUMARD) 1862, **90**, 195–196 *(Scalaria)*.

Shell medium-sized (26 mm. long), spire elevated, about 7 volutions, strongly rounded, suture deeply impressed; aperture ovate, oblique; umbilicus filled with callus; surface with sharp longitudinal ribs and fine lines crossed by revolving raised line, producing a finely cancellated appearance.

Navarro: Chatfield.

Epitonum ? lamarensis (SHUMARD) 1862, **90**, p. 197 *(Scala)*.

Eagle Ford?: Lamar County, bluffs of Red River.

Epitonum ? bicarinifera (SHUMARD) 1862, **90**, p. 197–198 *(Scala)*.

Eagle Ford: Lamar County, bluffs of Red River.

Scalaria sp. ROEMER 1849, **77**, p. 413.

Austin?: Waterfall, New Braunfels.

Scalaria sp. HILL 1889, **52**, p. 17.

Cretaceous?: North of Webberville.

SOLARIIDAE Chenu

SOLARIUM LAMARCK *(Architectonica)*

Solarium (?) planorbis ROEMER 1888, **80**, 15, pl. I, figs. 1 a–c.

Small, smooth, planospiral shell. It is not an *Architectonica*, and except for the taller aperture is somewhat similar to *Helicocryptus mexicanus* Böse.

Edwards: Austin, Barton Creek (type locality).

NATICIDAE Forbes

The distinctness of Cretaceous genera in this family is highly questionable, but the following key expresses arbitrarily a few distinctions which are most generally cited in the literature.

No umbilicus:
  Spire low, volutions rounded .... **Ampullina**
  Spire high
    Volutions angular; no varices .... **Amauropsis**
    Volutions rounded; varices present .... **Tylostoma**
Umbilicus present (said to be variable in *Natica* s. s.):
  Spire medium, volutions with angular margins .... **Gyrodes**
  Spire low; volutions rounded
    Umbilicus contains callus or spiral swelling .... **Natica**
    Umbilicus open .... **Lunatia**

NATICA Adams

Shell subspherical, smooth, often umbilicate, with callus or spiral thickening in umbilicus; spire very low; volutions rounded; aperture crescentic, nearly equally rounded at both ends; operculum horny with calcareous outer layer.

Natica (?) pedernalis Roemer 1852, **78,** 43, pl. IV, figs. 1 a–b. Böse 1910, **8,** 142, pl. XXX, fig. 9.

Large species with large body whorl; spire small, low (less than one-fourth the height of body whorl); volutions with angular margin; no umbilicus. It is not a *Natica;* it has some features of *Amauropsis* or of *Ampullina.*

Glen Rose: Fredericksburg, and Pedernales River (type localities).

Natica (?) cossatotensis Hill 1888, **51,** 130, pl. III, figs. 4–5. Hill 1893, **55,** p. 32 (as *Viviparus* [*Nautica?*]).

Trinity division: Sevier County, Arkansas (type locality).

Natica (?) striaticostata Cragin 1893, **21,** p. 225.

Indeterminate, from the description.

Eagle Ford septaria: Four miles east of Whitesboro (type locality).

Natica sp. Roemer 1852, **78,** p. 44.

Indeterminate casts.

Fredericksburg: Fredericksburg.

Natica (?) texana Conrad 1857, **18,** 157, pl. XIII, figs. 1 a–b.

Body chamber relatively large and rounded; spire medium, its volutions with rather angular margin. Umbilicus apparently present but shallow (pseudoumbilicate?), no varices. Generic assignments uncertain; it has some features of *Lunatia*.

Type locality: Between Rio San Pedro and Rio Puercos.

Natica acutispira SHUMARD 1860, **89**, 597.

Shell obliquely ovate, length greater than the width; spire not much elevated, contracted above and acutely pointed at apex; spiral angle 84°; volutions 6 or 7, neatly rounded, last one very ventricose, forming rather more than two-thirds the total length of the shell; aperture ovate rounded below, narrow above; columellar lip thickened, deflected and partially covering the umbilicus; suture distinctly impressed; surface smooth, or marked with fine lines of growth. Length 16.5 mm., width 13.3 mm., height of body volution 11 mm.

Glen Rose: Parker County (type locality).

LUNATIA GRAY

Rather like *Natica:* shell subspherical, smooth, thin, spire low; umbilicus wide or narrow, without callous filling; aperture oval-crescentic, occasionally somewhat oblique, inner lip thickened above.

Lunatia (?) pedernalis HILL (not ROEMER) 1893, **55**, 33, pl. VI, fig. 2.

Lower Glen Rose: Abundant in Central Texas.

Type locality: Travis County.

AMPULLINA LAMARCK

Shell subspherical, low spire, no umbilicus. Volutions rounded, inner lip thin and reflected, outer lip simple; somewhat like *Lunatia* but non-umbilicate.

Ampullina humilis (CRAGIN) 1893, **21**, 224, pl. XLVI, fig. 2 *(Natica)*.

Shell non-umbilicate; low spire; rounded volutions; aperture ovate, narrowed anteriorly, rounded posteriorly.

Lower Woodbine: Timber Creek, southwest of Lewisville.

Ampullina (?) collina (CONRAD) 1857, **18**, 157, pl. XIII, figs. 2 a–b. BÖSE 1910, **8**, 143, pl. XXX, figs. 7–8.

Conrad's figure shows the species to be non-umbilicate and low-spired; there are apparently no varices.

Horizon: Not stated.

Type locality: Between Rio San Pedro [Devil's River?] and Rio Puercos [Pecos]. Cerro de Muleros, subd. 5 (Fort Worth-Denton).

Ampullina (?) planata (ROEMER) 1852, **78**, 42, pl. IV, figs. 6 a-b *(Globiconcha)*.

Georgetown: Waco Camp, 10 miles west of New Braunfels (type locality).

TYLOSTOMA SHARPE

Sharpe 1849: On *Tylostoma*, a proposed genus of gasteropodous Mollusks. Proc. Geol. Soc. London, 376–380, pl. IX. Genotype: *T. torrubiae* SHARPE (Cretaceous, England).

Shell ovate or globose, thick, smooth, with varices (remains of former outer lips); spire rather elevated (one-half to three-fourths of height of body chamber); volutions rather rounded, without angular margins; aperture ovate-lunate, anteriorly acute-angled, posteriorly rounded; outer lip with thickened margin, inner lip calloused.

Tylostoma tumidum SHUMARD 1854, **87**, 182, pl. V, fig. 3.

Casts, ovate-globose; pyramidal spire; volutions about 6, whorls moderately convex; width of body whorl about one-half the total length of shell.

Cretaceous: Cross-Timbers, Texas.

Tylostoma elevatum SHUMARD 1854, **87**, 182, pl. IV, fig. 4 *(Globiconcha)*. TWENHOFEL 1924, **99**, 39, pl. XIV, fig. 5; pl. XXII, fig. 3.

Shell ovate, spire produced; whorls 6, regularly convex; body whorl shorter than spire.

Cretaceous: Cross-Timbers, Texas; **Kiowa** and **Champion shell beds** of Kansas.

Tylostoma (?) mutabile GABB 1869. CRAGIN 1893, **21**, 232.

Walnut: Two and one-half miles east of Benbrook.

Fredericksburg: Arivechi, Sonora (type locality).

Tylostoma chihuahuense BÖSE 1910, **8**, 144, pl. XXX, fig. 13; pl. XXXI figs. 1–2.

Casts ovate, globose; body chamber inflated, spire high, nearly equal to body chamber, sutures impressed. Varices at intervals of one-half volution. No umbilicus. Aperture wide, narrowed posteriorly.

Fredericksburg: El Paso, Cerro de Muleros, subd. 1–2, zone of *Exogyra texana* (type locality).

TYLOSTOMA aff. TORRUBIAE SHARPE. BÖSE 1910, **8**, 143, pl. XXX, figs. 11–12.

Fredericksburg (zone of *Oxy. chihuahuense)*: La Encantada, Chihuahua.

Tylostoma (?) praegrande ROEMER 1849, **77**, 410; ROEMER 1852, **78**, 44 *(Natica)*.

Large, spherical, spire about one-half height of living chamber, volutions rounded; umbilicus unknown; has mainly features of *Tylostoma*.

Glen Rose: Upper Pedernales River.

Tylostoma hilli WHITNEY 1911, **111**, 20, pl. VIII, figs. 1–2; pl. IX.

Shell large (height 100 mm.), subglobose, somewhat compressed, 5½ whorls, spire half the height of body chamber; varices well developed and strong on spire of adult; aperture elongate; lip unknown.

Buda: Austin, Shoal Creek, Barton Creek (type localities).

Tylostoma harrisi WHITNEY 1911, **111**, 20, pl. X, figs. 12–14.

Shell medium (39 mm. tall), 5 whorls, spire elevated, about one-fourth or more the height of body whorls, suture canaliculate; outer lip thin, slightly reflected; inner lip callous, narrow; aperture elongate, broadly rounded anteriorly, acute posteriorly; varices present on casts and on some shells.

Buda: Austin, Shoal Creek, Barton Creek (type localities).

AMAUROPSIS MORCH.

Shell high oval, spire medium (less than one-third the height of body chamber); volutions tall with angular margins; aperture oval, narrowed anteriorly, rounded posteriorly; inner lip broad, calloused, outer lip thin.

Amauropsis avellana ROEMER 1888, **80**, 14, pl. I, fig. 15.

Non-umbilicate or practically so; small, smooth, subglobular shell; medium spire with angular volutions; varices not recorded; aperture narrowed anteriorly; inner lip calloused. The outer lip is somewhat reflected as in *Tylostoma;* otherwise the species resembles *Amauropsis*.

Edwards: Austin, Barton Creek (type locality).

Amauropsis pecosensis n. sp.................................**Plate II, figures 8–9**

Shell large, tall, elongate ovate, non-umbilicate, with 5 or more whorls, rapidly increasing in size and height, the earlier ones more generally convex, the later ones sharply shouldered, with sides slightly concave in upper portion, inflated and convex basally; spire only moderately elevated, apical angle about 90°, sutures deeply impressed. Apertures roughly elongate-ovate, posteriorly narrowed and rather rectangular, narrowed at inner edge by indentation of suture, anteriorly broadly rounded; outer lip not preserved, possibly sharp; inner lip curved, thin, slightly reflected. Surface ornamentation not visible in casts at hand.

The large size, turreted profile, and the striking angularity of the shoulders, distinguish this species from others in the Texan Cretaceous.

	A (holotype)	B	C	D
Length	118 mm.	83+	101+	101
Breadth	96	82	85	71
Height of aperture	96	69	72	79
Breadth of aperture	46	35	46	30 ?

Upper Fredericksburg clay (Goodland equivalent): Pecos County, University Mesa, 12 miles northeast of Fort Stockton (sec. 33, blk. 24, University lands, loc. 2326). The level is about 20 feet below the base of the Kiamichi clay. Four individuals. Holotype in Bureau of Economic Geology.

GYRODES Conrad 1860

Shell subspherical, thin, spire low, margin of volutions angular. Umbilicus wide, basal; inner lip simple. Last volution prominent, extended.

Gyrodes supraplicata (Conrad) 1858. Stephenson 1923, **96**, 357, pl. LXXXIX, figs. 1–6.

Shell depressed conical, oblique, with 4 or 5 rapidly expanding whorls. Suture narrow, moderately impressed, paralleled in front by a concave tabulated area which is coarsely crenulated or plicated on the outer edge, the plications grading into coarse lines of growth on the body whorl of adults. Umbilicus wide, the perforation extending to the apex, with a thick, coarsely crenulated carina on the margin; on the wall of the whorl from the margin, is a distinct spiral ridge; the band between this ridge and the margin is concave. Aperture subovate, elongate, truncated posteriorly by the tabulation, and acutely angled anteriorly. Inner lip thin and forming a thin callous on the body whorl between the end of the suture and the umbilicus; outer lip thin and simple. Outer surface and surface of the perforation marked by distinct incremental lines which become stronger toward the aperture (Stephenson, **96**, 358).

Navarro *(Exogyra costata* zone): Near Corsicana, a variety (U.S.N.M. Cat. No. 20992).

Gyrodes sp.

Duck Creek: Near Fort Worth (casts).

TURRITELLA Lamarck

Shell turreted, with very high, acuminate spire; whorls numerous, mostly spirally ribbed; aperture oval or rounded quadrilateral; outer lip thin, excavated behind, and slightly produced in front. The subgenus *Mesalia* Gray has twisted inner lip and aperture with shallow canal (Tertiary). Range: Triassic to Recent.

Turritella austinensis ELLISOR 1918, **16**, pl. IV, figs. 3–4.

Georgetown: Austin, Shoal Creek (type locality).

Turritella bartonensis ELLISOR 1918, **16**, 9, pl. II, figs. 1–3.

Upper Buda: Austin, Shoal Creek, Barton Creek (type localities).

Turritella bonnellensis ELLISOR 1918, **16**, 17, pl. IV, figs. 5–6.

Georgetown: Austin, east side of Mount Bonnell (type locality).

Turritella bravoensis BÖSE 1910, **8**, 149, pl. XXXI, figs. 8–9; pl. XXXII, figs. 1–2.

Sides of volution somewhat rounded, with the bands projecting; bands unequal, prominently tuberculated; last volution has 6 prominent revolving bands, a fine one near the suture, 3 prominent ones, then 2 finer ones, the last of which makes the periphery of the whorl; below it are about 5 fine bands.

Fredericksburg (subd. 2, with *Exogyra texana)*: El Paso section, near Southern Pacific bridge over the Rio Grande (type locality).

Turritella budaensis SHATTUCK 1903, **86**, 31, pl. XIX, figs. 4–6. ELLISOR 1918, **16**, 10, pl. II, figs. 4–6.

Sides rounded, revolving bands dissimilar; 4 revolving bands, about equally developed in young stages, but the 2 middle ones more prominent in older shells; besides there are 2 or 3 fine lines; main ribs cut by vertical depressions into quadrangular raised areas.

Buda: Austin, Shoal Creek, Bouldin Creek, Barton Creek; near Buda, Onion Creek (type localities).

Turritella bybeei ELLISOR 1918, **16**, 7, pl. I, figs. 1–2.

Lower Buda: Round Rock (type locality).

Turritella coalvillensis MEEK. CRAGIN 1893, **21**, 230. WHITE 1879, **104**, 315, pl. IX, fig. 4 a.

Sides rounded, sutures impressed; several subequal revolving bands, and on each side about 5 longitudinal swellings, discontinuous at sutures but in alinement from one volution to the next.

Woodbine: Denton County (Timber Creek).

Turritella corsicana SHUMARD=**Turritella trilira** CONRAD.

Turritella denisonensis CRAGIN 1895, **23**, 65=**Turritella leonensis** CONRAD.

See CRAGIN 1897, Notes on some fossils of the Comanche series. Sci. (n. s.), VI, 134.

Turritella felteri ELLISOR 1918, **16**, 11, pl. II, figs. 7–8.

Buda: Austin, Shoal Creek (type locality).

Turritella flagellata CRAGIN 1893, **21**, 232.

Cretaceous: Windom, Kansas.

Turritella georgetownensis ELLISOR 1918, **16**, 15, pl. IV, figs. 1–2.

Georgetown: Austin, Shoal Creek (type locality).

Turritella granulata SOWERBY var. **cenomanensis** D'ORBIGNY. BÖSE 1910, **8**, 147, pl. XXXI, figs. 3–5, 7, 10–12.

Weno-Pawpaw (subd. 6; *Perv. trinodosa):* El Paso section, above the initial boundary monument; and at extreme southeast end of Cerro de Muleros.

Turritella graysonensis ADKINS 1920, **1**, 140, pl. X, fig. 43.

Nearly straight sided, sutures impressed; bands low, inconspicuous, numerous, about 10 on side of volution and 4 below the suture; bands slightly unequal, bear low tubercles.

Weno: Denison (type locality); Gainesville; southern Oklahoma.

Turritella irrorata CONRAD 1856, Proc. Acad. Nat. Sci. Phila. for 1854–1855, p. 268.

Conrad's description.—Turritella irrotata. Slightly turreted, subulate, elongated; whorls with 4 to 5 fine revolving unequal beaded lines on each, and an intermediate smooth minute line. Differs from *T. seriatim-granulata* in having much finer lines and tubercles, and in having a smooth line between each of the beaded ones. Associated with *Venus quinquecostata, Corbula occidentalis* and *Nodosaria occidentalis* [*N. texana?*].

Lower Cretaceous: Between El Paso and Frontera (?) (type locality).

Turritella kansasensis CRAGIN. CRAGIN 1897, Sci. (n. s.), VI, 135.

Revolving bands are plain or nearly so.

Cretaceous: Southern Kansas.

Turritella knikeri ELLISOR 1918, **16**, 12, pl. II, figs. 5–6.

Buda: Austin (type locality).

Turritella leonensis CONRAD 1857, **18**, 165, pl. XXI, figs. 7 a–b.

Casts with volutions rounded, sutures deep, not greatly impressed; with about 9 fine, remote, thread-like raised bands of fine elongate tubercles; the intervening spaces are smooth and nearly flat.

Lower Washita (or **Kiamichi**): Leon Springs, Pecos County (type locality).

Turritella mabriensis ELLISOR 1918, **16**, 18, pl. IV, fig. 8.

Georgetown: Near Camp Mabry; International & Great Northern Railway cut, West Sixth Street; and Barton Creek, near Austin (type localities).

Turritella manchacensis ELLISOR 1918, **16,** 12, pl. III, figs. 3–4.

Lower Buda: Near Manchaca (type locality).

Turritella marnochi WHITE 1879, **104,** 314, pl. VII, figs. 5 a–b. CRAGIN 1893, **21,** 232.

Sides straight, bands slightly unequal, tuberculate. Two bands nearest suture equal, composed of prominent, round or inclined, low, circular tubercles; the next band is composed of more numerous, fine, crowded tubercles; the 3 basal bands above the overlap are equal and consist of tubercles not quite so prominent as the first 2 bands; there are a few fainter bands below the overlap.

Cretaceous: Helotes, Bexar County (type locality).

Turritella moorei ELLISOR 1918, **16,** 14, pl. III, figs. 7–8.

Buda: Austin (type locality).

Turritella cfr. **nodosa** STOLICZKA (not ROEMER). BÖSE 1910, **8,** 150, pl. XXXI, fig. 13.

Upper Fredericksburg (subd. 2, with *Exogyra texana):* El Paso section, near Smelter, between the two railroad bridges (type locality).

Turritella planilateralis CONRAD 1857, **18,** 158, pl. XIV, figs. 1 a–b. CRAGIN 1893, **21,** 232. ELLISOR 1918, **16,** 18, pl. IV, fig. 7.

Sides nearly straight; bands unequal, with prominent tubercles. 'Volutions with 2 large, beaded, revolving lines, and 2 smaller ones beneath, with an intermediate fine crenulated line."

Locality and horizon: Not stated.

"**Cretaceous:** Texas."

Georgetown: Austin, east side of Mount Bonnell.

Turritella renauxiana D'ORBIGNY. CRAGIN 1893, **21,** 231.

Woodbine: Denton County, Timber Creek.

Turritella seriatim-granulata ROEMER 1849, **77,** 413. ROEMER 1852, **78,** 39, pl. IV, figs. 12 a–b. GABB 1864, Pal. Calif., I, 132–133, pl. XX, fig. 88. GABB 1869, Pal. Calif., II, p. 263. CRAGIN 1893, **21,** 231.

Sides of volution nearly straight; 5 equal revolving bands, the middle one being set off on either side by a revolving groove containing a fine raised tuberculate band; other bands equally spaced; all 5 bands have perched on summit a few remote, equal, low tubercles.

Fredericksburg: Fredericksburg (type locality). Fredericksburg and Washita divisions of Central Texas. Dakota of Kansas (CRAGIN). Sierra de las Conchas, Arivechi, Sonora; localities in California.

Turritella shippi ELLISOR 1918, **16,** 13, pl. III, figs. 1–2.

Buda: Austin (type locality).

Turritella simondsi ELLISOR 1918, **16**, 16, pl. III, figs. 9–10.

Georgetown: East side of Mount Bonnell (type locality).

Turritella trilira CONRAD 1860, Jour. Acad. Nat. Sci. Phila., IV, 285. SHUMARD 1862, **90**, 196 (as *T. corsicana).* STEPHENSON 1923, **96**, 360, pl. XC, figs. 2–9.

High spire, 15–20 volutions; shell constricted just above suture; 3 sharp-topped revolving bands, with the bottom slopes more gentle, crossed by backwardly curved growth striae.

Navarro: Corsicana, Chatfield Point; near Corsicana.
Escondido: Maverick County.
San Miguel *(Ex. ponderosa* zone): Kinney, Maverick counties.

Turritella ventrivoluta CRAGIN 1893, **21**, 232.

Shell small or medium sized; granules delicate; volutions rounded.

Weno float: Texas & Pacific Railway, 3 miles east of Fort Worth (type locality).

Turritella vertebroides MORTON 1834. STEPHENSON 1923, **96**, 366, pl. XCI, figs. 11–14.

Volutions rounded, sutures impressed; no tubercles; 5 main ribs above overlap, prominent, equal, smooth; between each two of these are 3 smaller ribs equally spaced, the central one being heavier than those on either side of it.

Navarro: Near Kaufman (U.S.N.M. Cat. No. 21025).

Turritella vibrayeana D'ORBIGNY. BÖSE 1910, **8**, 145, pl. XXX, fig. 10; pl. XXXI, fig. 6.

Upper Fredericksburg (subd. 1, with *Exogyra texana):* El Paso, Smelter, at Southern Pacific Railway bridge across the Rio Grande.

Turritella washitensis ELLISOR 1918, **16**, 9, pl. I, figs. 5–6.

Basal Buda: Near Austin, Onion Creek (type locality).

Turritella whitneyi ELLISOR 1918, **8**, pl. I, figs. 3–4.

Buda: Austin, Shoal Creek (type locality).

Turritella winchelli SHUMARD 1862, **90**, 196.

Volutions gently convex, sutures in moderately deep channel; aperture subquadrate, longer than wide. Volution has 3 moderately prominent, rounded, revolving carinae, 4 on last volution, with 1 or 2 fine, elevated, revolving lines in the interspaces. Spiral angle 16°; length (of Shumard's type) 37 mm., width at base 11 mm.

Navarro: Corsicana and Chatfield Point (type localities).

Turritella worthensis ADKINS 1920, **1**, 142, pl. X, fig. 42.

Sides of volution inflated-rounded; bands subequal, those above the suture tuberculate. Six equal, equally spaced revolving bands, with medium, numerous, equal tubercles; below overlap 2 rather smooth bands; lower down, several fine bands.

Basal Weno: Tarrant County (Loc. 618 is type locality).

Turritella sp. ROEMER 1849, **77**, 414. ROEMER 1852, **78**, 39.

Austin chalk?: Ford, New Braunfels.

MESALIA GRAY

Like *Turritella,* but aperture with shallow canal, and inner lip twisted. No species reported from the Texan Cretaceous; mainly Tertiary.

GLAUCONIA GIEBEL

Glauconia branneri HILL 1893, **55**, 34, pl. V, figs. 1–7 *(Vicarya).*

Length up to 2 inches; tall spire, sutures variably impressed; tubercles variable, 2 rows or none; outer lip with pronounced indentation near suture; inner lip reflected.

Trinity division: Arkansas (types); Travis County, Texas.

NERINEIDAE Zittel

NERINEA DEFRANCE[22]

Turreted or pyramidal shells; aperture anteriorly with short canal or shallow notch. Columella invariably, and inner and outer lips generally, with simple folds.

Sides of volutions convex
  Volution with sharp, projecting keel.......... **N. cultrispira**
  Volution without keel.......... **N. pellucida**
Sides of volution concave
  Volution entirely smooth.......... **N. austinensis**
  Volution has 2 revolving bands separated by a depressed line.......... **N. incisa**
Sides of volution straight
  Volution entire, 1 band
    Volution smooth.......... **N. schotti; N. volana**
    Volution with 2 rows of granules.......... **N. subula**
  Volution split into bands
    Cast with 3 or 4 revolving bands.......... **N. acus**
    Cast with 2 revolving bands
      Bands subequal.......... N. sp. ROEMER
      Bands unequal.......... **N. texana; N. hicoriensis**

[22]Dietrich, W., Gastropoda mesozoica, Fam. Nerineidae, Fossilium Catalogus, No. 31.

Nerinea acus Roemer 1849, **77**, p. 412. Roemer 1852, **73**, 42, pl. IV, fig. 10 a–b.

Small shell, subcylindrical (small apical angle), volutions nearly straight-sided, with about 10 revolving ridges of two, roughly alternate, sizes.

Fredericksburg (with *Exogyra texana*): Fredericksburg (type locality).

Nerinea austinensis Roemer 1888, **80**, 17, pl. I, fig. 8. Hill 1893, **52**, p. 36.

Medium-sized shell; apical angle about 20°; volutions smooth, concave. A line of granules above suture. Aperture oblique, with short anterior canal; 3 folds on inner lip, 1 on outer lip.

Edwards: Austin, 2 miles above mouth of Barton Creek (type locality).

Glen Rose: Austin (Mount Bonnell).

Nerinea cultrispira Roemer 1888, **80**, 17, pl. I, fig. 9.

Tall, slender shell; middle of volution with single, acutely projecting keel; space between keel on adjacent volutions concave, with indistinct suture in middle. Aperture open, almost vertical, with short canal and simple lips.

Edwards: Austin, 2 miles above mouth of Barton Creek (type locality).

Nerinea hicoriensis Cragin 1893, **21**, 225, pl. XLII, figs. 6–7.

Smooth cast; volution with 2 unequal spiral bands. Cragin's plate XLII, figure 7 shows some similarity to *N. texana* Roemer 1852, **78**, pl. IV?, fig. 7.

Travis Peak: Travis County, Hickory Creek (type locality).

Nerinea incisa Giebel 1853, **45**, p. 364. Roemer 1852, **78**, 41, pl. IV, fig. 8.

Medium-sized, subcylindrical cast; smooth, concave volution with 2 subequal, revolving bands. Specimens with 10 volutions reach a foot in length.

Trinity division (?): Upper Pedernales River (type locality). Medina County (with *Orbitulina texana*).

Nerinea pellucida Cragin 1893, **21**, 226, pl. XLII, fig. 5.

Small conical shell (some limonitic); volution convex, and consists of two bands each with two rows of granules. Apical angle large for the genus. Aperture oblique, short anterior canal, two folds on columella, one on outer lip.

Edwards: Austin, Deep Eddy Bluff (type locality).

Duck Creek: Near Fort Worth.

Nerinea schotti CONRAD 1857, **18**, 158, pl. XIV, figs. 3 a–b.

Large species, smooth, straight sided, sutures slightly impressed.

Fredericksburg: "Near mouth of Pecos River" [Live Oak Creek?] (type locality).

Nerinea subula ROEMER 1888, **80**, 18, pl. I, fig. 10.

Small shell, straight sided with 2 rows of granules, suture impressed. Aperture oblique, narrowed anteriorly in a canal posteriorly narrowed; no folds on columella or outer lip.

Edwards: Austin, Barton Creek, 2 miles above mouth (type locality).

Nerinea texana ROEMER 1852, **78**, 41, pl. IV, fig. 7.

Tall cast, nearly straight sided; volution with 2 unequal spiral bands. Columellar folds apparently absent.

Fredericksburg: Fredericksburg (type locality); Pedernales River.

Nerinea volana CRAGIN 1893, **21**, 226, pl. LXII, fig. 8.

Tall conical shell, apparently straight sided, with 2 unequal lobes. Ornamentation and aperture unknown.

Buda: San Gabriel River, 6 miles below Georgetown (type locality).

Nerinea sp. ROEMER 1852, **78**, 41, pl. IV, fig. 9.

Cast with volutions nearly straight sided, 2 subequal bands.

Cretaceous: Upper Pedernales River (type locality).

CERITHIIDAE Menke

CERITHIUM Bruguiere

Turreted shells with variable ornamentation; aperture oblong ovate; with backwardly curved anterior canal; outer lip often somewhat deflected; columella concave, frequently with 1 or 2 folds.

Shell nearly smooth except for growth lines .... **C. proctori**
Shell with spiral or radial ornamentation
  Spiral lines or ridges absent; longitudinal ridges present .... **C. hilli** and **C. texanum**
  Spiral lines or ridges present
    Prominent longitudinal ribs present
      Large species; about 10 longitudinal ridges ...... **C. bosquense**
      Small species.
        About 14 longitudinal ridges; 5–7 spiral lines .. **C. shumardi**
        About 8 longitudinal ridges; 4 spiral lines .... **C. interlineatum**

About 6 longitudinal ridges; 6–8 spiral lines..**C. austinensis**
Prominent longitudinal ribs absent
Tall species (16–27 whorls)
Two tuberculate spiral ridges....................................**C. stantoni**
Three–five spiral ridges..**C. tramitense**
Lower species (about 9 whorls); 6–8 spiral ridges with obscure granules....................................**C. obliterato-granosum**

Cerithium proctori CRAGIN 1893, **21**, 222, pl. XLII, figs. 11–12.

Species nearly smooth except for oblique growth lines.

Edwards: North Austin, Deep Eddy Bluff (type localities); Gillespie (or Hood?) County.

Cerithium hilli WHITNEY 1911, **111**, 21, pl. X, fig. 4.

Spiral angle about 19°; about 24 longitudinal costae; spiral lines faint or absent.

Buda: Austin (Shoal Creek). Holotype: University of Texas.

Cerithium bosquense SHUMARD 1860, **89**, p. 596. CRAGIN 1893, **21**, 220, pl. XLII, figs. 9–10.

Casts generally found; large shell with several oblique, longitudinal ribs appearing on upper angular margin of volution as obscure nodes; 10–12 revolving lines.

Comanche Peak and Walnut: Central Texas.
Walnut: Bosque Creek, Bosque County (type locality).
Comanche Peak ("Goodland"): Near Fort Worth.

Cerithium shumardi WHITNEY 1911, **111**, 21, pl. X, fig. 3.

Spiral angle 31°; about 14 costae traversed by 5–7 heavy revolving lines; lower part of volution lacks the costae.

Buda: Austin (Shoal Creek, Barton Creek). Types: University of Texas.

Cerithium interlineatum CRAGIN 1893, **21**, p. 221.

Small shell, 8 whorls; about 8 longitudinal ribs and 4 revolving lines.

Woodbine: Denton County, Timber Creek, 2 miles below Dallas-Lewisville road (type locality).

Cerithium (?) **austinense** ROEMER 1888, **80**, 16, pl. I, fig. 12.

Shell with 6 longitudinal ribs crossed by about 6–8 subequal, revolving ridges. Aperture posteriorly rounded, anteriorly constricted into a narrow canal. Both lips apparently simple. Generic determination uncertain.

Edwards: Austin, Barton Creek, about 2 miles above mouth (type locality).

Cerithium stantoni WHITNEY 1911, **111**, 20, pl. X, figs. 1–2.

Spiral angle 16°; 2 rows of tubercles, anterior ones larger.

Buda: Austin, Shoal Creek (type locality; types, University of Texas).

Cerithium tramitense CRAGIN 1893, **21**, p. 222.

With 16–25 whorls, ornamented with oblique growth lines and with 3–5 raised revolving lines, reduced in large specimens to one line just below the suture.

Woodbine: Denton County, Timber Creek near Lewisville (type locality).

Cerithium (?) obliterato-granosum ROEMER 1888, **80**, p. 222, pl. I, fig. 11.

Rounded volutions with 6–8 spiral rows of small granules, otherwise appearing smooth; aperture oblique oval, anteriorly rounded and entire, posteriorly narrowed; outer lip simple, inner lip reflected. Generic determination ?

Edwards: Austin, Barton Creek, 2 miles above mouth (type locality).

Cerithium (?) texanum SHATTUCK 1903, **86**, 32, pl. XIX, figs. 7–8.

No spiral ornamentation; several longitudinal ribs, each with a tubercle at upper (posterior) end; shell with 6 or more whorls.

Buda: Austin (Shoal Creek, Bouldin Creek), type localities.

TRICHOTROPIDAE

TRICHOTROPIS BRODERIP AND SOWERBY

Trichotropis (?) shumardi CRAGIN 1893, **21**, 229, pl. XLII, fig. 13 .... **Plate II, figure 7**

Cast; generic determination probably incorrect.

Comanche Peak: At and 1.5 miles east of Benbrook (type localities).

APORRHAIDAE Philippi

ANCHURA CONRAD

Turreted shell with no posterior canal. Outer lip expanded with 1 or 2 narrow or bluntly rounded terminal processes. *Drepanochilus* MEEK has 1 slender, sickle-shaped process apically upturned; *Anchura* s. s. has 2 processes, one apically unturned, the other turned away from the spire, both being short and bluntly rounded (in Texas species).

Shell nearly smooth; a single carinated, upturned process........ **A. modesta**
Shell with narrow, curved, subvertical ribs
Wing not distinctly carinate.............. **A. mudgeana**
Wing carinate externally.............. **A. kiowana**

Anchura mudgeana WHITE 1879, **104**, 312–313, pl. VII, figs. 3 a–b. ADKINS 1920, **1**, 139, pl. X, figs. 39–40.

Shell with vertical ribs; wing not distinctly carinate, distally expanded until taller than body whorl, terminally narrowed to a bluntly rounded, outwardly projecting, central lobe about one-third the height of body whorl.

Weno and **Pawpaw:** Denison (type locality); Gainesville.

Anchura modesta CRAGIN 1893, **21**, p. 218.

Shell nearly smooth; wing process upturned (apically), carinate externally, proceeding from basal two-thirds of expanded outer lip.

Eagle Ford: Four miles east of Whitesboro (type locality).

Anchura texana (ROEMER) 1852, **78**, 39, pl. IV, figs. 11 a–b *(Scalaria)*. GABB 1869, Pal. Calif., II, 261 *(Chemnitzia)*. GABB 1876, **43**, 298–299 *(Anchura)*.

Turreted shell, 4+ volutions, spire tall, sutures impressed, about 11 revolving, low ridges above the overlap (about every fourth one more prominent), and about 12 longitudinal swellings (6 on each side), discontinuous at sutures but in continuous longitudinal lines from one volution to the next. Inner lip broadly reflected, outer lip apparently simple, thin (broken?). Aperture biconvex in outline, equally narrowed at anterior and posterior ends; short anterior canal (broken?).

Gabb states that Stoliczka examined Roemer's original at Bonn and considered it an imperfect specimen of *Aporrhais*. "The long, slender spire of the species in question is very like many species of *Anchura*, but is wholly incompatible with *Aporrhais*." (GABB.) Lack of information concerning features of the wing prevents placing it in the key, even to the subgenus.

Austin chalk?: Waterfall of Guadalupe River below New Braunfels (type locality; "nicht selten"; 6 cotypes; type material at University of Bonn).

ANCHURA KIOWANA CRAGIN 1894, **23**, p. 66; TWENHOFEL 1924, **99**, 53, pl. IX, figs. 2–3.

Less slender than *A. mudgeana* and with fewer whorls. Wing process carinate, narrow and directed posteriorly, as in *Drepanochilus*.

Champion Shell Bed, and **Kiowa:** Southern Kansas.

ANCHURA MONILIFERA GABB 1869, Geol. Surv. Calif., Pal. II, 262, pl. XXXV, fig. 7.

Longer and more slender than *A. mudgeana*, aperture narrower, and wing process more pointed.

Fredericksburg (?): Arivechi, Sonora.

ANCHURA JOHNSONI STEPHENSON 1923, **96**, 370, pl. XCII, figs. 1, 4.

Navarro equivalent: Snow Hill, North Carolina (type); Las Esperanzas, Coahuila (BÖSE 1928, **10**).

APORRHAIS DA COSTA

Differs from *Anchura* in having posterior canal; outer lip expanded often covering penultimate whorls, and digitate or lobed.

Genus not recorded from Texas.

PTEROCERELLA MEEK

Shell smooth, with angulated carina near center of volution; three or more leaf-like expansions of outer lip.

Pterocerella tippana (CONRAD) 1858. WADE 1926, **103**, 152, pl. LIII, figs. 6–7.

Shell smooth with angular carina near middle of volution; 6 elongated, spreading leaf-like processes of outer lip, each centrally carinated and 5 of these carinae continuous onto body whorl.

Navarro: Chatfield.

STROMBIDAE d'Orbigny

HARPAGODES GILL

Spire short, body whorl large. Canal long, reflected; outer margin produced into a number of tubular, spinous processes, the posteriormost of which rests against the spire and extends nearly to the apex.

Harpagodes shumardi (HILL) 1889, **53**, p. 5, pl. II *(Pterocera)*. SHATTUCK 1903, **86**, 32, pl. XXI.

Subfusiform, smooth, large shell with a wing having about 5 points, between which the margin is indented.

Buda: Austin (Shoal Creek, Bouldin Creek); Buda (Onion Creek).

ROSTELLARIA LAMARCK

Spire high, whorls smooth. Aperture produced anteriorly into a beak-like canal, and continued posteriorly as a narrow channel resting on the spire (reaching tip of spire in *Hippochrenes)*. Outer margin with denticulate processes, notched anteriorly (apparently entire in Texas species).

Rostellaria monopleurophila ROEMER 1888, **80**, 16, pl. III, figs. 3 a–b.

Typical *Rostellaria*, smooth, sutures obscure, posterior margin of lip covering penultimate whorl.

Edwards: Austin, Barton Creek, 2 miles above mouth (type locality).

Rostellaria (?) texana CONRAD 1857, **18**, 158, pl. XIII, figs. 4 a–b.

Not typical; sutures impressed, outer lip covers only last whorl; casts.

Fredericksburg: Between Rio San Pedro and Rio Pecos (type locality); widespread in Central Texas.

Rostellaria (?) collina CONRAD 1857, **18**, 157, pl. XIII, figs. 3 a–b.

Not typical; sutures impressed, spire proportionately taller and body whorl shorter than in *R. texana;* casts.

Fredericksburg: Between Rio San Pedro and Rio Pecos (type locality).

Rostellaria (?) subfusiformis (SHUMARD) 1854, **87**, 182, pl. IV, fig. 3 *(Eulima?)*.

Not typical; fusiform shape; more inflated and sutures less indented than in *R. texana*; casts.

Fredericksburg: "Camp No. 4, Cross Timbers, Texas" (type locality).

PUGNELLUS CONRAD

Spire short, body whorl large, both covered with calcareous deposit; aperture narrow, narrowed posteriorly, broadened anteriorly; outer lip simple, thickened, flared.

Pugnellus densatus CONRAD 1860. STEPHENSON 1923, **96**, p. 374. WADE 1926, **103**, 148, pl. LII, figs. 4–5.

Navarro: "Texas."

Pugnellus sp. STEPHENSON 1927, **97**, p. 22.

Navarro: Kaufman County.

CYPRAEIDAE Gray

CYPRAEA LINNAEUS

Cyprea sp. SHATTUCK 1903, **86**, 33, pl. XXII.

Generic assignment uncertain.

Buda: Austin (Shoal Creek).

BUCCINIDAE Troschel

BUCCINOPSIS Conrad

Buccinopsis parryi Conrad 1857, **18,** 158, pl. XIII, figs. 5 a–b.

"Sub-pyriform; longitudinally undulated and ornamented with rugose revolving lines; volutions flattened above; spire scalariform; aperture large and patulous." Generic assignment uncertain. Hill (1893, **55,** 33, pl. VI, fig. 1) questionably refers to this species a cast belonging to some other species.

Cretaceous: "Between Rio San Pedro and Rio Puercos."

SARGANIDAE Stephenson 1923

"The columellar folds and the flattened spire are the chief characters which distinguish the family from the *Muricidae.*"

SARGANA Stephenson 1923

Sargana stantoni (Weller) 1907. Stephenson 1923, **94,** 337, pl. XCIII, figs. 1–5. Wade 1926, **103,** 136, pl. XLVI, figs. 7–8.

Navarro: Near Chatfield (type locality; holotype U.S.N.M. Cat. No. 21070).

FUSIDAE Tyron

FUSUS Lamarck

Shell narrow, elongate; spire acuminate. Aperture ovate; canal very long, straight, open. Outer margin thin, sometimes crenulate, and often striate within; columella smooth.

Fusus texanus Shattuck 1903, **86,** 33, pl. XIX, fig. 9.

Short spire, body whorl proportionately longer, and apical angle greater, than in *F. simondsi.*

Buda: Austin (Shoal Creek); Buda (Onion Creek).

Fusus simondsi Whitney 1911, **111,** 22, pl. XI, fig. 2.

Tall species, apical angle 25°; spire and body whorl about equal in length.

Buda: Austin (Shoal Creek) type; University of Texas.

Fusus sp. Shattuck 1903, **86,** 34, pl. XIX, figs. 10–11.

Shell small, spire short, body whorl inflated, aperture oval (?).

Buda: Austin (Shoal Creek, Bouldin Creek); Buda (Onion Creek).

VOLUTIDAE Tyron[23]

VOLUTILITHES SWAINSON

Volutilithes austinensis WHITNEY 1911, **111**, 22, pl. XI, fig. 1.

Small species, body whorl large; aperture narrow and elongated, canal long; columella with 3 plaits.

Buda: Austin, Shoal Creek (type locality; holotype, University of Texas).

VOLUTOMORPHA GABB

Volutomorpha differs from *Volutoderma* "by its sculpture, by having a single strong plait on the columella, and especially by the fact that the outer surface in the adult is covered with a varnish-like enamel."

Volutomorpha retifera DALL 1907, **120,** 15, text figs. 2, 3.

"Shell with 1 evident plait in the adult, 2 in the early stages, lagging behind the aperture and hardly visible from in front; penultimate whorl with 18–21 rounded ribs, most prominent at the shoulder, obsolete on the last half of the last whorl, but earlier extending well towards the base, with subequal interspaces; posterior sinus of the aperture deep, narrow, in the adult recurved (see figure 3), leaving a prominent ridge of callus in front of and close to the suture, in front of which the whorl is excavated, markedly so in the earlier whorls, and spirally obsoletely striated; the rest of the surface with about 22 spiral, strap-like ridges, very evenly disposed, prominent but hardly noduloud at the intersections, forming with the ribs a coarse, rather regular reticulum; spire short, conic; suture appressed; the whole shell in the fully adult stage with a very thin coat of enamel; outer lip thin, expanded, slightly reflected, more or less denticulate at the extreme margin. Lon. of shell 143 mm.; of aperture, 103 mm.; max. diam., 44 mm."

Navarro: Kaufman (type locality; holotype U.S.N.M., 20996).

VOLUTODERMA GABB

Volutoderma texana (CONRAD).

Rostellites texana CONRAD 1856, Proc. Phila. Acad. Nat. Sci., VII, 268. CONRAD 1857, **18,** 158, pl. XIV, figs. 2 a–b.

Volutilithes navarroensis SHUMARD 1862, **90,** 192.

Volutoderma texana DALL 1907, **120,** 20, text fig. 9. DALL 1890, Trans. Wagner Free Inst., Vol. III, 71–73.

Dall's description follows:

Pillar with 3 feeble plaits becoming obsolete near the aperture (the "numerous plaits" of Conrad being based on remnants

[23]Compare: Dall, 1907, **120.**

of the external spiral cords, and not on the true plaits); early whorls with 8–10 rounded, axial riblets, obsolete on the last whorl; suture appressed, the whorl in front of it flattish, with no well-marked shoulder, but more or less distinct axial wrinkling just in front of the suture; on the last whorl there are 15–17 prominent, distant, sharp spiral ridges, without nodulations, separated by much wider slightly excavated axially striate interspaces, in which occasional much finer intercalary spirals sometimes appear; outer lip thin, in the adult anteriorly expanded, slightly reflected; the posterior sinus narrow, well marked, close to the suture. Lon., 124 mm.; of aperture, 87 mm.; max. diam., 33 mm.

Navarro: Eagle Pass (type locality; holotype U.S.N.M. No. 9886). Kaufman (U.S.N.M. No. 20992). Webberville (U.S.N.M. No. 21183).

Volutoderma protracta DALL 1907, **120,** 21, text fig. 10. WADE 1926, **103,** 115, pl. XXXIX, fig. 4.

Shell very elongate, thin, with 8 whorls; pillar straight, with 3 feeble plaits lagging behind the aperture; on the early whorls 7–8 rounded axial ribs, obsolete on the later whorls; whorls slightly constricted in front of the appressed suture; sutural margin with conspicuous imbricated scales and striation axially directed, crossed by 3–5 faint spiral threads; on the body of the last whorl are 19–20 sharp spiral ridges with much wider, somewhat excavated interspaces; the spiral ridges are sometimes gently undulated but not nodulous, and there are occasionally faint intercalary spiral threads; outer lip thin, slightly reflected; posterior sinus close to the edge of the suture. Lon., 155 mm.; of spire above the first whorl, about 40 mm.; max. diam., 36 mm.

Navarro: Kaufman (cotype, U.S.N.M. No. 20992).

Subclass EUTHYNEURA

Order OPISTHOBRANCHIATA

ACTAEONIDAE d'Orbigny

CYLINDRITES FÉRUSSAC

Cylindrical-ovoid shells with short spire; columella with anterior fold.

Cylindrites formosus CRAGIN 1893, **21,** 223, pl. XLII, fig. 4.

Medium-sized, rhomboid-elliptical shells; spire short, body chamber ventricose; aperture crescentic with 2 anterior, thin, high columellar folds.

Upper Walnut: About 2.5 miles east of Benbrook (type locality).

Cylindrites whitei WHITNEY 1911, **111**, 23, pl. X, fig. 8.

Small shell, with prominent growth lines; spire short; aperture narrow; columella with 1 fold.

Buda: Austin, Shoal Creek (type locality). Type: University of Texas.

ACTAEONELLA D'ORBIGNY

Thick-shelled, inflated, smooth forms. Spire short; columella thickened anteriorly, with 3 sharp folds. Mainly in the Rudistid Facies.

Actaeonella n. sp.

Main Street equivalent ("upper cap rock"): Pecos County, Sec. 33, Blk. 24, University Land, Pecos County (University Mesa, about 12 miles northeast of Fort Stockton; type locality; holotype in Bureau of Economic Geology).

VOLVULINA STOLICZKA

Like *Actaeonella*, but with insunken spire.

Volvulina texana (ROEMER) 1849, **77**, p. 411. ROEMER 1852, **78**, 43, pl. IV, fig. 4 *(Actaeonella)*.

Thick, subovate shell, with insunken spire; 3 columellar plaits; casts.

Fredericksburg: Near Fredericksburg (type locality).

ACTEON MONTFORT *(Tornatella* LAMARCK)

Oval thin shells with conical spire; 1 columellar fold.

Acteon texana SHUMARD 1862, **90**, p. 194 *(Tornatella)*.

Shell small (7 mm. long), thin, ovate; spire short, spiral angle 78°, about 5 volutions, the last one large, ventricose. Aperture narrow, subovate; outer lip sharp; 1 oblique, twisted columellar fold near middle of lip. Shell ornamented with fine, sharply impressed, punctate, revolving striae.

Eagle Ford (?): Lamar County, on Red River (type locality).

SOLIDULA FISCHER DE WALDHEIM

Ovate to elongate, thick shell with short, conical spire. Two columellar folds.

Solidula riddelli SHUMARD 1862, **90**, p. 194.

Small, thick, elongate-ovate shell, with short, blunt spire; ornamented with 9–10 revolving, punctate striae.

Navarro: Navarro County (type locality).

RINGICULIDAE Meek

Columellar folds as in *Actaeonidae*, but lacking operculum; mostly subglobose shells; columellar border thick and calloused.

Many species smooth; outer lip greatly thickened .... **Ringicula**
Spirally grooved or punctate; outer lip only slightly thickened; columellar border not thick and calloused
  Inside of outer lip smooth; inner lip with 1 fold ...... **Cinulia s. s.**
  Inside of thickened outer lip crenate; inner lip with 2–4 folds .... **Avellana**

There are other subgenera of *Cinulia*, as: *Ringinella* with the columellar folds often split, and only 1 fold on the inner lip; *Eriptycha* with inside of outer lip crenate. and folds of inner lip replaced by a broad, sometimes toothed ridge; *Oligoptycha* with very low spire, outer lip smooth inside, base of columella with a single prominent plication.

CINULIA Gray

(Genotype: *Auricula globulosa* Deshayes)

Cinulia texana (Shumard) 1860, **39**, p. 597 *(Avellana?)*.

Shell small, globose, spire about one-fifth the total length; outer lip thickened; 22–25 revolving lines on body whorl.

Fredericksburg (with *Exogyra texana* and *Engonoceras pierdenale)*: Bosque County, on Bosque River.

Cinulia tarrantensis Cragin 1893, **21**, 223, pl. XLII, figs. 1–2.

Small shell (12 mm. tall), with 3 whorls; ornamented with about 20 revolving lines; outer lip thickened, not covering penultimate whorl; aperture crescentic, narrowed posteriorly; 3 plicae on thickened inner lip, 2 of them median and 1 anterior.

Upper Walnut: Two and one-half miles east of Benbrook (type locality).

Cinulia washitaensis Adkins 1920, **1**, 143, pl. X, figs. 33–37.

Larger than *C. tarrantensis*, and with the outer lip thicker and covering part of the spire, teeth of inner lip placed more anteriorly.

Weno: Gainesville brickyards (type locality); Denison.

Cinulia pelleti Whitney 1911, **111**, 23, pl. X, figs. 9–11.

Small species, spire about one-sixth the height of shell; about 27 revolving costellae, outer lip not greatly thickened, smooth within, not extended over spire; inner lip with 3 plications placed rather anteriorly.

Buda: Austin (Barton Creek, type locality; types, University of Texas).

Cinulia conradi WHITNEY 1911, **111**, 23, pl. X, figs. 5–7.

Small species, spire about one-eighth the height of shell; about 14 revolving costellae; inner lip with 3 plications, 2 of them placed rather posteriorly.

Buda: Austin (Shoal Creek, type locality; types, University of Texas).

CINULIA RECTILABRUM GABB 1869, Geol. Surv. Calif., Pal. II, 264–265, pl. XXXV, figs. 10–10 a.

Cretaceous: Sierra de las Conchas, Arivechi, Sonora.

RINGICULA DESHAYES

(Genotype: *R. buccinea* BROCCHI, Miocene-Pliocene)

Ringicula pulchella SHUMARD 1862, **90**, p. 192. STEPHENSON 1914, **94**, tables 2 and 8. WADE 1926, **103**, 105, pl. XXXIV, figs. 10–11.

Spire medium, body whorl large with about 16 revolving ridges; aperture narrow, crescentic; outer lip thickened, extended over spire, plicate within; inner lip calloused, with anteriorly placed folds.

Navarro: Chatfield (type locality).

Ringicula subpellucida SHUMARD 1862, **90**, p. 193.

Shell small, smooth, spire elevated; outer lip thickened, prolonged towards spire, crenulated within; inner lip calloused, with 3 plications.

Eagle Ford: Lamar County (bluffs of Red River).

Ringicula acutispira SHUMARD 1862, **90**, p. 193.

Shell small, polished, tall, spire elevated; outer lip with narrow, reflected margin; inner lip calloused, with 2 anterior plications. Is distinguished from *R. subpellucida* by "its greater proportionate length, more acute spire, and by revolving lines of the body volution."

Eagle Ford: Lamar County (bluffs of Red River).

CYLICHNA

Cylichna striatella SHUMARD 1862, **90**, 194.

Shell elongate-ovate, length twice the width, aperture with subparallel sides, narrow above the middle, wider below; surface marked with growth lines and 56–60 distinct revolving striae which are narrower than the interspaces. Length 23 mm., width 12 mm.

Navarro: Navarro County (type locality).

Cylichna secalina SHUMARD 1862, **90**, 195.

Differs from preceding species by its narrow, subcylindrical form, finer striae and smaller size.

Navarro: Corsicana (type locality).

Cylichna minuscula SHUMARD 1862, **90**, 195.

Shell very small, narrowly rounded below, subtruncate above, aperture narrow, outer lip nearly parallel with long axis of shell. Surface with numerous faint striae. Length 4.5 mm., width 2.5 mm., width of aperture 1 mm.

Upper Cretaceous (Eagle Ford): Lamar County near Red River (type locality).

Class CEPHALOPODA

Sub-class TETRABRANCHIATA

Four gills; no ink bag; tentacles without suckers.

Order NAUTILOIDEA Zittel

NAUTILIDAE Owen

CYMATOCERAS HYATT 1875, Genera Foss. Ceph.; HYATT 1894 **60**, 553

Costae pass entirely across the venter. "In the type species, these appear very late in the ontogeny in the ephebic stage, where as in *neocomense* and other species the costations appear earlier in the ananeanic substage. The sutures have slight ventral lobes or saddles with deep lateral and dorsal lobes. There are annular lobes at a very early stage in some species." Genotype: *Nautilus pseudo-elegans* d'Orbigny.

Cymatoceras texanum (SHUMARD) 1860, **88**, 590. SHATTUCK 1903, **86**, 34, pl. XXIII, figs. 1–2 *(Nautilus)*................................**Plate IV, figure 5**

Species becomes rather large; form laterally compressed; flanks slightly convex; umbilicus median; aperture tall oval. The sutures turn slightly forwards from the umbilicus, and after a short distance turn sharply backward describing a symmetrically rounded curve near middle of flank, thence gently forward to venter. Shell ornamented with numerous broad, flat, sigmoid ribs, with narrow, incised interspaces. Shumard compares this species with *Nautilus pseudo-elegans* d'Orbigny, the genotype of *Cymatoceras.*

Entire **Washita Division**; Fort Worth, Weno, Main Street: Tarrant County. Buda: Austin (Shoal Creek). Washita limestone (with *Epiaster elegans* and *Ostrea subovata):* Austin, and Grayson County (type localities).

Cymatoceras hilli (SHATTUCK) 1903, **86**, 35, pl. XXII, fig. 3; pl. XXIV, figs. 3–4 *(Nautilus).*

The septa are more widely separated on the venter, the whorls less tall, and the form generally thicker, than in *Cymatoceras texanum,* and the shell is smooth except for growth lines, while in *C. texanum,* it is ribbed. The sutures turn forward from umbilicus for a short distance, then bend sharply back, describing an asymmetrical curve, thence gently forward with a broad gentle curve to the venter. Shell without ornamentation except growth lines.

Buda: Austin, Shoal Creek (type locality; types in U. S. National Museum).

Cymatoceras elegans (SOWERBY) ROEMER 1852, **78**, 37 *(Nautilus)*. HYATT 1894, **60**, 553, pl. XII, figs. 16–21; on plate has label "Cymatoceras (Naut.) (sp. ?). Texas."

"The large size of the apical chamber is noticeable, and the great distance apart of the first sutures indicates the rapid growth of the young shell. This fact is very interesting since here we also find a high degree of acceleration in other characters. Thus the dorsal furrow appears in the ananepionic substage at a considerable distance from the gyroceran bend and continues after this, as is shown in Fig. 20 (Hyatt 1894, **60**, pl. XII), along the dorsum and is continuous with that of the paranepionic. The costations appear in the neanic stage." (Hyatt).

Cymatoceras simplex (SOWERBY) ROEMER 1852, **78**, 37 *(Nautilus)*. Hyatt 1894, **60**, 554, pl. XII, fig. 28.

"The dorsal furrow is present in this shell both in the metanepionic and the paranepionic substages."

Nautilus n. sp. HILL 1889, **52**, p. 21. Prob.=*Cymatoceras hilli* (Shattuck).

Buda: Austin (Shoal Creek).

EUTREPHOCERAS HYATT 1894, **60**, 555

"This genus includes those forms like the type, *Eutrephoceras Dekayi*, which have globose ananepionic substages, increasing subsequently with great rapidity in all their diameters. The ana- and metanepionic substages are highly tachygenic and these shells have very small, and often hardly perceptible and much flattened, umbilical perforations. The siphuncles are subdorsan from the apex through the nepionic stage in some species, in others this position is not maintained, but the siphuncle is generally in later stages near the dorsum and in the ephebic stages it is dorsad of the center.

"The nepionic stage has longitudinal ridges and transverse bands, the former disappearing in adults, which are smooth. The form of the whorl in section is nephritic from an early age and changes but little throughout life.

"The sutures are almost straight, having but slight ventral lobes, broad ventro-lateral saddles, lobes on the umbilical zones and deep lobes in the zone of impression. There are no annular lobes at any stage of development." Genotype: *Nautilus dekayi* Morton. Upper Cretaceous.

Eutrephoceras dekayi (MORTON) 1833, Amer. Jour. Sci.,Vol. XXXIII, 291, pl. VIII, fig. 4 *(Nautilus)*. HYATT 1894, **60**, 556, pl. XIII, figs. 4–8; pl. XIV, fig. 1. STEPHENSON 1923, **96**, 389, pl. XCVI, figs. 3–4. MEEK 1876, **70**, 496, pl. XXVII, figs. 1 a–e.

"Shell rather small, subglobose, the outermost volution enveloping the others. Sutures rather distantly spaced, with a broad, gentle lateral lobe and an equally broad ventral lobe. In form and in the spacing of the sutures the specimen appears to agree fairly well with the type and with other specimens from New Jersey, as these have been figured by several authors." (Stephenson.)

Navarro: Terrell County, near Kaufman (U. S. Nat. Mus. Cat. No. 20963). Navarro County, near Chatfield (7571 and U. S. Nat. Mus. Cat. No. 21109); near Corsicana (U. S. Nat. Mus. Cat. No. 20873). Hunt County: about 5 miles east of Greenville.

CLYDONAUTILIDAE Hyatt

Hercoglossa *(Enclimatoceras)* is known from the Midway formation in Texas; the only Texan species so far described is *E. vaughani* Gardner. There has been some dispute over the age of the basal Midway: G. Scott 1926, **85**, has claimed that it is of Danian age (which he considers as Cretaceous) though most writers consider it Eocene.

Sub-class DIBRANCHIATA

Order AMMONOIDEA Zittel[23a]

The classification followed is generally that of Hyatt, with some later modifications and revisions introduced by Spath and others.

[23a] Glossary of ammonite terminology:—Form:—*Inflated*, whorls thick from side to side, flanks generally convex. *Compressed*, thin from side to side. *Elevated*, whorl taller than wide. *Depressed*, whorl wider from side to side than tall. *Discoid*, form biconvex in cross-section. *Planospiral*, coiled in one plane. *Venter*, outer edge of normal discoid ammonites, bears siphonal lobe and siphuncle. *Dorsum*, inner edge of volution. *Flanks*, the two sides of volution. Other form terms for irregularly coiled ammonites: scaphitoid, hamitean, turrilitic, crioceran, baculitic, ptychoceran, and others, corresponding to the genera of the same names. Coiling: *Involute*, whorls overlapping over next inner whorls. *Evolute*, open-coiled, but coils in contact, with little or no overlap of whorl on next inner one. *Gyral*, whorls not in contact but forming regular spiral. *Polygyral*, many whorls, with comparatively little overlap. *Oligogyral*, few whorls, with considerable overlap. Umbilicus:—*Concentrumbilicate*, umbilicus regularly increasing in diameter. *Excentrumbilicate*, umbilicus suddenly opening out, or narrowing. *Umbilical ratio (u)*, width of umbilicus (i.e., width of all whorls except outer one) divided by the total diameter. *Angustumbilicate*, u=8 to 17 per cent. *Subangustumbilicate*, u=17 to 34 per cent *Sublatumbilicate*, u=34 to 50 per cent. *Latumbilicate*, u=50 to 66 per cent *Perlatumbilicate*, u=66+ per cent. Venter and ornamentation:—*Carinate*, venter

Artificial Key to Texan Genera of Ammonites[23b]

A. Normal discoid coiling (shell almost a planospiral coil):
  I. No carina
    1. Venter convexly rounded in adult
      Ribs cross venter
        Large inflated ammonites; coarse, sparse ribs..**"Desmoceras"**
        Small ammonites; fine ribs
          Flanks flattened (Texas species).................**Mantelliceras**
          Flanks convex
            Ribs sigmoidal, mostly gently curved.....................
            ....**Dufrenoya; Parahoplites**
            Ribs almost straight
              Long and short ribs in regular alternation........
              .... **Metacalycoceras**
              Long and short ribs irregularly arranged, some
              set at angle to others..................................**Stoliczkaia**
      Ribs do not cross venter
      a. Midline of venter smooth
        Form inflated; venter rounded
          Limonitic micromorphs (Texan species)
            Suture complicated................**Kossmatella; Tetragonites**
            Suture simplified
              Ribs obscure or absent; tubercles absent.........**Flickia**
              Ribs or tubercles present..................................**Adkinsia**
          Macromorphs
            Large species; ribs obsolete....................**Parapachydiscus**
            Small species, ribbed..................................**Douvilleiceras**
        Form compressed, venter truncated or excavated
          Venter excavated, bounded by nodes..............**Metoicoceras**

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with thin, elevated keel. *Fastigate,* venter merely sharpened. *Arched,* venter evenly rounded. *Costate,* strongly ribbed. *Prorsiradiate,* ribs or striate inclined forwards. *Rusiradiate,* inclined backwards. *Sigmoid,* slightly S-shaped. *Sulcus,* radial groove. *Tuberculate,* provided with tubercles. *Spinate,* tubercle high and conical. *Nodate,* tubercle low and blunt. *Bullate,* tubercle elongated transversely, i.e., radially. *Clavate,* tubercle elongated longitudinally., i.e., spirally. Size of shell:—*Macromorphs,* large to giant forms. *Micromorphs,* dwarf forms. Suture:—*Lobe,* inflection which points away from aperture. *Saddle,* inflection which points toward aperture. *Lobule,* small secondary incision, points away from aperture. *Siphonal lobe,* a symmetrical lobe, bifid in discoid forms on the siphuncle (middle of venter). *Antisiphonal lobe,* a symmetrical, frequently trifid, lobe lying on the dorsal mid-line. *Lateral lobes and saddles* lying on each flank between the venter and the dorsum. *Adventive lobes,* secondary lobes formed by subdivision of a primitive lobe in development stages of ammonite. *I. U. L. E. nomenclature,* a system of designating the primitive ammonite lobes (I=internal, antisiphonal; U=umbilical; L=lateral; E=external, siphonal), and their secondary derivatives.

For further details see BUCKMAN: Type Ammonites; and SPATH, Mon. Gault Amm., pt. I, 1923.

[23b]Genera printed in italics in this key have not yet been recorded from Texas.

Venter narrow, not bounded by nodes; form discoid
.... **Placenticeras**

b. Mid-line of venter tuberculate

Mid-ventral tubercle prominent at all stages........
.... **Acanthoceras**

Mid-ventral tubercle reduced or absent in adult

Micromorphs (Texan species)........**Submantelliceras**

Macromorphs ....**Eucalycoceras**

2. Venter acute in some stages, not carinate

Giant species (Texan forms)....................**Parapuzosia**

Medium-sized forms

Saddles generally undivided..............**Engonoceratidae**

Saddles generally divided

One adventive lobe in external saddle; saddles simpler ....*Coahuilites*

Two adventive lobes in external saddle........**Sphenodiscus**

II. Carinate ammonites

Carina nodose or serrate

Carina coarsely serrate..............................**Barroisiceras**

Carina with medium-sized serrations

Ribs fine, numerous..................................**Prionotropis**

Ribs coarser, fewer..................................**Budaiceras**

Carina entire

Whorl elevated, compressed in cross-section

Ribs with obscure or no tubercles

Size large; ribs numerous, curved ....**Oxytropidoceras**

Size medium; ribs fewer, generally straight..**Prionocyclus**

Ribs tuberculate

Three or more rows of tubercles

Whorl very elevated, compressed..............**Mortoniceras**

Whorl trapezoidal, tall; multiple rows of tubercles
.... **Elobiceras**

Whorl quadrate; 3 rows of tubercles........**Pervinquieria**

One or two rows of tubercles

Ribs and tubercles very projecting..............**Dipoloceras**

Ribs not prominent

Ribs sparse..............................*Mammites*

Ribs numerous ....**Prohysteroceras**

Whorl depressed

Keel depressed below shoulder tubercles......**Neokentroceras**

Keel not depressed..................................**Pervinquieria**

B. "Phylogerontic" ammonites (partly uncoiled, or coiling not discoid)

1. Coiled or bent in one plane

No initial coil; limbs straight, mainly ribbed

Two limbs, one elbow
  Limbs in contact; some species nearly smooth .... *Ptychoceras;* **Oxybeloceras**
  Limbs not in contact; all ribbed (Necomian) .... *Hamulina*
Three limbs, two elbows
  Limbs in contact, with deep impressed zone
    Suture simpler .... *Mastigoceras*
    Suture complicated .... *Diptychoceras*
  Limbs not in contact, ribbed; occasionally 4 limbs, 3 elbows .... **Hamites**
Planospiral coil; initial volution in contact, later ones free
  Discoid portion small (usually not preserved)
    An open coil, ribbed, usually tuberculate .... **Crioceras**
    Straight limb, oval in cross-section
      Lateral lobes bifid .... **Cyrtochilus; Baculites**
      Lateral lobes trifid .... *Bochianites*
    An open coil followed by a straight limb ending in a hook (crosier); tubercled or spined .... **Ancyloceras;** *Tonoceras*
  Discoid portion prominent
    Shells ribbed
      Suture complicated (lytoceran) .... *Macroscaphites*
      Suture simpler (scaphitic) .... **Scaphites;** *Yezoites*
    Shells not ribbed; first lobe pointed.... **Worthoceras n. gen.**

2. Coil or inflections not in one plane
  Coil not a tight turrilitic spire
    Coil an open, regular spiral .... **Helicoceras**
    Straight or slightly curved limbs (like *Hamites)* but coiling out of plane .... **Anisoceras**
    Coiling erratic, serpuloid .... *Nipponites*
  Coil, at least in initial or central portion, a tight, turrilitic spire
    Initial portion a tight conical spire
      Terminal (apertural) portion of shell uncoiled
        Later stage irregular, extended; siphon in middle of volution .... **Bostrychoceras**
        Later stage a free limb, ending in hook .... *Heteroceras*
      Terminal portion not uncoiled; siphon near overlap .... **Carthaganites; Turrilites**
    Initial portion irregular; central (ephebic) portion a conical spire; terminal portion uncoiled (or else unknown)
      Shell faintly ribbed; 3 rows of tubercles; like *Turrilites* except that initially is an extended limb.... **Wintonia n. gen.**
      Shell ribbed
        Three tubercles per rib; gerontic stage like *Ptychoceras* .... *Helicancyclus*

Tight spiral; living chamber upturned... **Nostoceras; Exiteloceras**
Loose spiral (coils not in contact)
Early stage unknown; living chamber upturned (retroversal) .... *Didymoceras*
Early stage two straight (hamitic) limbs; terminal stage unknown (possibly limbs extended straight) .... *Emperoceras*

LYTOCERATIDAE

(1) KOSSMATELLA JACOB 1907

Genotype: *Ammonites agassizi* PICTET.
Kossmatella sp. aff. **marut** (STOLICZKA) ADKINS 1920, **1**, 51.
Pawpaw: Near Fort Worth. In India, *K. marut* occurs in the Lower Utatur beds (Albian).

(2) TETRAGONITES KOSSMAT

Genotype: *Ammonites timotheanus* PICTET ET ROUX.
No grooves.. **T. brazoensis Böse**
Tangential grooves present.................................... **T. timotheanus**

Tetragonites brazoensis BÖSE 1928, **10**, 203, pl. I, figs. 2–7.
Shell small (about 11 mm. diameter), smooth, angustumbilicate.
Del Rio clay: McLennan County (type locality).

Tetragonites zacatecanus BÖSE.
Upper Albian: Opal, Camacho (Zacatecas).

BACULITIDAE

Shells starting with a close coil (small, usually not preserved), and thereafter straight.

Aperture directed forwards; lip with lateral sinuses directed backwards; the projection of its siphonal margin straight and its antisiphonal margin convex in outline; interior without regularly disposed ridges.................................... **Baculites**
Aperture opening towards antisiphonal side; lateral sinuses of lip excavated towards siphonal side; projection of siphonal margin of lip abruptly arching over the aperture, and antisiphonal margin of lip deeply sinuous instead of convex in outline; interior with regularly disposed ridges, leaving oblique constrictions on internal casts.................................... **Crytochilus**

BACULITES[24] LAMARCK

Aperture directed forwards, not obstructed by lip; antisiphonal margin convex. Genotype: *B. vertebralis* Lamarck.

Baculites annulatus SHUMARD 1856, Proc. Acad. Nat. Sci. Phila., for 1854–1855, p. 265.

Upper Cretaceous: Dallas County (type locality) (probably **Eagle Ford**).

Baculites asper MORTON 1834. ROEMER 1849, **77**, 416. ROEMER 1852, **78**, 36, pl. II, figs. 2 a–d. MEEK 1876, **70**, 404, pl. XXXIX, figs. 10 a–d. LASSWITZ 1904, **67**, p. 15.

Cross-section trapezoidal-oval, narrowed ventrally. Casts laterally with strong, crescentic widely spaced swellings or short ridges; ventrally with lines of growth strongly bent towards aperture.

Austin chalk: New Braunfels, falls of Guadalupe River; Cibolo Creek crossing of New Braunfels-San Antonio road; Austin (Travis Heights).

Baculites anceps LAMARCK. ROEMER 1849, **77**, 416. ROEMER 1852, **78**, 36, pl. II, figs. 3 a, d–g, not figs. 3 b–c. MEEK 1876, **70, 406.** LASSWITZ 1904, **67**, p. 15.

Casts with numerous lateral crescentic swellings, smaller, more closely spaced and more numerous than in *B. asper*.

Austin chalk: New Braunfels, falls of Guadalupe River; Cibolo Creek crossing of New Braunfels-San Antonio road.

Baculites aspero-anceps LASSWITZ 1904, **67**, 16, pl. III, figs. 1 a–b. ROEMER 1852, **78**, 36, pl. II, figs. 3 b–c only. SPATH 1921, Cret. Ceph. Zululand, Ann. S. Afr. Mus., XII, pt. VII, no. 16, p. 259, pl. XXIV, figs 4–4a.

Cross-section oval, but more compressed ventrally. Young has form of *B. anceps* with numerous nodes, adult stage has fewer, rounded nodes like *B. asper*. Coarse ribs are present only laterally and dorsally; on venter, lines of growth are sharply convex towards the aperture.

Austin chalk: Austin (type locality; 3 cotypes in University of Breslau).

Baculites gracilis SHUMARD 1860, **89**, 596........**Plate XXIV, figure 3**

Shell slender, cross-section broadly ovate to subcircular; some individuals nearly smooth, but most have "moderately prominent.

[24]Baculites: Brown, A. P., 1891. On the young of *Baculites compressus* Say Acad. Nat. Sci. Phila., Proc. 1891, 159–160, and Nautilus, 5, 19–21. Brown, A. P. The development of the shell in the coiled stage of *Baculites compresus* Say. Acad Nat. Sci. Phila., Proc., 1892, 136–141.

Meek: Inv. Pal. Mo.: 1876, 391–408, pl. 20, 33, 39.

rounded costae which on the dorsum are distinct and arched towards the aperture, and on the sides curve obliquely backwards and downwards to the ventral margin, before reaching which they become nearly obsolete" (Shumard interchanged "dorsal" and "ventral" in this description).

Eagle Ford: Grayson County, Shawnee Creek (type locality). (?)

Baculites ovatus SAY. MARCOU 1853, Geol. Map. U. S. and British Provinces (etc.), p. 46, pl. VII, fig. 5. BOYLE 1893, U. S. Geol. Surv. Bull. 102, p. 62.

Cretaceous: Texas (Taylor marl?).

CYRTOCHILUS MEEK 1876

Lip margin on siphonal side arches over aperture, and on antisiphonal side is indented into a sinus. Genotype: **B. baculoides** Mantell.

Cyrtochilus (?) **comanchensis** (ADKINS) 1920, **1**, pl. II, figs. 20–22 *(Baculites)*..**Plate XX, figure 9**

Straight, tapering fragments, cross-section ovate; low, transverse, evenly rounded, annular swellings, tallest on venter and ventral half of sides, faint on dorsum. Aperture unknown, generic assignment therefore doubtful.

Pawpaw: About 4.5 miles south of Fort Worth (type locality); elsewhere in Tarrant County.

Cyrtochilus aff. **baculoides** (MANTELL) BÖSE 1928, **10**, 210, pl. III, figs. 11–14; pl. IV, figs. 3–11.

Possibly identical with the preceding species.

Del Rio: McLennan County (numerous localities).

HAMITIDAE Hyatt

"A provisional group of uncoiled shells having single costae crossing the venter uninterruptedly, and no tubercles at any stage" (HYATT). Several tuberculate Texan species, not yet critically studied, are included here.

HAMITES PARKINSON

Ribbed shells with 2 (rarely 3 or 4) straight or somewhat curved limbs, recurved but not in contact; suture simple, with 2 lateral lobes (6 lobes in all). Limb fragments generally found. Genotype: *H. attenuatus* Sowerby (fig. in D'Orbigny, Pal. Franç., Terr. crét., Céph., pl. CXXXI, figs. 9–13); it lacks tubercles; some of the Texas species, currently referred to *Hamites,* are tuberculate, and upon further study, may be placed in other genera.

Large species, calcareous preservation
  Tubercles lacking
    Ribs lacking..**H. nokonis**
    Ribs dissimilar..**H. adkinsi**
  Tubercles present
    Tubercles of every third or fourth rib more prominent..**H. fremonti**
    Tubercles equal, similar, on all ribs
      Ribs oblique; cross-section oval......................................**H. larvatus**
      Ribs transverse
        Cross-section subcircular..................................**H. comanchensis**
        Cross-section hexagonal...**H. tanima**
Dwarf species, mainly limonitic micromorphs
  Cross-section ovate
    Ribs prominent, with tubercles...**H. varians**
    Ribs less prominent, no tubercles; sutures more crowded; shell diameter increases rapidly..............................**H. polyseptus**
  Cross-section subcircular
    Ribs faint...**H. sp. (Eagle Ford)**
    Ribs prominent...**H. tenawa**

Hamites adkinsi SCOTT 1928, Jour. Pal., pl. II, figs. 10, 13.

Megalomorph, calcareous; two limbs preserved, practically parallel, cross-section elongate oval; numerous, unequal, fine and coarse, non-tuberculate ribs.

Middle Comanche Peak: One mile west of Valley Mills, Powers place (type locality).

Hamites nokonis ADKINS AND WINTON 1920, **3**, 39, pl. VI, figs. 5–6..**Plate XII, figure 2**

Straight fragments found; tall oval cross-section; ribs straight, transverse, crowded, equal, and non-tuberculate.

Basal Duck Creek: One-half mile north of Texas Christian University, Fort Worth (type locality; holotype in Bureau of Economic Geology).

Hamites fremonti MARCOU 1858, **68**, 36, pl. I, fig. 3. ADKINS AND WINTON 1920, **3**, 40, pl. VI, fig. 3. HILL 1901, **57**, pl. XXXV, fig. 3..**Plate VI, figure 2**

Straight or hook-shaped fragments found; every third or fourth rib bears a more prominent pair of tubercles. The generic assignment of this species is uncertain; HYATT (1894, **60**, 577) suggests that it may be the gerontic stage of *Exiteloceras*.

Duck Creek: Grayson County, Preston (type locality; holotype British Museum Natural History, South Kensington, BM 12667; plaster replica in Bureau of Economic Geology). Denison; Fort

Worth; near Waco; Fort Stockton; 17 miles northeast of Alpine on the Fort Stockton road. A widespread and important marker of the basal Duck Creek formation. **Kiamichi:** Rare, North-Central Texas, and Fort Stockton region.

Hamites larvatus CONRAD 1855, **16**, p. 265. CONRAD 1857, **18**, 165, pl. XXI, fig. 8.

Fragment nearly straight; ribs numerous, similar, oblique, obsolete dorsally, with one tubercle on either side of the venter.

Horizon unknown: Conrad reports it from Leon Springs [Pecos County], and from White River, Arkansas; Dallas County (type locality).

Conrad's description.—H. larvatus. Ovate-oval, obliquely ribbed; back rounded, the opposite side truncated; ribs obsolete on the back, prominent and acute laterally, and increasing in elevation alternately towards the back, where they are truncated and form two series of salient angles or tubercles; intermediate rib nearly equal in size, rounded on the submargin of the back entire. A cast.

Locality: Dallas County.

Horizon unknown (Upper Cretaceous?): Dallas County (type locality); Leon Springs, Pecos County; White River, Arkansas (CONRAD).

Hamites rotundatus CONRAD 1855, **16**, p. 266.

Conrad's description.—H. rotundatus. Rounded, ribs distant, acute, the intervening spaces regularly and profoundly concave; back flattened, with the ribs obsolete and three indistinct longitudinal lines. A cast.

Locality: Dallas County.

Horizon unknown, possibly Upper Cretaceous.

Hamites comanchensis ADKINS AND WINTON 1920, **3**, 38, pl. VI, fig. 10..**Plate XII, figure 4**

Fragments broadly curved; ribs only slightly oblique, similar; cross-section nearly circular, while that of *H. larvatus* Conrad seems to be oval.

Basal Duck Creek: About 5 miles southeast of Fort Worth (type locality; holotype in Bureau of Economic Geology); widespread in North-Central Texas; near Fort Stockton; Sierra de Tamaulipas, southern Tamaulipas, Mexico.

Hamites tanima ADKINS AND WINTON 1920, **3**, 41, pl. VI, figs. 1–2.

Calcareous preservation; shell prominently curved, cross-section subhexagonal, with distinct, rather distant ribs, obsolete over dorsum, bearing 3 rows of tubercles, one of them on the ventral midline; small secondary ribs are present.

Duck Creek: One-half mile north of Texas Christian University, Fort Worth (type locality; holotype in Bureau of Economic Geology).

Hamites tenawa ADKINS AND WINTON 1920, **3**, 43, pl. VI, fig. 4 .... **Plate XX, figure 14**

Micromorph, with subcircular cross-section; prominent ribs, practically without tubercles.

Basal Pawpaw: northern Tarrant County, near Blue Mound (type locality; holotype in Bureau of Economic Geology); 714 and other localities near Fort Worth. **Weno:** near Fort Worth (rare).

Hamites varians SCOTT 1924, **84**, 14, pls. I–III; pl. IV, figs. 1, 2, 4, 7, 9; pl. VII, figs. 3–4; pls. III; pl. IX, figs. 1, 3–5, 7 .... **Plate XII, figure 5**

Micromorph, with oval cross-section and variable, generally prominent, ribs and tubercles.

Duck Creek (marl above *Desmoceras* zone): Duck Creek type locality, about 2½ miles north of Denison near Frisco track (type locality; types at Texas Christian University); Fink; Fort Worth region. The species is abundant at many localities.

Hamites polyseptus SCOTT 1924, **84**, 17, pl. IV, figs. 3, 5–6, 8; pl. IX, fig. 2.

Micromorph, with oval cross-section and obscure ribs lacking tubercles; shell diameter increases rapidly.

Duck Creek (marl above *Desmoceras* zone): Grayson County, Duck Creek type locality (type locality; types in Museum of Texas Christian University).

Hamites (?) sp.

Micromorph, straight limb fragments; ribs numerous, transverse, subequal, faint on venter, tubercles reduced.

Eagle Ford (top of middle flag member): about 5 miles southwest of Waco.

HELICOCERAS D'ORBIGNY

Shell an open, regular spiral; most species ribbed or (and) tuberculate. Genotype: *H. annulatum* d'Orbigny. Cretaceous.

Helicoceras (?) navarroense (SHUMARD) 1862, **90**, 190. HILL 1889, **52**, 23. HYATT 1894, **60**, 572. WADE 1926, **103**, 184, pl. LXI, figs. 8–11; pl. LXII, figs. 1–2.

Shell large, dextral and sinistral, composed of distant, free, convex volutions; last volution rounded, gradually enlarging to within a short distance of the aperture, where it becomes suddenly expanded and flattened above and below; dorsum ornamented with two revolving series of prominent nodes, one series situated near the middle and the other near the base of the volution. On the anterior third of the volution the nodes are flattened, and the inferior ones project obliquely downwards and forwards. The nodes of one series usually alternate with those of the other, but sometimes they are nearly opposite. The surface is likewise marked with prominent, rounded, oblique annular costae, which are indistinct on the ventral side, and frequently bifurcate at the nodes."

Total height of spire (estimated), 150 mm., diameter of base, 87 mm., diameter of last volution, near aperture, 30 mm.

Navarro: Chatfield Point (type locality). Associated with *Oxybeloceras texanum* (Shumard).

Heteroceras sp. (Escondido), see **Bostrychoceras.**

ANISOCERATIDAE Hyatt

"Two rows of tubercles on either side the median line of the venter; costae large and single, or imperfectly bifurcate and may cross the venter. . . The adult *Anisoceras* has a Helicoceran aspect, develops a long eccentric *Toxoceras*-like volution in the gerontic stage, and terminates with a retroversal bend or crook." (Hyatt.)

Aniscoceras sp. aff. **armatum** (SOWERBY). ADKINS 1920, **1**, p. 69. SPATH 1922, Angola, p. 151. SPATH, Ann. Transv. Mus., 1925, p. 190, pl. XXXIV, fig. 3; pl. XXXV, figs. 4–5; pl. XXXVI.

Limonitic micromorph, two lateral and two ventro-lateral rows of tubercles.

Basal Pawpaw: Locality 714, near Fort Worth.

NOSTOCERATIDAE Hyatt 1894, **60**, 568

An artificial group of American Cretaceous ammonites with unsymmetrical spirals in the ephebic stages, more or less prominent costae, and two rows of tubercles on the venter. Extreme gerontic stage often retroversal, the return being in some cases complete, so that the aperture is brought close against the base of the spire.

The family includes: *Nostoceras, Didymoceras, Emperoceras, Exiteloceras, Bostrychoceras, Diplomoceras, Oxybeloceras* and *Neocrioceras.*

NOSTOCERAS HYATT

A true turrilite in the ephebic stage, with two rows of ventral tubercles; final stage of shell free, eccentric and recurved. Genotype: *N. stantoni* Hyatt (Navarro, Chatfield).

Nostoceras stantoni HYATT 1894, **60,** 570.
Navarro: Chatfield, Navarro County (type locality; types in United States National Museum).

Nostoceras stantoni var. **retrosum** HYATT 1894, **60,** p. 570.
Navarro: Chatfield, Navarro County (type locality; types in United States National Museum).

Nostoceras stantoni var. **prematurum** HYATT 1894, **60,** p. 570.
Navarro: Chatfield, Navarro County (type locality; types in United States National Museum).

Nostoceras stantoni var. **aberrans** HYATT 1894, **60,** 572.
Navarro: Chatfield, Navarro County (type locality; types in United States National Museum).

Nostoceras helicinum (SHUMARD).
Turrilites helicinus SHUMARD 1862, **90,** 191.
Turrilites helicinus SHUMARD. HILL 1889, **52,** p. 23.
Nostoceras helicinum HYATT 1894, **60,** p. 573.
Navarro: Chatfield Point, and Corsicana (type localities).

EXITELOCERAS HYATT 1894, 60, p. 576

Young has single costae with two lines of tubercles. Ephebic stage helicoceran; gerontic stage with retroversal living chamber. Genotype: *Ancyloceras jenneyi* WHITFIELD. Upper Cretaceous.

Exiteloceras angulatum MEEK. HYATT 1894, **60,** p. 577.
"Very prominent, subacute, single costae reaching completely around the whorl, each costa having two tubercles on the venter with a slight depression on the prominent costation between them."
Horizon: uncertain. Locality: Elm Fork, Dallas County.

Exiteloceras pariense (C. A. WHITE)............**Plate XXVI, figure 3**
Helicoceras pariense WHITE, U. S. Geol. Surv. W. 100th Mer. (WHEELER), Pal., 203, pl. XIX, fig. 2. MOREMAN 1927, **73,** 95, pl. XIV, fig. 3. HYATT 1894, **60,** p. 577.
Eagle Ford: Three miles northwest of Midlothian; near Austin.

Exiteloceras fremonti (MARCOU). See **Hamites fremonti.**

OXYBELOCERAS HYATT

HYATT 1900, in Zittel-Eastman Handbook, p. 588. Genotype: *Ptychoceras crassum* WHITFIELD.

Oxybeloceras texanum (SHUMARD) 1862.
Ptychoceras texanum SHUMARD 1862, **90**, VIII, 190.
Ptychoceras texanus HILL 1889, **52**, p. 23.
Ptychoceras texanum HYATT 1845, **60**, p. 580.

Two straight, ribbed limbs, the smaller one initially free, but later closely appressed against the terminal larger limb. Ribs (annular costae) wider than intervening spaces, slightly oblique, with a node on each side of venter. Gerontic umbilical perforation larger and wider proportionately than in *Oxy. crassum*.

Navarro: Chatfield Point, and Corsicana (type localities).

WINTONIA new genus

Turriliticones having initial stage extended, apparently hamitean, and the body portion a tight turrilitic spiral with three rows of tubercles lying on inconspicuous ribs. Genotype: *Wintonia graysonensis* n. sp.

Wintonia graysonensis n. gen., n. sp.........**Plate XXIII, figures 7–9**
Limonitic micromorph; small, tall, tight-spired turriliticone, ribbed and tuberculate on body portion. Initial portion (broken) consists of an extended, smooth limb, grooved on the inner side, and septate. It passes into a tight, ribbed, tuberculate spiral with prominently convex sides, deep sutures, narrow, inconspicuous ribs and on the ribs three rows of tubercles. The two upper rows of tubercles bound a projecting shelf which occupies the middle of the volution; below it is a narrow, spiral depression, beneath which at the overlap there is a third row of somewhat smaller tubercles. Aperture unknown; broken portion suggests a typical *Turrilites*. Suture unknown.

The species somewhat resembles *Hyphantoceras* Hyatt,[25] but that genus has two rows of tubercles, is mostly loosely coiled, and does not seem to have a hamitic initial stage. It has generally greater resemblance to forms included in the family Nostoceratidae (Hyatt, *ibid.*, p. 558), which has one row of tubercles on each side of the venter, a hamitic initial portion in some genera, and a retroversal terminal portion in some genera. It suggests *Emperoceras* in this feature of a hamitic initial portion, but differs in costation and in tuberculation. Its exact family assignment awaits better preserved material.

Grayson: Denton County, Grayson bluff, east of Roanoke (type locality). Holotype and two figured individuals (of doubtful identification) in Museum of Texas Christian University.

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[25]Hyatt, in Zittel-Eastman, Textbook of Paleontology, London, 1900, p. 587. Genotype: *Heteroceras reussianum* d'Orbigny, Schlüter, Ceph. ob. deutsch. Kr., pl. XXXII, fig. 13–21; pl. XXIII, fig. 1.

BOSTRYCHOCERAS HYATT 1900

Coils as a turrilitic spire, with the apertural end becoming free and recurved; siphon in middle of volution. Genotype: *B. polyplocum* (ROEMER). Upper Cretaceous.

Bostrychoceras n. sp. aff. **polyplocum** (ROEMER)..............................**Plate XXXVII, figures 1, 3**

Large, fine-ribbed shell with terminal portion recurved; suture not seen.

Escondido: Near D'Hanis.

TURRILITIDAE Meek

Hyatt's diagnosis (HYATT, in Zittel-Eastman, 1900, p. 587).—Turriliticones having more or less angulated volutions, with two rows of tubercles on either side of the median line of the venter. Shells close-coiled from the earliest stage, or with only a slight eccentric deviation in old age; often partially costate, and sometimes with only three rows of tubercles in older stages. Aperture much elongated transversely, and contracted in extreme age of *Turrilites* by ingrowth of the right side. Costae continuous across the venter or interrupted by a smooth zone, and either single or divided between the rows of tubercles. The family includes *Turrilites* and *Ostlingoceras.*

TURRILITES LAMARCK

Turreted shells with volutions completely in contact at both ends, and more or less angulated; siphon at or near the line of overlap of volutions; three, or else four, rows of tubercles; rarely ribbed.

Genotype: *T. costatus* LAMARCK. Albian-Cenomanian; a few species in the Upper Cretaceous.

Turrilites brazoensis ROEMER 1852, **78,** 37, pl. III, fig. 2. LASSWITZ 1904, **67,** 13, pl. II, fig. 2. HILL 1901, **57,** pl. XXXVII, fig. 3 a. ADKINS AND WINTON 1920, **3,** 45, pl. VII, figs. 14–15. BÖSE 1928, **10,** 199, pl. I, fig. 1..............................**Plate XXI, figure 10**

Largest American species of the genus; four rows of tubercles, two making a flat band which is separated by a groove from the other two.

Main Street and **Grayson:** West of Aquilla, Hill County, i.e., about 30 miles up the Brazos from Torrey's Trading House (type locality; holotype in Geological Museum, University of Bonn); Central Texas from Red River to San Antonio; rare or unknown in West Texas.

Turrilites wysogorskii LASSWITZ 1904, **67,** 15, pl. I, fig. 5.

Calcareous preservation; four rows of tubercles nearly equally strong and equally spaced, making a prominent truncated band.

Species has great similarities to *T. bergeri* as figured in d'Orbigny, Pal. franç., terr. crét., Céph., pl. CXLIII, fig. 3.

Buda: Shoal Creek, Austin (two cotypes, University of Breslau).

Turrilites roemeri WHITNEY 1911, **111**, p. 24, pl. XII, fig. 203.

Calcareous preservation; conical species, apical angle 49°. Four rows of tubercles, three of them small and covered by overlap; one row large, in middle of volution.

Buda: Shoal Creek, Austin (holotype, University of Texas).

Turrilites worthensis ADKINS AND WINTON 1920, **3**, 44, pl. VII, figs. 10, 11, 13 .... **Plate XXI, figure 1**

Limonitic micromorphs; volution rounded, four rows of tubercles on flank and base of the last volution, one row being diminutive; a broad space above the superior row of tubercles and below the overlap.

Pawpaw: Locality 714, near Fort Worth (type locality; holotype in Bureau of Economic Geology). **Grayson-Del Rio:** Grayson, Tarrant, and McLennan counties.

Turrilites bosquensis ADKINS 1920, **1**, 76, pl. III, figs. 3, 7. SCOTT 1926, **85**, 147, pl. III, figs. 5–6. BÖSE 1928, **10**, p. 206, pl. I, figs. 8–23; pl. II, figs. 2–18; pl. III, figs. 4–10; pl. IV, figs. 1–2 .... **Plate XXIII, figure 12**

Limonitic micromorphs; four rows of prominent tubercles, of which the row nearest the umbilicus is small; the other three rows form a prominent projecting truncated band with angular shoulders. The species has some resemblance to *T. acutus* Passy, which however has three rows of tubercles.

Del Rio-Grayson: McLennan County (type locality); Bell County. Holotype in Bureau of Economic Geology.

Turrilites peramplus LASSWITZ 1904, **67**, 14, pl. II, figs. 1 a–b.

Conical species with wide apical angle; three (?) rows of tubercles; calcareous preservation.

Austin Chalk: Austin (two cotypes in Museum, University of Breslau).

Turrilites n. sp. aff. **costatus** LAMARCK .... **Plate XXIV, figure 7**

Middle Flag Member of **Eagle Ford:** Bell County.

Turrilites n. sp. aff. **desnoyersi** D'ORBIGNY .... **Plate XXIV, figure 6**

Middle Flag Member of **Eagle Ford:** Bell County.

Turrilites hilli WINTON AND SCOTT 1922, Univ. Texas Bull. 2229, p. 27 *(nomen nudum)*.

Pawpaw: Johnson County.

Turrilites splendidus SHUMARD 1862, **90,** 191. HILL 1889, **52,** p. 23.
Spire sinistral or dextral, very much elevated, apical angle 23°, volutions about 10, strongly rounded, suture deeply excavated; aperture subcircular. Surface with simple or bifurcated ribs, 24–28 on last volution, oblique on whorl, near suture bend forwards; each rib has two small elongated tubercles, one near inferior edge and one near middle. Length 42 mm.; diameter of last volution 14 mm.
Navarro: Chatfield Point, and near Corsicana (type localities).

Turrilites irridens SCHLÜTER 1887, **83.**
Eagle Ford? (HILL): Austin.

Turrilites tridens SCHLÜTER 1887, **83.**
Eagle Ford? (HILL): Locality uncertain.

Turrilites varians SCHLÜTER 1887, **83.**
Eagle Ford? (HILL): Austin.

Carthaganites (?) sp.
Buda: Austin.

ANCYLOCERATIDAE Hyatt 1900, emend. Whitehouse 1925

"Includes only such forms usually assigned to *Ancyloceras Crioceras*, etc., as have three rows of tubercles on either side of the larger costae. Between the latter are smaller costations without tubercles. Costae sometimes interrupted across the venter by a smooth zone." (HYATT, in Zittel-Eastman, 1900, p. 587.)

ANCYLOCERAS D'ORBIGNY

Genotype: *A. dilatatum* D'ORBIGNY.
Ancyloceras bendirei ADKINS 1920, **1,** 70, pl. II, fig. 1.
Coiled portion unknown; fragments consist of most of long limb and of hook connected with shorter thick limb. Superficially resembles *A. matheronianum* d'Orbigny, but differs in having only two rows of spines on each side, mid-lateral and sub-ventral, instead of three, and in details of suture.
Weno: Near Fort Worth (type locality; holotype in Bureau of Economic Geology).

Ancyloceras (?) annulatum SHUMARD 1860, **89,** 595. WHITE 1883, **106,** 39, pl. XVIII, fig. 10.
White's figure shows a small ribbed ammonite of the shape of this genus; suture unknown; generic assignment uncertain.

Eagle Ford: Shawnee Creek, Grayson County (type locality). Shawnee Creek, except perhaps at the very headwaters, does not contain Eagle Ford.

Ancyloceras (?) *texanum* HILL 1889, **53**, p. 6, pl. III, as *Crioceras (Ancyloceras) texanus.*

According to Hill (1889, **52**, p. 21) Hyatt considered this species to be identical with *Lituites bickmoreanus* Whitfield, a nautiloid species originally found in the Niagara limestone of Wabash, Ind., and Hill for that reason withdrew it from the list of Cretaceous species. Length, 8½ inches; breadth, 6 inches; diameter of largest end, 2½ inches.

Locality: Said to be near Fort Washita, Bryan County, Oklahoma.

Position uncertain:

FLICKIDAE new family

Non-carinate, smooth or faintly ribbed, coiled ammonites with simplified sutures, having entire lobes and saddles. Albian-Cenomanian.

Species smooth, rather flattened..**Flickia**

Ribbed or tuberculate, thicker volution..............................**Adkinsia**

FLICKIA PERVINQUIÈRE

Genotype: *Flickia simplex* PERVINQUIÈRE.

Flickia boesei ADKINS 1920, **1**, 85, pl. I, figs. 1–3. BÖSE 1928, **10,** p. 233..**Plate XXI, figures 5–6**

Pawpaw: South of Riovista (type locality; holotype in Bureau of Economic Geology).

ADKINSIA BÖSE 1928, 10, 232

Genotype: *Adkinsia adkinsi* BÖSE.

Adkinsia adkinsi BÖSE 1928, **10**, p. 237, pl. VIII, figs. 3–14.

Suture slightly angular; faint tubercles and ribs. "It differs from all the other species through its compressed form, its narrow umbilicus, the very inconspicuous ornamentation, and the outline of the suture."

Del Rio: McLennan County. Locality 966, 4.5 miles south of McGregor (type locality; holotype in Bureau of Economic Geology).

Adkinsia sparsicosta BÖSE 1928, **10**, p. 238, pl. VIII, figs. 15–20.

"The narrow ribs, which in a later stage cross the venter, are not found in any other species; the umbilicus is much wider than in *A. adkinsi;* the suture is more rounded than that of most other species and the straight bottom of the second lateral lobe is very characteristic. The general form of the shell is less inflated than *A. bosquensis* or *A. tuberculata*, but much more so than in *A. adkinsi*."

Del Rio: McLennan County, locality 966 (type locality; holotype in Bureau of Economic Geology).

Adkinsia tuberculata Böse 1928, **10**, p. 240, pl. VIII, figs. 21–26.

External saddle and first lateral lobe narrower than in *A. bosquensis*.

Del Rio. McLennan County, locality 964 (type locality; holotype in Bureau of Economic Geology).

Adkinsia bosquensis (Adkins)........................**Plate XXIII, figure 6**

Flickia (?) *bosquensis* Adkins 1920, **1**, 87, pl. I, fig. 4; pl. IV, fig. 11. Böse 1928, **10**, p. 242, pl. IX, figs. 1–6.

"Differs from *A. tuberculata* by its more prominent tubercles, its broad triangular ribs, lower external saddle and shallower lobes. It is much more distinct from all other species described here, in ornamentation as well as in dimensions and sutural elements."

Del Rio: McLennan County, 5 miles west of Waco (type locality; holotype in Bureau of Economic Geology); several other localities.

Adkinsia semiplicata Böse 1928, **10**, 246, pl. IX, figs. 7–12.

"Sutural elements very low, and appear much broader than in other species. With the exception of the siphonal lobe and the external saddle, they have a decidedly angular outline, which distinguishes the species from all others. *A. adkinsi* has also rather angular lobes and saddles but they are asymmetrical, while in *A. tuberculata* they are practically symmetrical."

Del Rio: McLennan County, locality 966 (type locality; holotype in Bureau of Economic Geology).

Position uncertain:

WORTHOCERAS new genus

Initial portion a planospiral coil, followed by a straight limb, which connects by a bend to a shorter and thicker straight limb subparallel to the first but not touching it. Ribs and tubercles reduced or absent. Suture simplified. Genotype: *Macroscaphites platydorsus* Scott 1924.[26]

As figured by Scott, the suture of *M. platydorsum* has the quadrate siphonal lobe prominently divided by a simple saddle, the lobules being entire; first and second saddles equal, each broader than

[26]Scott, Gayle, 1924. Some gerontic ammonites of the Duck Creek formation. Texas Chr. Univ. Quart., Vol. 1, No. 1, p. 18, pls. V, VI; pl. IX, fig. 6.

siphonal lobe, and each subsymmetrically bifid but devoid of secondary incisions; first and second lateral lobes simple, half as wide as saddles; third saddle undivided; antisiphonal lobe small, triangular, undivided. The suture of a related species, *Worthoceras worthense,* is here figured; the antisiphonal lobe of this species is trifid with an elongated central lobule.

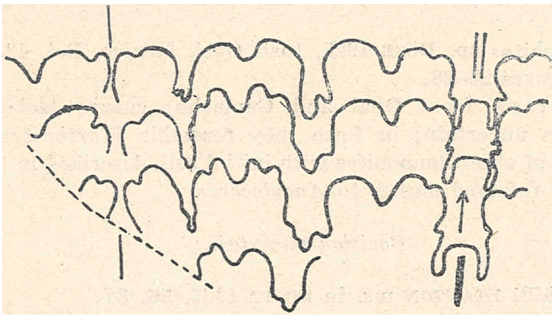

Figure 1. Suture of *Worthoceras worthense* (ADKINS), camera lucida drawing, × 15.

The simplification of the suture recalls *Mastigoceras* Böhm, which however has the shape of *Diptychoceras* Gabb (three straight, appressed limbs, two elbows). The general form of *Worthoceras* is that of *Scaphites, Macroscaphites,* or close-coiled *Ancyloceras,* but the suture forbids reference to these genera. The simplified sutures of *Mastigoceras* and *Worthoceras* recall those of *Flickia* and *Adkinsia,* themselves of unknown affinities, but differ generally in having the saddles divided.

Worthoceras platydorsum (SCOTT) 1924, **84,** 18, pls. V, VI; pl. IX, fig. 6 .... **Plate XII, figures 1, 3**

Small limonitic micromorph; small coil; long limb enlarging rather rapidly, septate over half its length; hook and short limb thick; dorsum flat or even slightly excavated; venter rounded; ribs faint, practically obsolete; no tubercles.

Upper Duck Creek: Grayson County, on Duck Creek about 3 miles north of Denison (type locality; holotype in Museum of Texas Christian University).

Worthoceras worthense (ADKINS) 1920, **1,** 71, pl. II, figs. 23–26 *(Hamulina).* SCOTT 1924, **84,** pp. 18–19 *(Macroscaphites)* .... **Plate XX, figure 8**

Larger and more slender than the preceding species; the venter is more clearly marked into longitudinal facets; the suture is more complicated, particularly in the greater subdivision of the saddles. The coiled initial portion has not been found, but there is a groove into which such a coil would fit; the form and suture make reference to this genus fairly certain. Limonitic micromorphs.

Pawpaw: Locality 714, Sycamore Creek near Fort Worth (type locality); several other Tarrant County localities.

Scaphites vermiculus SHUMARD 1860, **90,** 594 *(q. v.)*. The form of this species strongly suggests *Worthoceras*, but in the absence of the suture generic assignment remains impossible. Horizon: **Eagle Ford.**

Macroscaphites sp. BÖSE 1925, Inst. Geol. Mexico, Bol. 42, p. 129, Plate IX, figures 23–28.

Silicified casts from Opal and Camacho; suture lacking, and identification uncertain; in form they resemble *Worthoceras*. The same is true of other ammonites with initial coil, described in the same bulletin and referred mostly to *Ancyloceras*.

Position uncertain:

Saynella hilli STANTON ms. in SCOTT 1926, **55,** 37.

Ammonites walcotti HILL (not SOWERBY) 1888, **51,** II, 139, pl. I, figs. 1–1 a–1 b.

Neumayria walcotti HILL 1893, **55,** 37, pl. VIII, figs. 1–3.

Saynella hilli STANTON. SCOTT 1926, **85,** p. 34.

Trinity Division: Travis County (Cow Creek).

DESMOCERATIDAE Zittel

This group is in need of serious study, and the names here given will doubtless require revision.

Desmoceras (?) brazoense (SHUMARD)................**Plate IX, figure 2**

Ammonites brazoensis SHUMARD 1860, **89,** p. 594. ADKINS 1927, **2,** pl. VI, fig. 2 *(Desmoceras)*.

Shumard's description leaves little doubt as to the identity of this species: his largest individual, in the State Geological Survey (Shumard Survey) at Austin was 21 inches in diameter and had 10 or 11 broad ribs; he mentions that it is the largest species of ammonite that he had seen in the Texas Cretaceous.

Basal Duck Creek: Shovel [Shoal?] Creek near Austin; Fort Washita; Grayson, Fannin, and McLennan counties (type localities); Central and West Texas.

Desmoceras (?) laevicaniculatum (ROEMER).......**Plate IX, figure 1**

Desmoceras laevicaniculatus ROEMER, in LASSWITZ, 1904, **67,** 16, pl. III, fig. 2, text fig. 3.

Desmoceras laevicaniculatum ADKINS 1927, **2,** pl. VI, fig. 1.

This species has nearly symmetrical (bifid) saddles, and symmetrical trifid lobes, including the first lateral lobe. There are about 12 remote low ribs, each of which has just behind it a shallow parallel groove.

Duck Creek: Austin (type locality; holotype, University of Breslau); Grayson County; Fort Washita, Okla.; Tarrant County; Waco; Fort Stockton.

Desmoceras (?) **marcianum** SHUMARD 1854, **87**, 183, pl. IV, fig. 5 (*Ammonites*).

"Shell compressed, not carinated, with about 12 simple, prominent rounded ribs, which cross the dorsum and sides of the last volution obliquely, without interruption; dorsum convex, whorls compressed; surface smooth in the intervals between the ribs; aperture longitudinal, sub-oval." Length of last whorl 22 mm., width of last whorl 9 mm., width of umbilicus 6 mm.

Cretaceous: Cross-Timbers, Texas.

CRAGIN (**23**, p. 55) records its horizon as Duck Creek and considers it identical with *D. brazoense* (**23**, p. 54, footnote). SHUMARD'S figure and description might refer to the juvenile, strongly ribbed form, which is widespread in the basal Duck Creek of North-Central Texas and northern Trans-Pecos Texas. The relations of this form to other species are as yet undetermined.

Parapachydiscus n. sp. aff. **colligatus** BINKHORST. BÖSE 1928, **10**, p. 305, pl. XV, fig. 11.

Large, involute, rounded volutions, taller than wide; low, distant, subequal ribs; venter grooved; suture complicated.

Lower Escondido (Lower Maestrichtian): Progreso-Sta. Cruz road, Coahuila; ? near Eagle Pass.

Nowakites (?) **flaccidicosta** (ROEMER) 1852, **78**, 33, pl. I, fig. 1 a–b. DIENER 1925, *Fossilium catalogus*, Pars 29: Ammonoidea neocretacica, p. 113. SPATH 1922, Trans. Roy. Soc. S. Afr. X, 124.

Austin Chalk?: Waterfall below New Braunfels (type locality). **Lower Santonian** (middle Austin chalk): Arroyo Plano between La Laja and Loma Blanca, Coahuila (BÖSE).

Parapachydiscus streckeri n. sp. .... **Plate XXXV, figure 1; plate XXXVI, figures 3–4**

Involute, whorls inflated, flanks somewhat convex, ventral region sharply convex, surface devoid of ribs or tubercles. In cross-section the whorl is elevated oval; about one-third of the height consists of overlap on the next inner volution. The greatest thickness is near the umbilical margin of the whorl. The siphuncle, about 5 mm. in diameter, is prominent; the ventral mid-line is marked by a shallow, narrow, straight-sided groove.

The best specimen, locality unknown, consists of the completely septate outer half-whorl of an ammonite of about 257 mm. diameter

(Baylor University Museum). The following table shows the change in proportions at different diameters:

Diameter mm.	H[27] mm.	h mm.	th mm.	H/th	h/H
257	116	78	113	1.03	.67
232	114	74.5	104.5	1.1	.65
215	113	68	96	1.18	.60
197	90(?)	64	90.5	1.0 (?)	.71(?)
183	88(?)	61	85+	1.0 (?)	.7 (?)

The same individual has the following proportions:

Diameter	257 mm.
Height of last whorl	116 mm.=45 %
Thickness of last whorl	113 mm.=44 %
Umbilicus (est.)	45 mm.=17.5%

The holotype, an outer fragment of a larger ammonite of an estimated diameter of about 275 mm., has the proportions:

Diameter (est.), 275 mm. (?); H=120 mm. (est.); h=80 mm.; th=125 mm.; H/th=±.96; h/H=±.67.

It thus appears that, with increasing diameter, the per cent of overlap of the whorl on the next inner one decreases slightly; the cross-section of the whorl also changes by becoming less elevated with age, contrary to certain other species of the genus.

The suture is nearly straight, and is elaborately dissected. Siphonal lobe deep, irregularly trifid at tips, nearly as long as first lateral lobe. Four lateral lobes visible on flanks, others on umbilical wall, all symmetrically trifid. Four bifid saddles on flank.

Spath has pointed out that the genus contains two subdivisions, one with the form compressed and the ornamentation reduced over the flanks but developed near the ventral margins; the other with inflated volutions, and mainly costate species. The Texan species belong to the latter subdivision, but differs from most described species apparently in lacking costae. The individual figured has a few, barely visible, raised, radial areas near the ventral borders, but erosion along the sutures has made a study of them impossible; they may be obsolete ribs.

One species of the genus has been noted from the Texan area: *Parapachydiscus* sp. cfr. *colligatus* Binkhorst.[28] It is more distinctly costate, and probably more elevated, than the present species. A closely related species is *P.* n. sp. aff. *colligatus* Spath[29] from the Upper Senonian, Umkwelane Hill, Zululand; the figured specimen (No. 5489) has a diameter of 145 mm., umbilicus 20%, whorl thickness

[27]H=total height of volution; h=height of volution from ventral mid-line of one whorl to that of next outer whorl; th=greatest thickness of whorl.

[28]BÖSE 1928, **10**, 305, pl. XV, fig. 11; from the Escondido beds.

[29]SPATH 1921, *Zululand*, Ann. Afr. Mus., XII, pt. VII, No. 16, 226, pl. XXII, figs. 1 a–b.

60%, of the diameter, about 25 costae on the outer whorl; it is thicker and more distinctly costate than the Texan species. *Parapachydiscus* aff. *ootacodensis* Stoliczka[30], which at a diameter of 150 mm. has a whorl-height of 50%, whorl-thickness of 45%, umbilicus of 19%, of the diameter, differs from the Texan species in becoming more compressed with age, and in being thickest in the middle of the flank (Spath, *Pondoland*, pl. VII, fig. 6); Kossmat[31] figures this species with scattered, sinuate ribs.

Parapachydiscus umtafunensis Spath,[32] a smooth species of which two examples (C19434–5) have the dimensions (listed as above) 75 mm.–.35–.36–.40 and 72.5 mm.–.34–.35–.39, are much more evolute and widely umbilicate than the present species. *P. cricki* and *P. ganesa*[33] differ in being more widely umbilicate, and the former in being thicker whorled.

Anacacho reef facies of Taylor: Texas Quarry Company's pit at Cline (holotype) a better individual of diameter 257 mm., exact locality unknown probably came from the Upper Cretaceous in Hill or McLennan County (Baylor University Museum).

Parapachydiscus n. sp.................................**Plate XXXVII, figure 7**
Smooth, inflated species.
Escondido: Medina County.

Parapuzosia bosei SCOTT AND MOORE 1928 Ms., pl. I, figs. 1–3; pl. II, fig. 2.

Giant species of discoidal Upper Cretaceous ammonites.

Austin chalk: 24.7 miles from Eagle Pass on the Del Rio road, long exposure in west bank of creek west of road (type locality).

Parapuzosia americana SCOTT AND MOORE 1928 Ms., pl. II, figs. 1 and 3.

Austin chalk: Same type locality as preceding species.

The genus in general differs from *Parapachydiscus* in being more compressed laterally, in having wider umbilicus, and in having remote curved ribs.

DIPOLCERATIDAE Spath

Ribs generally prominently elevated, sigmoid or falcate; keel low ....**Dipoloceras**
Keel high; ribs prominent, generally sigmoid.........**Oxytropidoceras**
Keel medium; ribs low..................................**Prohysteroceras**

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[30] SPATH 1921, *Zululand*, p. 229 (footnote). SPATH 1922, *Pondoland*, Trans. Roy Soc. S. Afr., X, pt. III, 132, pl. VII, fig. 6.

[31] KOSSMAT 1895, Unt. Südind. Kr. Form, pl. XVI, figs. 1 a–b.

[32] SPATH 1922, *Pondoland*, 133, pl. IX, figs. 4 a–b.

[33] KOSSMAT 1895, pl. XV, fig. 2 a–c *(ganesa)*, 3 a–c *(cricki)*.

DIPOLOCERAS HYATT 1900

Genotype: *Ammonites cristatus* DELUC.

Dipoloceras sp. aff. **cornutum** (PICTET). SCOTT 1928, Jour. Pal. pl. II, figs. 11–12, text fig. A–2. PICTET, in PICTET AND ROUX 1847–1853, Mém. Soc. Phys. Hist. Nat. de Genève, XI, 93, pl. VIII, figs. 6 a–c *(Ammonites)*. JACOB Thèse, Paris. JACOB 1907. Trav. Lab. Univ. Grenoble, VIII, pp. 326, 384. *(Mortoniceras?)*. JACOB Clansayes, p. 49. STEILER 1922, N. Jahrb., Min. Geol. u. Pal., Beil.–Bd. XLVII, 309, text figs. 2–3 *(Inflaticeras)*. SPATH 1921, Ann. S. Afr. Mus. XII, pt. 7 *(Dipoloceras)*. SPATH 1921, Cret. Ceph. Zulul., 278. SPATH 1923, Gault Ammoncidea, pt. 1, p. 4.

This species is very close to some *cornutum*-forms from Europe. At Folkestone, *D. cornutum* is limited to zones V–VII.

Lower Goodland: Tarrant County, one mile northwest of Benbrook (Scott).

Dipoloceras tarrantense SCOTT 1928, Jour. Pal. pl. II, figs. 1–2, text figs. A2–A3.

Goodland of Fort Worth region, 20 feet below top (=Comanche Peak): two miles north of point where White Settlement road crosses Tarrant-Parker County line (type locality).

Dipoloceras cristatum (DELUC), var. SCOTT 1928, Jour. Pal., pl. II, figs. 3–5, 8–9. D'ORBIGNY 1842, Pal. franç., terr. crét., Ceph., Vol. I, 298, pl. LXXXVIII, figs. 1–5 *(Ammonites)*. PICTET, in PICTET AND ROUX 1847, Mém. Soc. Phys. Hist. Nat. de Genève, XI, 90, pl. VIII, figs. 2–5 *(Ammonites)*. PERVINQUIÈRE 1907, Mém. Carte Géol. Tunisie, Céph., p. 239 *(Mortoniceras?)* JACOB Thèse; Trav. Lab. Geol. Univ. Grenoble, 1907, VIII, pp. 326, 384 *(Mortonicera)*. JACOB 1905, *Clansayes*, p. 49. SPATH 1921, Ann. S. Afr. Mus., XII, pt. 7, 277, pl. XXV, fig. 2; pl. XXVI, fig. 6 *(Dipoloceras)*. SPATH 1922, Trans. Royal Soc. Edinburg, LIII, pt. 1, p. 97 *(Dipoloceras)*. SPATH 1923, Gault Ammonoidea, pt. 1, p. 4. STIELER 1922, N. Jahrb., Beil.–Bd., XLVII, 301 *(Inflaticeras)*.

Top of **Goodland:** Crossing of Chara Creek and Pecan Branch road, one mile northwest of Texas Christian University, Fort Worth; top of Goodland at type locality of *Dipoloceras tarrantense;* top of Goodland northwest of Fort Worth near Arlington Heights car line. Zone VIII of Folkestone.

Dipoloceras fredericksburgense SCOTT 1928, Jour. Pal., pl. I, figs. 1–4.

Top of **Goodland** of Fort Worth region: Two miles northwest of Texas Christian University at the Nine-Mile dam on the Clear Fork of Trinity River (type locality); one mile northwest of Texas Christian University under bridge of Pecan Branch road over Chara Creek, in topmost Goodland.

Dipoloceras sp. indet. SCOTT 1928, Jour. Pal., pl. II, figs. 6–7. **Goodland** (near the top): Same locality as *Diploceras tarrantense.*

OXYTROPIDOCERAS STIELER 1920[34]

Compressed ammonites, coiling polygyral, sublatumbilicate, ribs numerous, flexuous, elevated; carina tall. First lateral saddle broad, and distinctly asymmetrical. Genotype: *Ammonites roissyanum* D'ORBIGNY. A few species are known from Africa, Europe and South America.

Ribs alternately long and short; volution inflated
  Ribs numerous, fine .... n. sp. 1
  Ribs fewer, coarse .... **bravoense** (BÖSE)
All ribs of last volution reach umbilical border
  Ribs more or less sigmoid, unbranched, their ventral ends bend forward towards the aperture
    Ventral ends of ribs with a swelling or node
      Swelling broad, low; ribs faintly sigmoid .... **kiowanum** (TWENHOFEL)
      Node prominent, excavated toward aperture .... **trinitense** (GABB)
    Ventral ends of ribs lack swelling or node
      Ribs numerous, plainly sigmoid; volution tall .... **supani** (LASSWITZ)
      Ribs sparser; volution lower .... **chihuahuense** (BÖSE)
Some ribs of last volution branched
      Ribs numerous, flattened; volution tall .... **acutocarinatum** (SHUMARD)
      Ribs less numerous; volution thickened .... **belknapi** (MARCOU)

Range of genus: **Middle and Upper Albian** in western Europe: Bed VIII, Folkestone (zone of *Dipoloceras cristatum);* has been recorded as low as Bed III; in Africa and South America; in Texas, *Comanche Peak to top of Kiamichi* (i.e., Upper Fredericksburg).

Ammonites geniculatus CONRAD 1857, **18**, 159, pl. 15, fig. 2 a–b. Judging from the figures alone this species has some similarity to *Oxy. belknapi* (Marcou). Volution inflated, fairly tall (h/t=1.36), subangustumbilicate (u=0.22–0.25), ribs numerous, strongly sigmoid, unbranched, similar, all starting from umbilical border; no nodes. It is more inflated and has coarser and sparser ribs than *O. supani.* The

[34]STIELER 1920, Uber sogenannten Mortoniceraten des Gault. Centr. f. Min., p. 346. STIELER 1922, Anomale Mündungen bei Inflaticeraten. N. Jahrb., Beil. Bd., XLVII, 309, 340–346. STIELER 1922, Uber Gault und Cenoman-Ammonitem aus dem Cenoman des Cap Blanc Nez. N. Jahrb., II, 1922, 19–44. SPATH 1922, Cret. Amm. Angola, p. 107 *(Pseudophacoceras).* SPATH 1921, Cret. Ceph. Zulul., p. 281 *(Pseudophacoceras).*

type is not in the United States National Museum. Locality: "Leon Springs and Rio San Pedro."

Oxtropidoceras acutocarinatum (SHUMARD) 1854, **87**, 183, pl. III, fig. 1 *(Ammonites)* .... **Plate V, figure 1**

Until Shumard's type can be refigured and described, the identity of this species will remain doubtful. The following is a description of a common *Oxytropidoceras* which is currently referred to Shumard's species:

Subangustumbilicate (u=0.27–0.28?); flanks flattish, volution rather tall (h/t=? 2.5); tall carina. Ribs branched or unbranched, mainly unbranched on last volution, flexuous or sigmoid, flat-topped, with narrow interspaces.

Middle and Upper Fredericksburg: Widespread in North-Central, South-Central, and Trans-Pecos Texas. Forms similar to this range at least from the Comanche Peak to the basal Kiamichi.

Oxytropidoceras supani (LASSWITZ) 1904, **67**, 22, pl. IV, fig. 3. *(Sonneratia).* ADKINS 1927, **2**, 39, 52, 55, pl. III, fig. 2.. **Plate IV, figure 2**

Subangustumbilicate (u=0.325), flanks slightly inflated, volution rather tall (h/t=2.4–2.5), carina tall; ribs mainly unbranched on last volution, prominently sigmoid, similar, narrower than interspaces; thickened at ventral end, tops sharply rounded. Branching is obsolescent at about 162 mm. shell diameter.

Kiamichi: Double Mountain (holotype, University of Breslau); Grayson County; Denton County; Tarrant County; Round Rock; Fort Stockton.

Oxytropidoceras n. sp. 1.

Subangustumbilicate (u=0.28–0.3), flanks slightly inflated, volution tall (h/t=2+); ribs numerous, fine, of alternate lengths, sigmoid, of equal thickness. Branching obsolescent at about 175 mm. shell diameter.

Kiamichi: University Mesa near Fort Stockton (type locality).

Oxytropidoceras belknapi (MARCOU) 1858, **68**, 34, pl. II, fig. 1 a–b. *(Ammonites)*.......... **Plate IV, figure 3; Plate VII, figures 1, 4**

Subangustumbilicate (u=0.26–0.30, from holotype), flanks inflated, volution tall (h/t=1.6, holotype); ribs mainly prominent, distant, sigmoid, some on last volution alternate, not much thickened at ventral end, branching obsolescent at about 175 mm. shell diameter.

Kiamichi: "In the Cretaceous rocks near the town of Preston [Grayson County] Texas, in the bed of a little creek flowing into the Red River" (Holotype, BM 12662, Natural History Museum, South Kensington; cast in Bureau of Economic Geology); Duck Creek type locality, about 2.5 miles north of Denison (abundant);

one mile northwest of Fort Washita, Bryan County, Oklahoma (abundant); Fort Worth; Fort Stockton.

Oxytropidoceras bravoense (BÖSE) 1910, **8**, 69, pl. III, fig. 6; pl. IV, figs. 1–5 *(Schloenbachia)*. ADKINS 1927, **2**, pp. 39, 52, 55 .... **Plate IV, figure 2**

Subangustumbilicate-sublatumbilicate (u=0.28–0.36?), volution an inflated oval (h/t=1.36). Ribs narrow, round-topped, widely spaced, curved forwards but not sigmoid, of two lengths, of which one-third fail to reach umbilical margin. Branching obsolescent at about ? 212 mm. shell diameter.

Upper Fredericksburg and Kiamichi: El Paso (8); Fort Stockton.

Oxytropidoceras trinitense (GABB) 1876. MARCOU 1858, **68,** 35, pl. II, fig. 2 a–b. *(Ammonites gibbonianus* Lea) GABB 1877, Proc. Ac. Nat. Sci. Phila., p. 278 *(Ammonites trinitensis)*; STANTON 1897, Jour. Geol., V. 606 *(Ammonites trinitensis)* .... **Plate IV, figure 4; plate V, figure 3**

Sublatumbilicate (u=0.34–0.36), section elongate oval (h/t=1.64, holotype), flanks inflated, carina tall, ribs sigmoid, narrow, elevated, round-topped, at ventral end thickened into a node and excavated on side toward aperture. This species is unique in having branched ribs up only to a small diameter (38 mm.); thereafter the ribs are unbranched and all reach umbilical margin.

Comanche Peak to Kiamichi: "In Cretaceous limestone forming the bed of the Elm Fork, one of the affluents of the Trinity River, Texas" (Holotype, BM 12665, British Museum Natural History, South Kensington; plaster replica in Bureau of Economic Geology); precise type locality uncertain but probably in western Cooke or eastern Montague County. Fort Worth; Valley Mills; Fort Stockton; Leander.

Oxytropidoceras chihuahuense (BÖSE) 1910, **8,** 73, pl. V, figs. 3–4; pl. VII, figs. 3–4; pl. VIII, figs. 1–2. SCOTT 1926, **85,** pl. I, fig. 1; pl. II, fig. 1 (?). ADKINS AND WINTON 1920, **3,** 32, pl. II, figs. 4–5 *(Schloenbachia belknapi)*. ADKINS 1927, **2**, pp. 39, 52, 55, pl. IV, fig. 5 .... **Plate VI, figure 5**

Tall-ovate cross-section, thinned ventrally; entire, subequal, faintly sigmoid ribs, sharp-topped and much narrower than the interspaces. Siphonal lobe relatively short, first lateral saddle broad, asymmetrically divided.

This species has a great similarity to *Oxy. trinitense*, so that only a special study will decide whether it is synonymous. The sutures seem generally similar, but differ in the relative lengths of the siphonal and the first lateral lobes: in *O. trinitense* the siphonal lobe is longer than the first lateral, but in *O. chihuahuense* the siphonal lobe is shorter or at most equal in length; *O. chihuahuense* has sparser ribs.

Upper Fredericksburg division: Placer de Guadalupe, Chihuahua (type locality); near Fort Worth, Leander, Fort Stockton.

Oxytropidoceras kiowanum (TWENHOFEL) 1924, **99**, 89, pl. IX, fig. 1 *(Schloenbachia)*. ADKINS 1927, **2**, p. 55.

Umbilical ratio unknown, flanks flattish, keel tall. Ribs curved, swollen at ventral end, generally wider than interspaces, apparently unbranched and all reach umbilical border.

Kiamichi: Fort Stockton (University Mesa).

Oxytropidoceras ? n. sp. 2. ADKINS 1927, **2**, pl. IV, fig. 4.

Has the general form of *O. trinitense* but with the ribs taller and sharper-topped and the ventral forward curvature and excavation more striking. Lobes narrow, quadrangular, saddles (particularly the first lateral) very wide quadrangular and symmetrical. This species should possibly be placed in a different genus or subgenus from *Oxytropidoceras*.

Fredericksburg division and **Kiamichi:** Fort Stockton, Leander.

PROHYSTEROCERAS SPATH

Prohysteroceras SPATH 1921, Cret. Ceph. Zululand, 143, pl. III, fig. 4 a–c; SPATH 1922, Cret. Amm. Angola, 104–105, 143; pl. III, figs. 4–6; SPATH 1925, Ann. Transv. Mus. 187. Genotype: *P. wordiei* SPATH, *Angola*, p. 153, pl. III, figs. 4–6. Horizon: Upper Albian.

Sublatumbilicate, tall cross-section, somewhat quadrangular; keel rounded, mainly rather low; ribs flexuous or sigmoid, having umbilical nodes but no other tubercles. About 17 species and varieties are known from Angola, Portuguese East Africa and Australia.

Micromorph: umbilicus wide (u=0.42) .... **wenoense (Adkins)**
Macromorphs: umbilicus narrower (u=0.32–0.37)
  Lobes slender, pointed; saddles wide
    Ribs sparse; large species .... **austinense (Roemer)**
    Ribs crowded; smaller species .... **burckhardti (Böse)**
  Lobes wider, bifid .... **whitei (Böse)**

Prohysteroceras austinense (ROEMER), in LASSWITZ 1904, **67**, 24, pl. VII, figs. 3–4 .... **Plate XI, figure 2; plate XII, figure 7**

Tall cross-section (h/t=2.0), flanks flat; subangustumbilicate (u=0.24–0.27); ribs scattered, sinuous, umbilical tubercles prominent. Lobes pointed, narrower than saddles.

Duck Creek-Fort Worth: Austin (Shoal Creek, and "Gap-Bahneinschnitt" i.e., I.-G.N. Ry. cut on West Sixth Street, Austin), type localities; Denison; Tarrant County; McLennan County; Fort Stockton; Kent.

Prohysteroceras burckhardti (BÖSE) 1910, **8**, 61, pl. I, figs. 1, 2, 4, 5. SPATH 1922, Cret. Amm. Angola, 105, 146. WHITEHOUSE 1925, Queensl., 222.

Volution tall, quadrangular (h/t=1.52); sublatumbilicate (u=0 35); ribs numerous, sigmoid; lobes pointed, much narrower than saddles.

Duck Creek: Cerro de Muleros (type locality): Central Texas.

Prohysteroceras whitei (BÖSE) 1910, **8**, 63, pl. I, figs. 6–9, pl. XLVI, figs. 6–8. SPATH 1922, Cret. Amm. Angola, 105, 146.

Volution quadrangular, tall (h/t=1.4); subangustumbilicate (u=0.33); ribs numerous, somewhat sigmoid; lobes bifid narrower than saddles.

Duck Creek: Cerro de Muleros (type locality): Central Texas.

Prohysteroceras wenoense (ADKINS) 1920, **1**, 89, pl. I, fig. 14 *(Schloenbachia).* SPATH 1926, Proc. Geol. Assoc., XXXVII, 424 *(Prohysteroceras? wenoense)*............**Plate XX, figure 13**

Subquadrangular volution, tall (h/t=1.55), sublatumbilicate (u=0.42); ribs numerous, flexuous, branched or alternating, prominent umbilical tubercles. Limonite micromorph.

Pawpaw: Type locality: 723, Glen Garden Country Club, near Fort Worth; also loc. 714, near Fort Worth. Holotype: Bureau of Economic Geology.

PERVINQUIERIDAE Spath, 1926, Geol. Mag., LXIII, p. 79

Ammonites with generally quadrangular cross-section, polygyral, sublatumbilicate (u=.40–.45); ribs generally branched in some stages, frequently bifurcated, bearing umbilical and ventral tubercles and in some groups a median tubercle; keel low, rounded; suture with first lateral lobe tall and narrow, first lateral saddle tall, subquadrate, and divided more nearly symmetrically than in *Oxytropidoceras.*

Ornamentation generally 2 (or 3) rows of nodes or tubercles
- Cross-section squarish or broader than tall, generally depressed; keel low, rounded, depressed below shoulder tubercles............**Neokentroceras**
- Cross-section rather quadrangular, proportions variable; keel not depressed............**Pervinquieria**

Ornamentation generally spiral rows of imbrications or nodes; cross-section tall subrectangular to trapezoidal............**Elobiceras**

PERVINQUIERIA J. BÖHM 1910

J. BÖHM 1910, Neues Jahrb., pt. II, 152. (Genotype: *Ammonites inflatus* SOWERBY, *fig.* SPATH, Angola, p. 101, text fig. SPATH 1921, Zululand, 284 *(Subschloenbachia).* SPATH 1922, Cret. Amm. Angola, 100, 113–132 *(Subschloenbachia)*, 91, 160 *(Inflaticeras)*. STEILER 1920, Centr. f. Min., 345–352, 392–400 *(Inflaticeras)*.

Cross-section of volution rectangular, mainly taller than broad, in some species nearly square or even broader than tall; keel low, rounded; ribs fine or coarse, straight or flexuous, many branched in younger stages, mainly unbranched in adult, with umbilical and ventral (rarely also a median) tubercle. Range: Kiamichi to Main Street. Range outside Texas: Upper Albian (beds IX–XIII of Folkestone).

The genus *Schloenbachia* Neumayr 1875 as formerly understood in the Texan literature (i.e., in the broad sense, not restricted to the *varians* group) has been abandoned by most Cretaceous workers, and its Texan representatives placed in the genera *Oxytropidoceras, Prohysteroceras, Neokentroceras, Elobiceras,* and *Pervinquieria.* The last-named genus is the most conspicuous ammonite group in the lower Washita strata, particularly in the Duck Creek beds.

I. Inner ribs coarse, widely spaced, many of them bifurcated; outer ribs distant, straight; two nodes (umbilical and ventral)........ .... **Leonensis group**

II. Like preceding, but ribs trinodose..................... .... **group 2**

III. Ribs fine, numerous (like *kiliani*), not distinctly trinodose........ .... **Kiliani group**

IV. Like preceding, but ribs sparser and trinodose ....**group 4**

I. Group of Pervinquieria leonensis (CONRAD)

Pervinquieria leonensis (CONRAD).

Ammonites leonensis CONRAD 1857, **18**, 160, pl. XVI, figs. 2 a–b.

Pervinquieria leonensis (CONRAD), ADKINS, **2**, pl. V, fig. 4 (holotype). The holotype is a weathered cast, 80 mm. in diameter; ribs straight, thick, all bifurcated except the last three; umbilical and ventral nodes present. The specimen appears juvenile; sutures were not seen, it is uncertain whether any of the living chamber is preserved, but the ribbing would indicate that it is not. Typical low pervinquierian keel. Differs from *P. nodosa* in cross-section, and from *P. shumardi* in having sparser ribs. Umbilicus wide (u=.44).

Duck Creek: Leon Springs, Pecos County (type locality). Holotype: United States National Museum, No. 9878; plaster replica in Bureau of Economic Geology (courtesy of Dr. T. W. Stanton).

Pervinquieria nodosa (BÖSE).

Schloenbachia nodosa BÖSE 1910, **8**, 75, pl. VIII, figs. 11–12; pl. IX, fig. 1–3. This species in costation somewhat resembles *P. leonensis* (CONRAD) but has a very characteristic cross-section, as figured by Böse, **8**, pl. IX, fig. 4.

Duck Creek: Monument Mtn., El Paso (type locality); Kent. Cotypes: Instituto Geológico de México.

Pervinquieria shumardi (MARCOU) .... **Plate XI, figure 1**

Ammonites shumardi MARCOU 1857, **68**, 33, pl. I, figs. 1–1 a. HYATT, in HILL AND VAUGHAN 1898, **58**, p. 21. The holotype of *P. shumardi* preserves almost exactly one volution more than the holotype of *P. leonensis.* At the same diameter, *shumardi* differs from *leonensis* in having the bifurcated ribs more numerous and finer, the umbilical nodes bullate instead of round, and the cross-section thicker.

Duck Creek: Preston, Grayson County (type locality); Duck Creek, near Denison; Kent; Fort Stockton; Tucumcari (Hyatt). Holotype: British Museum Nat. Hist., South Kensington, BM. 12662; (replica in Bureau of Economic Geology).

Pervinquieria maxima (LASSWITZ) .... **Plate XIII, figure 3**

Schloenbachia leonensis var. *maxima* LASSWITZ 1904, **67**, 24, pl. VI, fig. 2, and text figure 5 (on page 24).

Schloenbachia leonensis HILL AND VAUGHAN 1901, **59**, pl. LV, figs. 2 a–b.

Schloenbachia sp. J. WINTON AND ADKINS 1920, **57**, pl. V, fig. 1.

Schloenbachia leonensis? ADKINS AND WINTON 1920, **3**, 34, pl. IV, figs. 4–5.

Schloenbachia leonensis WINTON 1925, **115**, pl. IV, fig. 2.

Schloenbachia leonensis BULLARD 1925, Okla. Geol. Surv., Bull. 33, pl. XXII, fig. 1.

Schloenbachia leonensis BULLARD 1926, Okla. Geol. Surv., Bull. 39, pl. XXII, fig. 1.

Lasswitz's description: "The largest individual already mentioned, whose dimensions are listed in the table at the end of this group, forms a variety [of *leonensis* Conrad]. It is more strongly evolute, as it has a striking external resemblance to the large *Ammonites bajuvaricus* Redtenbacher (in Grossouvre), but differs from it in having the ribs plainly dichotomous even in the early volutions. In this respect it is transitional to *Schloenbachia (Gauthiericeras) austinensis* Roemer."

Volution relatively taller, ribs more numerous than in *P. leonensis* Conrad; the degree of involution is about the same. Holotype: University of Breslau; stated to come from the Emscher of Hood County, an erroneous designation. It is from the Georgetown limestone, probably in South-Central Texas.

Fort Worth limestone, and upper **Duck Creek** beds.

Pervinquieria wintoni (ADKINS) .... **Plate XIX, figure 5**

Schloenbachia wintoni ADKINS 1920, **1**, 90, pl. III, figs. 8–11.

Schloenbachia wintoni ADKINS. WINTON, **115**, pl. V, fig. 4.

This species has paired shoulder tubercles; it differs from *Neokentroceras worthense* in cross-section and ornamentation.

Weno, Pawpaw: Brickyards at Gainesville (type locality); Tarrant County and elsewhere in North-Central Texas.

Pervinquieria n. sp. .... **Plate XIII, figures 1–2**

Ribs thick, unbranched from an early stage.

Duck Creek: Fort Stockton; Bell County; Fort Worth; Georgetown. Also in the Fort Worth limestone.

II. *Group of Pervinquieria* n. sp. 2

Pervinquieria n. sp. 2 .... **Plate X, figure 2**

Juvenile ribbing as in *P. leonensis*, coarse bifurcated ribs; adult and living chamber having coarse, unbranched ribs with trinodose ornamentation.

Duck Creek: Fort Stockton; Central Texas.

Pervinquieria vespertina (MORTON) 1834, Syn. Org. Rem. Cret. Group U. S., 40, pl. XVII, fig. 1. D'ORBIGNY, Prodrome Pal., II, 212. SHUMARD 1854, **87**, 183. PERVINQUIERE 1907, Ét. pal. tun., Céph., p. 227. MEEK 1876, **70**, 448 (footnote). GROSSOUVRE 1903, Rech. Craie Sup., II, Pal., p. 66. GABB 1860, **122**, p. 202. GABB 1861, **123**, p. 17. CRAGIN 1893, **21**, 241–242 (as *Schloenbachia leonensis* var. *equidistans*). STANTON, in CRAGIN 1905, **27**, pp. 30–31 (with Washita fossils).

P. vespertinus and *P. equidistans* are evidently both *Pervinquieria* of the "trinodose" type, but neither description is sufficiently explicit to decide among the several Texan species of that general group. SHUMARD (**87**, 183) says of *Amm. vespertinus* that it has "section subquadrangular; ribs prominent, each garnished with three nodules, the dorsal [ventral] one most prominent; dorsal [ventral] margin furnished with a prominent rounded carina." "In the Cretaceous strata near Fort Washita, specimens were found to measure nearly three feet in diameter, and estimated to weigh upwards of two hundred pounds." He states that it is the largest Texan Cretaceous ammonite known to him. Dr. Stanton has examined the type (PERVINQUIERE 1907, *op. cit.*, p. 227) and considers to be close to *Amm. inflatus*, the genotype of *Pervinquieria*, as the description and localities of occurrence indicate. CRAGIN mentions three features in his var. *equidistans:* the ammonite has the general proportions of the typical *leonensis;* the tubercles are spaced equidistantly; and the ventral tubercle is particularly large and prominent, and gives to the venter a decidedly squarish appearance.

Lower Washita (probably **Duck Creek**)**:** Plains of the Kiamesha, Arkansas (type locality); near Fort Washita, northwestern Bryan County, Oklahoma.

III. *Group of Pervinquieria kiliani* (LASSWITZ)

Pervinquieria kiliani (LASSWITZ)....................................**Plate V, figure 4**

Schloenbachia kiliani LASSWITZ 1904, **67**, 25, pl. VII, fig. 1, text fig. 6.

Pervinquieria kiliani (LASSWITZ). ADKINS 1927, **2**, pl. III, fig. 4 (holotype).

Duck Creek: "Gap; Bahneinschnitt," *i.e.*, International & Great Northern Railway cut, West Sixth Street, Austin (type locality); Denison; Fort Worth; Kent; Fort Stockton; and numerous other localities. Holotype: Museum, University of Breslau.

Pervinquieria minima (LASSWITZ).

Schloenbachia austinensis ROEMER, var. *minima* LASSWITZ 1904, **67**, 25, pl. VI, fig. 1.

Fine sigmoid ribs, flattened flank, tall subrectangular volution.

Duck Creek, and **?Fort Worth:** Shoal Creek and International & Great Northern Railway cut, West Sixth Street, Austin (type localities); Fort Worth; Fort Stockton.

Pervinquieria sp. aff. **ootatoorensis** (STOLICZKA).

Small species, flattish flanks, tall, subrectangular volution. The original species has prominent falciform ribs; there are other Texan species of the same proportions which have numerous fine ribs.

Duck Creek, Fort Worth: At Fort Worth; Belton; Fort Stockton.

Pervinquieria aguilerae (BÖSE)....................................**Plate XII, figure 6**

Schloenbachia aguilerae BÖSE 1923, Inst. Geol. Mex., Bol. 42, 167, pl. XI, figs. 33–36, 37–40, 42–44.

Schloenbachia aff. *inflata* CASTILLO AND AGUILERA 1895, Com. Geol. Mex., Bol. 1, 18, pl. IX, fig. 1.

? Schloenbachia aff. *inflata,* WINTON 1925, **115**, pl. VI, fig. 2.

Ribs more prominent and volution lower than in *ootatoorensis;* Winton's species like also *P. minima,* is more involute than either of the others.

Duck Creek: Fort Stockton.

Pervinquieria leonensis (HILL).

Schloenbachia leonensis HILL 1901 (not CONRAD), **57**, pl. XXXVI, fig. 1 a.

This species may belong to the group of *P. kiliani,* or else to *Prohysteroceras.*

Pervinquieria n. sp. aff. **orientalis** KOSSMAT.

Duck Creek: Near Fort Stockton.

IV. *Group of Pervinquieria* n. sp. 4

Pervinquieria n. sp. 4.. **Plate X, figure 1**

Compare: KOSSMAT 1895, Süd. ind. Kr., pl. XXIII, fig. 2 *(Schl. "inflata")*. This species is rather similar to the Kossmat figure: it has the "*Elobiceras*" imbrications on the ventral tubercles, and has the juvenile ribbing of *P. kiliani;* the ribs on the living chamber become coarser and straighter, and retain the trinodose ornamentation.

Duck Creek: Fort Stockton.

Pervinquieria trinodosa (BÖSE).

Schloenbachia trinodosa BÖSE 1910, **8**, 78, pl. IX, fig. 4; pl. X, figs. 1–4.

The real *P. trinodosa* has flat flanks, a tall cross-section (as in Böse's pl. X, fig. 4), and nodes arranged as in Böse's pl. X, fig. 2.

Horizon: Reported by Böse in Divisions 4, 5, and 6 of his El Paso section, *i.e.*, as high as the red quartzite and shale (about Main Street); Black Mountain, Hudspeth County, under the igneous cap (Beede and Adkins, 1920); exact range uncertain, probably **Middle Washita.**

Pervinquieria n. sp. 5.

Ribs on two sides alternate; may be pathological.

Duck Creek: Fort Stockton.

ELOBICERAS SPATH 1921, S. Afr., Mus., XII, 306

"Compressed discoidal shells with elevated or acute periphery and delicate ornament of quite a peculiar type." Ornament consists of several spiral rows of nodes or imbrications; this feature alone is not diagnostic of *Elobiceras,* but occurs in other Albian or even Coniacian genera.

Genotype: *Schl. elobiensis* Szajnocha 1885.

Elobiceras serratescens (CRAGIN).

Schloenbachia leonensis var. *serratescens* CRAGIN 1893, **21**, p. 241.

Cragin's description.—"The form is strongly compressed and the outer part more lentoid than usual, the ribs low and presenting a centripetally diminishing series of 7 to 9 compressed tubercles."

Upper Kiamichi: North of Denison (type locality).

Elobiceras n. sp. aff. **arietiforme** SPATH.

Kiamichi: Near Fort Stockton.

Elobiceras n. sp. aff. **angustum** SPATH.

Kiamichi: Near Fort Stockton.

Elobiceras n. sp. aff. **flexuicostatum** SPATH.

Kiamichi: Near Fort Stockton.

NEOKENTROCERAS SPATH[35]

Small ammonites, some of them micromorph; cross-section quadrate, depressed, mainly wider than tall, sublatumbilicate, with straight thick, sparse ribs bearing umbilical and ventral tubercles; keel low, rather rounded.

About 9 species and varieties are known from Africa and India.

Volution thicker (h/t=0.61); ribs sparser........................**N. n. sp.**

Volution thinner (h/t=0.76); ribs more crowded..**N. worthense** (ADKINS)

Neokentroceras n. sp.

Shell small (pyritic preservation), subquadrangular volution, thicker than tall (h/t=0.61), sublatumbilicate (u=0.47); straight, thick, sparse ribs, mainly branched. Keel low, rounded, not depressed below shoulder tubercles. Species has similarities to *N. choffati* Spath (=*Schl. lenzi* Szajnocha in Choffat: *Benguella*, pl. I, fig. 3). It is possible that this species should be referred to *Dipoloceras*.

Horizon: **Duck Creek** (upper marl). Duck Creek type locality, Frisco Cut about 2.5 miles north of Denison, pyritic marl near top (holotype: Bur. Econ. Geol.).

Neokentroceras worthense (ADKINS) Univ. Texas Bull. 1856, 91. pl. I, figs. 6–10, 18–19, 26 *(Mortoniceras)*. ADKINS 1927, Univ. Texas Bull. 2738, p. 54....**Plate XX, figures 4–6; plate XXI, figure 9**

Shell small, volution subquadrangular, thicker than tall (h/t=0.76), sublatumbilicate (u=0.47); ribs more crowded than in *N.* n. sp.; keel depressed below shoulder tubercles.

Pawpaw: Locality 723 near Fort Worth (holotype: Bur. Econ. Geol.); 714 and other localities near Fort Worth. Bowen, N.M., opposite the smelter. This species appears to be a marker for the Pawpaw beds.

LYELLICERATIDAE Spath

STOLICZKAIA NEUMAYR

Discoid, rather involute, round-ventered ammonites; ribs generally of alternate length, some set at an angle to others in some species. Genotype: *S. dispar* d'Orbigny. Upper Albian-Lower Cenomanian.

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[35]*Neokentroceras* SPATH 1921, Cret. Ceph. Zululand, Ann. S. Afr. Mus., XII, 306 (genotype: *N. curcicornu* SPATH. Fig.: Spath, *Angola*, p. 141, text fig. D.) SPATH 1922, Cret. Amm. Angola, 105, 139–143. SPATH 1925, Upper Albian Amm. Port. East Africa, 185.

Volution elevated, compressed; ribs fine, numerous........**S.** n. sp.
Volutions more inflated; ribs coarser, fewer
Ribs radial, practically straight..................**S. texana; S. uddeni**
Some ribs set at angle to others..................................**S. adkinsi**

Stoliczkaia n. sp.

Stoliczkaia dispar SCOTT (not D'ORBIGNY) 1926, **85**, pl. III, figs. 3–4.

Volution elevated, compressed laterally, flanks almost flat; ribs numerous, a few (earlier ones) slightly sigmoid, most of them nearly straight, and of two lengths. The species is somewhat similar to those figured in PICTET AND CAMPICHE, Ste. Croix, pl. XXXVIII, fig. 5; and in CHOFFAT 1888, Mat. Ét. strat. pal. prov. Angola, pl. II, fig. 6.

Main Street (top): Two miles east of Belton at bridge of Hyde-Hammer highway across the Leon Liver.

Grayson: Denton County.

Stoliczkaia texana (CRAGIN) 1893, **21**, 235, pl. XLIV, figs. 1–2 *(Hoplites)*.

Subangustumbilicate (u=.3); ribs continuous across flanks, equal over venter; living chamber constricted towards aperture.

Buda and upper **Grayson:** Denton County, Elm Fork near Missouri-Kansas & Texas Railway bridge; and 2 miles southeast of Roanoke; Eagle Mountains (type localities).

Stoliczkaia uddeni BÖSE 1928, **10**, 211, pl. IV, figs. 12–15.

In form and ribbing, so far as can be determined by Cragin's description this species seems identical with *S. texana* Cragin.

Uppermost **Del Rio:** Hill County just above Hill-McLennan County line on Aquilla Creek, loc. 951 (type locality); Bosqueville; other McLennan County localities.

Stoliczkaia adkinsi BÖSE 1928, **10**, 193, pl. XVIII, figs. 9–17..........
....**Plate XX, figure 15; plate XXI, figure 4**

Subangustumbilicate (u=.24?); ribs roughly alternating in length, and some of the shorter ones set at an angle to the longer ones.

Pawpaw: Near Fort Worth, Glen Garden Country Club, loc. 723 (type locality).

BUDAICERAS BÖSE 1928, 10, p. 255

Discoidal, flanks flattened, ribs low, unbranched, straight or falciform; venter acute with a row of small nodules on mid-line, rounded on living chamber. Genotype: **Budaiceras mexicanum** BÖSE 1928. Horizon: Buda limestone.

Budaiceras evae (LASSWITZ) 1904, **67**, p. 29, pl. VIII, fig. 2 *(Schloenbachia)*. BÖSE 1928, 10, pp. 91, 92, 258........................ **Plate XXIII, figure 2**

Buda limestone: Shoal Creek, and Austin (no specification) (type localities).

Budaiceras frechi (LASSWITZ) 1904, **67**, p. 28, pl. VI, figs. 6 a–b. *(Schloenbachia)*. BÖSE 1928, **10**, pp. 91, 162, 258.

Buda limestone: Austin, and Shoal Creek (type localities).

Budaiceras frechi var. **curvatum** (LASSWITZ) 1904, **67**, p. 28, pl. VI, fig. 7 *(Schloenbachia)*. BÖSE 1928, **10**, pp., 91, 162, 258.

Buda limestone: Shoal Creek near Austin (type locality).

Budaiceras hyatti (SHATTUCK) 1903, **86**, p. 36, pl. XXV, figs. 3–4 *(Barriosiceras)*. BÖSE 1928, **10**, pp. 91, 162, 258.

Buda limestone: Austin, Shoal Creek (type locality).

Budaiceras mexicanum BÖSE 1928, **10**, p. 259, pl. IX, figs. 16–23; pl. X, figs. 1–3.

Buda limestone: El Remolino, near Jimenez, Coahuila, and about 4 kilometers south of Tinaja de la Huerfana on road from Villa Acuña through Rancho San Gregorio to El Colorado, Coahuila, Mexico (type localities).

Budaiceras roemeri (LASSWITZ) 1904, **67**, p. 27, pl. VI, fig. 3 *(Schloenbachia)*. BÖSE 1928, **10**, pp. 91, 162, 258.

Buda limestone: Austin, and Shoal Creek (type localities).

Budaiceras roemeri var. **harpax** (LASSWITZ) 1904, **67**, p. 27, pl. VI, fig. 4 *(Schloenbachia)*. BÖSE 1928, **10**, pp. 91, 162, 258.

Buda limestone: Shoal Creek (type locality).

Budaiceras roemeri var. **elegantior** (LASSWITZ) 1904, **67**, p. 28, pl. VI, figs. 5 a–b *(Schloenbachia)*. BÖSE 1928, **10**, pp. 91, 162, 258........................ **Plate XXIII, figure 4**

Buda: Austin.

Budaiceras texanum (SHATTUCK) 1903, **86**, p. 35, pl. XXV, figs. 1–2 *(Barroisiceras)*. BÖSE 1928, **10**, pp. 91, 162, 258.

Buda: Austin.

Budaiceras sp. (=*Barroisiceras haberfellneri* LASSWITZ 1904, not v. HAUER). LASSWITZ 1904, **67**, p. 28, pl. VIII, fig. 3. BÖSE 1928, **10**, pp. 91, 162, 258.

Buda: Shoal Creek near Austin. The original of Lasswitz at Breslau has typical Buda lithology.

Budaiceras ? sp. *(Barroisia sequens* LASSWITZ 1904, not GROSSOUVRE). LASSWITZ 1904, **67**, p. 27. BÖSE 1928, **10**, pp. 91, 162, 258.

Buda: Austin.

Artificial Key to Texan Acanthoceratids and Mantelliceratids

Ribs continuous over venter
  Flanks compressed, with numerous fine ribs; shoulder tubercles paired........ **Mantelliceras sellardsi**
  Flanks inflated
    Tubercles prominent in adult; shoulder tubercles single
      Mid-ventral tubercle persists to late stage........ **Eucalycoceras leonense**
      Mid-ventral tubercle absent in adult
        Shoulder tubercles conical........ **Acanthoceras n. sp. 6**
        Shoulder tubercles alate, prominent........ **Acanthoceras n. sp. 7**
    Tubercles absent in adult, no mid-ventral stage
      Ribs coarse........ **Metacalycoceras (?) tarrantense**
      Ribs fine........ **Metacalycoceras (?) n. sp.**
Ribs not continuous over venter
  A single ventro-lateral (shoulder) tubercle on each side; flanks flat; low, continuous (?) keel........ **Acanthoceras (?) sp. 3**
  A pair of ventro-lateral tubercles on each side
    Venter convex
      Ventral mid-line with row of numerous, fine tubercles........ **Acan. lonsdalei**
      Ventral mid-line with scattered tubercles........ **Acan. bellense**
    Venter concave
      Flanks flattened........ **Acan. stephensoni**
      Flanks convex
        Outer ventro-lateral tubercle reduced; venter excavated (somewhat as in *Metoicoceras)*........ **Acan. wintoni**
        Outer ventro-lateral tubercle prominent........ **Acan. aff. turneri**

MANTELLICERATIDAE Hyatt 1903, **61,** 105; emend. **Spath**

Restricted by Spath "to retain Hyatt's family name *Mantelliceratidae* for those groups that range themselves around the closely-allied *Mantelliceras* and *Submantelliceras* Spath, the former comprising such typical species as *M. couloni* (d'Orbigny), *M. hyatti* Spath, *M. saxbyi* (Sharpe), *M. subcostatum* Spath; the latter genus including several new forms farther removed from the ancestral *Stoliczkaia* stock than is *Mantelliceras*." Allied genera: *Eucalycoceras, Paracalycoceras* and *Metacalycoceras* Spath, *Sharpeiceras* Hyatt. "Until zonal collecting provides the clue to the interrelation of these various

Acanthoceratid genera, the separate family Mantelliceratidae cannot be considered to be well established" (Spath).

SUBMANTELLICERAS SPATH 1923, Summ. Prog. Geol. Surv., Gt. Britain, p. 143

Texan species pyritic micromorphs, costae and ventro-lateral tubercles prominent, mid-ventral tubercle broad and faint. Genotype: *Acanthoceras aumalense* (Coquand) Pervinquière 1910, Amm. Crét. Alger., Mém. Soc. Geol. France, Pal., No. 42, p. 42, pl. IV, fig. 11. Uppermost Albian-Basalmost Cenomanian: Algeria, Tunis, England, Texas, Coahuila, and elsewhere.

Submantelliceras worthense (ADKINS) 1920, **1**, 93, pl. I, figs. 11–13, 15–17, 20–25 *(Acanthoceras)*. BÖSE 1928, **10**, pp. 217–218 *(Mantelliceras)*. SCOTT 1926, **85**, 137–141, pl. I, figs. 7–9 (as *Acanthoceras martimpreyi* and *A. aumalense*) .... **Plate XX, figures 10–11**

Pawpaw: Tarrant County, several localities; Glen Garden Country Club (loc. 723) near Sycamore Creek southeast of Fort Worth (type locality).

Submantelliceras (?) brazoense (BÖSE) 1928, **10**, 220, pl. VI, figs. 5–43........**Plate XXIII, figures 5, 11**

Del Rio: McLennan County, localities 955, 964, 966; near Villa Acuña, and near Jimenez, Coahuila (type localities); other localities in Bell and McLennan counties.

Submantelliceras (?) wacoense (BÖSE) 1928, **10**, 215, pl. V, figs. 9–25; pl. VI, figs. 1–4.

Del Rio: McLennan County, east side of Santa Fe track 4.5 miles south of McGregor, locality 966 (type locality).

MANTELLICERAS HYATT 1903, 61, p. 113

Young stage like *Douvilleiceras,* with broad ventral channel, costae crossing venter, and 6 rows of tubercles; in octituberculate stage, like *Sharpeiceras laticlavium;* in adult all except two ventral rows of tubercles disappear, and in old age these also disappear. Genotype *M. mantelli* (SOWERBY) 1814, Min. Conch., pl. LV. Lower Cenomanian.

Mantelliceras sellardsi n. sp. .... **Plate XXV, figure 1; plate XXVI, figure 4**

This species is discoidal, compressed laterally, sublatumbilicate (u=.31). Ribs numerous, about 18 on the last half volution, flexuous, mainly of alternate lengths, subequal at ventro-lateral margin where there is a prominent angulation formed on the outer one of a pair of shoulder tubercles. Ribs cross venter as prominent rounded elevations; there is no tubercle on the mid-line. There are thus 4 ventral rows of tubercles. (One fragment from McLennan County, perhaps the same species, has a median row of tubercles.) Shell about one-half millimeter thick. Suture not observed.

This species belongs to the *M. couloni* group (*cf.* D'ORBIGNY, Pal. franç., terr. crét., Céph., pl. CIV, fig. 2), and resembles *M. rowei* Spath.[36] However it does not occur in a level corresponding to low Cenomanian as recorded by Spath (*M. martimpreyi* zone), but is perhaps comparable to "unnamed *couloni* forms" (SPATH 1926, Proc. Geol. Assoc., XXXVII, 427) recorded from a high level, the *subflexuosum* zone. Otherwise, no *Mantelliceras* in the strict sense has been observed in the Eagle Ford flags. *M. rowei* has nearly 50 per cent more ribs than the Texan species, and differs also in having many ribs branched instead of alternate. A related species is *M. hyatti* SPATH 1925, Ann. Transv. Mus., XI, pl. III, p. 197 (= *Amm. mantelli* SHARPE 1857, Foss. Moll. Chalk, pl. XVIII, fig. 4 only, B.M. 50288).

Eagle Ford (flag member): Locality 2425, Williamson County, about one-half mile southeast of Round Rock (type locality); locality 2412, near Belton-Temple highway. Professor W. M. Winton reports a similar fossil from 3 miles east of Britton.

EUCALYCOCERAS SPATH 1923, Summ. Prog. Geol. Surv. Gt. Britain for 1922, p. 144

Texan species have prominent ribs crossing venter, with a pair of ventro-lateral tubercles on each side and a mid-ventral row of rather obscure tubercles (or swellings). Genotype: *E. pentagonum* Jukes-Browne 1896, Q.J.G.S., LII, pl. V, figs. 1–1 a. Other species: *E. newboldi, spinosum, choffati, gothicum,* Kossmat; *subgentoni, lymense* Spath. Basal part of Upper Cenomanian.

Eucalycoceras leonense n. sp.. ....**Plate XXVIII, figure 1; plate XXIX, figure 3**

Involute, inflated, sublatumbilicate (u=.38), whorls somewhat depressed (h/w=.88). Flanks flat, almost parallel, venter with 3 facets, a truncated middle band bounded on each side by the inner shoulder tubercles, and on each side an inclined band ending on the flank at an angulation of the ribs (tuberculate in young). The 3 facets have approximately equal width in the young stages, and the 3 ventral tubercles are small and subequal. The lateral tubercles are less prominent, and after a shell diameter of about 25 mm. are visible only as faint swellings on the ribs. Mid-ventral tubercle perceptible to a shell diameter of at least 55 mm.; it and the lateral facets disappear with age. The ribs, bearing the 5 rows of tubercles mentioned, are narrowly rounded, somewhat elevated, subequal on

[36]*Mantelliceras rowei* SPATH, 1926, Proc. Geol. Assoc., XXXVII, p. 431 =GUERANGER, 1867, Album paléontologique du départment de la Sarthe, pl. V, fig. 1 (as *Ammonites couloni?*). *M. rowei* occurs in high Cenomanian zones, the *rotomagense* and *subflexuosum* zones of Spath.

crossing venter, but of alternate lengths, the long ones being narrowly elevated at their umbilical ends, the shorter ones covering about two-thirds the width of the flank. Suture of holotype not observed.

Eagle Ford (flag member): Near Belton-Temple highway, loc. 2412 (type locality), and nearby locality 2410.

METACALYCOCERAS SPATH 1926, Geol. Mag., LXIII, p. 83

Texan species have ribs crossing venter uninterruptedly; mid-ventral tubercle absent in adult, the other tubercles reduced. Genotype: *Ammonites navicularis* (*"mantelli"* D'ORBIGNY, Pal. franç., terr. crét. Céph., pl. CIII). Middle and Upper Cenomanian.

Metacalycoceras (?) tarrantense n. sp. .... **Plate XXVIII, figure 3; plate XXIX, figure 1**

Acanthoceras rotomagense SCOTT (not DEFRANCE) 1926, Bull. Am. Assoc. Petr. Geol., X, 621, pl. XXII, fig. 1 only.

Discoidal, involute, sublatumbilicate (u=.25), cross-section of volution practically quadrate in last volution, sides convex, venter truncate. Up to a diameter of about 90 mm., there is a fairly distinct elevation on the ventral mid-line, and on each ventro-lateral shoulder a pair of prominent tubercles; these 5 tubercles lie on the remote, straight, radial ribs, which cross the venter. In later stages the median tubercle becomes obscure, the widely spaced ribs more prominent, and the ribs in part are of alternate lengths, all being of equal strength near the venter but some reduced toward the umbilicus. On the last volution those ribs which reach the umbilicus are narrow and sharply raised near the umbilical wall.

Suture typically Acanthoceran: long siphonal lobe, rather rectangular, with long lobules; wide first lateral saddle, nearly symmetrical; first lateral lobe prominent, subquadrate, as long as the siphonal lobe, generally quadrifid; 2 other lobes of decreasing length, trifid, pointed, the last lying on the umbilical wall.

This species in some features resembles *Acanthoceras confusum* (Guéranger)[37] and particularly *A. confusum* var. *tunetanum* Pervinquière[38] from the Cenomanian of England (Spath's *diadema* zone), France and Tunis. However the Texan species is more involute than those mentioned, has proportionately narrower umbilicus and taller outer volution, the ribs are less distinctly tuberculate on the outer whorl and shows to a greater extent an alternation of two lengths. The Texan species thus has, especially in the younger stages, features of *Acanthoceras*, the general form of the suture, the mid-ventral row of tubercles, and the paired shoulder tubercles. Its later form how-

[37]Guéranger, 1867, Album paléontologique du département de la Sarthe (Le Mans), p. 5, pl. II, fig. 4; pl. III, fig. 1; pl. VIII, fig. 1 *(Ammonites)*.

[38]Pervinquière, 1907, Et. pal. tun., I, Céph., 268, pl. XIII, figs. 4 a–b.

ever suggests the groups of *Eucalycoceras* and *Metacalycoceras:* the mid-ventral tubercles disappear, and the coarse ribs cross the venter uninterruptedly. Another somewhat similar species is *Acanthoceras meridionale* Stoliczka var. *africanum* Pervinquière,[39] which seems to have coarser and more prominent tubercles in the mature stage, but young individuals referred to the same species (pl. XV, figs. 2 a–b) are entirely different, lack the excavated venter, and have numerous tubercles. The adult has certain similarities to *Metacalycoceras subwiesti* Spath.[40]

It does not appear that this species can be referred to *Mammites.* That genus has no median line of tubercles at any stage, but some species have a low keel (elevation of siphuncle?). The excavated juvenile venter of this species suggests *Mammites,* except that the median tubercles are conspicuous. Most species of *Mammites* are of Turonian age; those which have been recorded from the Cenomanian[41] either are doubtfully identified, or else do not resemble the Texan species.

The species is more involute and more inflated than *Ac. wintoni* and at comparable diameters has the ribs and shoulder tubercles coarser.

Basal Eagle Ford: Two miles east of Tarrant station (type locality); other nearby localities; locality 2410, Belton-Temple highway.

Metacalycoceras (?) sp. 1 .... **Plate XXVII, figure 1**

Acanthoceras mantelli Lasswitz (not Sowerby) 1904, **67**, pp. 18, 36.

Lasswitz's specimen, examined and photographed by the writer in Breslau, came from "El Paso Creek in the Eagle Mountains" and was sent to Roemer by the Dumble Survey. It has a height of volution of 65 mm., thickness 64 mm. (on the ribs) or 53 mm. (in the intervals), and bears several equal, sharply elevated, round-topped ribs, rather closely spaced, and non-tuberculate, crossing the venter uninterruptedly. The ribs are more elevated and crowded, and the venter less angular, than in *Metacalycoceras* (?) *tarrantense.*

Eagle Ford (?): Eagle Mountains, on "El Paso Creek" (not located).

Metacalycoceras (?) sp. 2 .... **Plate XXVIII, figure 2; plate XXIX, figure 2**

This occurs with *Eucalycoceras* and may be a member of that genus. Flanks and venter are convex, ribs prominently alternating in length, the long ones narrowly elevated at their umbilical ends.

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[39]Pervinquière, 1907, Et. pal. tun., Céph., pl. XV, figs. 4 a–b.

[40]*Metacalycoeras subwiesti* Spath, 1926, Proc. Geol. Assoc., XXXVII, 431 = *Amm. mantelli* Guéranger, 1867, Alb. Pal. Sarthe, pl. VI, fig. 2 only.

[41]*M. coleruenense* Stoliczka; *M. conciliatus* Stoliczka; *M. crassitesta* Stoliczka; *M. geslianus* d'Orbigny; *M. lapparenti* Pervinquiere; *M. pseudonodosoides* Choffat.

Material poorly preserved; no mid-ventral tubercle visible; the two lateral tubercles reduced if present at all. It resembles the genotype, *Metacalycoceras naviculare,* as figured by D'ORBIGNY, Pal. franç., terr. crét. Céph., pl. CIII.

Eagle Ford (flag member): Belton-Temple highway, locality 2410. Hays County, east-west road 1 mile southwest of San Marcos (identification uncertain).

ACANTHOCERATIDAE

"It seems advisable to restrict Acanthoceratidae s. s. to *Acanthoceras* Neumayr emend. Grossouvre 1893 (genotype: *Acanthoceras rotomagense* DEFRANCE in BRONGNIART="*Metacanthoplites*" HYATT 1900), and its allies, such as *Euomphaloceras* SPATH (an offshoot of *Acanthoceras* via the group of *Acanthoceras cunningtoni* SHARPE, the suture line of which it retains), and *Protacanthoceras*" (SPATH).

ACANTHOCERAS NEUMAYR

These ammonites (Texan species) have mostly straight, remote ribs, in some species prominently raised or even nodose near the umbilical border, and with generally 5 rows of tubercles, 2 ventrolateral pairs and a mid-ventral row. The ribs do not cross the venter. Genotype: *Acanthoceras rotomagense* DEFRANCE (Upper Cenomanian, Rouen). Range: Upper Cenomanian, *diadema* to *vicinale* zones of SPATH, 1926. The numerous Texan species have not yet been well studied, and only a few are included here. The upper part of the Woodbine formation near the Tarrant-Dallas county line and elsewhere contains one or more species; the Eagle Ford flag member in Bell and McLennan counties contains several species, associated with *Eucalycoceras* and *Turrilites.*

Acanthoceras wintoni n. sp.............................**Plate XXV, figures 2–3**

Form discoidal, somewhat compressed, sublatumbilicate (u=.27), last volution rapidly increasing in height (h/t=1.1), flanks slightly convex. Venter excavated, bounded by longitudinally elongated shoulder tubercles, but with a median row of low, elongated tubercles, lying on ribs which cross venter as low, broad elevations. Ribs radial, nearly straight, roughly alternate in length on last volution, with paired shoulder tubercles, of which the lateral one is faint, the ventral one prominent and longitudinally elongate. Inner volutions marked by a few coarse, distant, straight ribs, elevated at umbilical ends.

Siphonal lobe long, rectangular in outline, laterally much dissected, with 2 long lobules. First saddle about as broad as tall, asymmetrically divided by a small trifid lobule lying nearer the internal side. First lobe shorter than siphonal, fairly narrow, quadrifid. Second saddle broad, asymmetrical. Second lobe shorter than first, irregularly trifid. Third saddle tall, narrow. Third lobe narrow, lying on umbilical wall. The rest of the suture is concealed by the overlap. The venter and suture of this species are in many ways strikingly suggestive of *Mammites*.

Upper Woodbine: East of Tarrant station, on Bear Creek, near Tarrant-Dallas county line (locality 2426, type locality).

Acanthoceras lonsdalei n. sp...
..................................**Plate XXVI, figure 5; plate XXVII, figure 3**

Form inflated, flanks rather flat, venter nearly truncate, cross-section of outer volution somewhat depressed (h/t=.78), sublatumbilicate (u=.31). Ribs similar, straight, coarse, distant, with tubercle at umbilical end and a pair of tubercles on each shoulder, the lateral tubercle being conical and prominent, the ventral one longitudinally elongate and less conspicuous. The mid-ventral line bears a row of small, low, circular, equal tubercles, one of which is in line with the pairs of shoulder tubercles, and two more lie in the intervening space not in line with any shoulder tubercle. In the younger stages all of these smaller tubercles lie on small ribs crossing the venter, but with age these fine ribs disappear. The shell of this species is less than one millimeter in thickness. The holotype does not clearly show the suture.

This species has a considerable resemblance to *Acanthoceras cunningtoni* Sharpe,[42] and to its variety *cornutum*.[43] It differs from both in having, at the same diameter, the ribs more crowded, the tuberculation much more reduced, and the whorl less depressed; it is conspicuously similar in general form and in having a mid-ventral row of small tubercles. From *Acanthoceras evolutum* SPATH[44] it differs in having, at the same diameter, the ribs more sparse, the tuberculation on the venter differently arranged, and the whorl somewhat less depressed.

Acanthoceras sp. 1.

Acanthoceras rotomagense LASSWITZ (not DEFRANCE) 1904, **67**, pp. 17, 18, 36.

The writer examined and photographed at Breslau this specimen from the Eagle Mountains, sent to Roemer by the Dumble Survey. It is an inflated species with rather remote, low, rounded ribs of two general lengths, with a pair of shoulder tubercles on each side

[42] *Acanthoceras cunningtoni* (SHARPE), 1853, Foss. Moll. Chalk Engl., p. 35, pl. XV, figs. 2 a–c.

[43] *Acanthoceras cunningtoni* var. *cornutum* KOSSMAT, 1895, Unt. Südind. Kr., Form., p. 18, pl. V, figs. 1 a–c.

[44] *Acanthoceras evolutum* SPATH, 1926, Geol. Mag., LXIII, p. 82=*Amm. sussexiensis* SHARPE, 1853, Foss. Moll. Chalk Engl., p. 34, pl. XV, figs. 1 a–d. This species is recorded from the base of the Upper Cenomanian, in SPATH'S *diadema* zone (SPATH, 1926, Proc. Geol. Assoc. XXXVII, p. 426).

and a row of low, mid-ventral tubercles, which become faint in the adult. It somewhat resembles the species here described as *A. bellense.*

Eagle Ford: Eagle Mountains, on "El Paso Creek"; two individuals, one complete, the other one-half of an outer whorl. Lasswitz was one of the first to recognize clearly that the Texan *Acanthoceras* beds are Cenomanian.

Acanthoceras (?) aff. **kanabense** STANTON 1893, U. S. Geol. Surv. Bull. 106, 181, pl. XXXVI, figs. 6–8 (not MOREMAN 1927, **73**, pl. XIII, fig. 5).

The species as figured is suggestive of *Protacanthoceras* Spath,[45] especially in its laterally compressed form, sigmoid ribs, simple suture, and the presence of three lines of nodes on the venter. There is however a discrepancy in the horizons of the two fossils.

Austin chalk: Near New Braunfels.

ACANTHOCERAS COLORADOENSE HENDERSON 1908, Proc. U. S. Nat. Mus., XXXIV, 259, pl. XIII, figs. 10–11.

Ribs cross mid-line and bear each 4 tubercles, a pair of closely set longitudinally elongate tubercles one on either side of the midline, and a tubercle on each shoulder; no mid-ventral tubercles. Genus?

Upper Benton: Left Hand Creek, 10 miles north of Boulder, Colorado, in limestone bands of Upper Benton shale, associated with *Inoceramus labiatus* and other Benton fossils (type locality; holotype U.S.N.M. No. 30877).

Acanthoceras bellense n. sp.............................**Plate XXX, figures 1–2**

Form robust, flanks and venter slightly inflated, volutions quadrate (h/w=1.0), sublatumbilicate (u=.27). Ribs straight or slightly flexuous, only slightly elevated near umbilical wall (on shell; more elevated on cast), interspaces with fine, flexuous, radial striae. Shoulder tubercles paired, subequal, longitudinally elongated, closely spaced, connected by a low ridge. Median line of low tubercles on cast (on shell appears as a low, nearly continuous ridge). Shell about 1 millimeter thick. Suture of holotype not completely observed on account of shell. Siphonal lobe long, quadrangular, first lateral saddle quadrate, almost symmetrically divided by a small, trifid lobe; first lateral lobe almost as long as siphonal lobe.

The ribs are finer and the tubercles less prominent than in *Acanthoceras stephensoni,* and the venter is in general convex instead of being excavated as in that species. It differs from *Acanthoceras*

[45] *Protacanthoceras* SPATH, 1923, Summ. Prog. Geol. Surv. Gt. Britain for 1922, p. 144. Genotype: *Amm. bunburianus* SHARPE, 1854, Foss. Moll. Chalk, p. 25, pl. IX, figs. 3 a–c.

n. sp. 3 (from Round Rock) in having paired shoulder tubercles and a less continuous keel.

Eagle Ford (flag member): Bell County, Belton-Temple highway, locality 2410 (type locality).

Acanthoceras stephensoni n. sp.——————**Plate XXXI, figures 1–2**

Form robust, flanks nearly plane, cross-section of volution quadrate; latumbilicate (u=.4). The ribs are straight, nearly radial, 16 or more on last volution, narrowly raised umbilical ends, crossing the venter as slight elevations which become obsolete in the adult. On each ventro-lateral margin is a characteristic pair of closely spaced, prominent, conical tubercles, set at an angle to each other and connected by a short, low, rounded ridge; in this feature the species resembles *Acanthoceras evolutum* SPATH and differs from other Texan species. The ventral mid-line has a row of tubercles, slightly elongated and relatively more conspicuous in young stages, inconspicuous and elongated longitudinally in the adult. The shell is 1–2.5 mm. thick.

The holotype does not clearly show the suture. Other individuals from the type locality show a long siphonal lobe, a broad first saddle, first lateral lobe shorter than the siphonal, second saddle equal in width to first lateral lobe, but second lobe shorter and narrower.

The species corresponds in some features to *Acanthoceras evolutum* SPATH,[46] especially in its general form, cross-section of volution, and arrangement of shoulder tubercles, but differs in lacking the fine ribs and the median row of fine tubercles on the venter.

Eagle Ford (flag member): Bell County, east side of Pepper Creek, near Belton-Temple highway, north of track (locality 2412, type locality); locality 2410, about one-fourth mile south of preceding locality.

Acanthoceras n. sp. 2 (aff. *A. turneri* C. A. WHITE)——————————————**Plate XXX, figures 3–4**

Medium size, inflated, sublatumbilicate (u=.33), volutions moderately tall (h/w=1.15), venters somewhat rounded. Ribs numerous, 24 on last volution, nearly straight, irregularly alternate in length, equal at ventro-lateral margin, do not cross ventral mid-line. Five rows of tubercles on each rib, a subequal ventro-lateral pair and a low tubercle on mid-line, becoming fainter in adult. Suture generally as in *Acanthoceras rotomagense.* KOSSMAT'S figured individual[47] of *A. turneri* has the volutions more depressed and inflated, at the same diameter.

[46]*Acanthoceras evolutum* SPATH, 1926. Geol. Mag., LXIII, p. 82=*Amm. sussexiensis* SHARPE, 1853, pl. XV, figs. 1 a–c.
[47]KOSSMAT, 1895, Südind. Kr. Form., pl. I, figs. 1 a–b.

Eagle Ford (flag member): Belton-Temple highway, locality 2410.

Acanthoceras (?) n. sp. 3.

Flanks very slightly convex, shell generally smooth, except for remote, low, straight ribs, which do not cross the venter. One conical shoulder tubercle on each side. Ventral mid-line a continuous, low elevation on the shell. The species has some features of *Mammites*.

Eagle Ford (flag member): Williamson County, one-half mile southeast of Round Rock (locality 2425), with *Mantelliceras sellardsi* n. sp. and *Turrilites* n. sp.

Acanthoceras n. sp. 4.

Inflated species, flanks flattish, venter rounded, general aspect smooth, ornamentation very subdued, volution subrectangular, slightly taller than wide. The last half-volution bears on the flanks 10 or more low, striaeiform radial ribs, somewhat more raised near the shoulder and near the umbilical wall, and passing over the venter nearly to the mid-line. Between them are scattered, fine, radial striae. Mid-line with a row of low, rounded, separated tubercles.

Eagle Ford (flag member): Near Belton-Temple highway (locality 2410).

Acanthoceras n. sp. 5.

This poorly preserved species has five rows of ventral tubercles, arranged somewhat as figured by PERVINQUIERE 1907, Ét. pal tun., Céph., pl. XV, figs. 6 a–c, for *Acanthoceras meridionale* STOLICZKA var. *tuberculatum* PERV.

Eagle Ford (flag member): Belton-Temple highway, locality 2410. A somewhat similar, but defective, individual was found in the top Woodbine, on the Meridian highway 2 miles north of Grandview.

Acanthoceras n. sp. 6, aff. **cunningtoni** var. **cornutum** KOSSMAT 1895, Unt. Südind. Kr. Form., pl. V, figs. 1 a–c.

The spacing of the ribs, the shape of the outwardly directed conical tubercles, and the suture, are practically identical with those figured by KOSSMAT. The Texan specimens at hand differ from KOSSMAT'S material in the arrangement of tubercles on the venter: the line of fine mid-line tubercles is lacking in the Bell County fossils, and the ribs make a noticeable smooth elevation in crossing the venter. This shell is 5 mm. thick between the ribs.

Eagle Ford (flag member): Near Belton-Temple highway, locality 2410.

Acanthoceras n. sp. 7.

This species also has the general form of var. *cornutum* KOSSMAT, but has very coarse clavate (or alate) enlargements on either side of the venter; there is a radial swelling at the umbilical end of each rib; the ribs cross the venter as a prominent smooth elevation; there is no median tubercle.

Eagle Ford (*flag member*): Near Belton-Temple highway, locality 3410.

VASCOCERATIDAE Spath[48] 1925, Ann. Transv. Mus. XI, 198

This family is not yet recorded from Texas, but occurs at two localities in northern Mexico (Mohovano, on the Coahuila-Chihuahua boundary; and region of Piedra de Lumbre, west of Cuatro Cienegas, Coahuila), and one in Montana, and will likely be found in Texas in the Eagle Ford (or Woodbine). The main genera are *Vascoceras* Choffat; *Fagesia* Pervinquière; *Thomasites* Pervinquière; *Plesiovascoceras* Spath.

MAMMITIDAE Hyatt 1903, **61**, p. 24

So far no species of this family has been recognized with certainty from Texas. They are to be looked for in the Eagle Ford formation.

METOICOCERATIDAE Hyatt

METOICOCERAS HYATT 1903, 61, 115

Discoidal, subangustumbilicate, flat to inflated flanks, ribs generally alternate in size, umbilical and ventral tubercles variably developed; characteristic suture. Horizon: Eagle Ford. First species described: *M. swallovi* (Shumard).

Metoicoceras swallovi (SHUMARD) 1860, **89**, 591 (*Ammonites swallovi*). HYATT 1903, **61**, 118, pl. XI, figs. 7–24; pl. XII, figs. 1–2; pl. XV, figs. 1–4.

Flanks rather rounded, ribs broadly rounded, umbilical and ventral tubercles prominent, not elongated; subangustumbilicate (u=.21).

Eagle Ford: Grayson County (type locality).

Metoicoceras gibbosum HYATT 1903, **61**, 121, pl. XV, figs. 5–8.

Volutions stouter and broader than in other species of the genus, and do not become compressed in the adult stages; umbilicus same relative size as in *M. swallovi*, larger and smoother than in *M. whitei*.

Type locality: "Texas." Horizon: **?Eagle Ford.**

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[48]Kossmat, 1895, Unt. Südind. Kreide Form. Pervinquière, 1907, Etudes de paleontologie tunisienne, Cephalopoodes; Paris. Böse, 1920, Nniv. Texas Bull. 1856. Böse and Cavins, 1928, Univ. Texas Bull. 2748. Reeside, 1927, U. S. Geol. Surv. Prof. Paper 151.

Metoicoceras whitei HYATT 1903, **61**, 122, pl. XIII, figs. 3–5; pl. XIV, figs. 1–10, 15..**Plate XXVI, figures 1–2**

Flanks flatter and ribs more numerous than in *M. swallovi*, umbilical nodes less prominent, and the ventral nodes clavate (elongated circularly). Umbilicus narrow (u=.12).

Eagle Ford: Elm Fork, Dallas County (type locality).

Metoicoceras acceleratum HYATT 1903, **61**, p. 127, pl. XIV, figs. 11–14.

Tubercles practically lacking; adult stage reached at small diameter, at 28 mm. diameter the living chamber occupies three-fourths of a volution.

Eagle Ford: Elm Fork, Horton's Mill, Dallas County (type locality).

Metoicoceras irwini MOREMAN 1927, **73**, p. 92, pl. XIII, figs. 3–4.

Species small, flat-flanked, with numerous low ribs which diminish toward umbilicus; umbilicus wide (u=.18), smooth.

Eagle Ford: Six miles northwest of Irving (? type locality).

PRIONOTROPIDAE Hyatt 1903, 61, p. 24

Keel entire or very minutely serrate in adult..................**Prionocyclus**
Keel serrate or nodose in adult..**Prionotropis**

PRIONOTROPIS MEEK 1876, 75, p. 453

"Shell, when very young, with costae sharply defined, and as the whorls increase in size, becoming more distant, without having the intervening spaces occupied by smaller ones; on the last turn, costae and their nodes becoming very prominent, and the keel depressed and broken into a series of isolated, elongated nodes." Genotype: *Prionotropis woolgari* MEEK 1876, **71**, pl. VII, figs. 1 a–h (no individual yet designated).

Prionotropis graysonensis (SHUMARD) 1860, **89**, 593. WHITE 1883, **106**, 39, pl. XVIII, figs. 9 a–b *(Ammonites)*. STANTON 1893, U. S. Geol. Surv. Bull. 106, pp. 48, 177. Not *Schloenbachia graysonensis* BAKER 1927, Univ. Texas Bull. 2745, p. 29.

This species as figured, is laterally compressed, with rather straight flanks and tall cross-section (h/t=1.5), umbilicus rather wide (u=.43); ribs sigmoidal, somewhat coarse, about 42 on last volution, mostly unbranched (a few branched or alternate in length); keel serrate. In the collections at hand, there are some fossils both large and micromorph, which have essentially these features.

Eagle Ford: Fannin County, Lowell's Bluff; and 4 miles north of Sherman, with *Scaphites vermiculus* SHUMARD (type localities). Eagle

Ford scarp on Speegleville road about 4 miles southwest of Waco; Arcadia Park, Dallas County; Austin (exact locality unknown).

Prionotropis sp. 2, aff. *Gauthiericeras bravaisi* MOREMAN 1927, **73,** pl. XIV, fig. 2, not *Ammonites bravaisianus* D'ORBIGNY, Pal. franç., terr. crét., Céph., pl. XCI, figs. 3–4.

Apparently laterally compressed, volutions expanding rapidly, umbilicus wide (u=.37). Ribs sigmoidal, generally alternately long and short or else branched, about 48 on the last whorl, many with a double line of nodes on the ventro-lateral shoulder. *A. bravaisianus* d'Orbigny is generally listed as *Prionotropis* or *Prionocyclus.*

Eagle Ford (upper): Denton County; Hill County, northeast of Maypearl; McLennan County, west of Waco.

Prionotropis aff. **hyatti** STANTON 1893, U. S. Geol Surv. Bull. 106, 176, pl. XLII, figs. 5–8.

Cross-section of whorl nearly quadrate, coiling rather evolute, umbilicus wide (u=.38); ribs prominent, mainly similar, unbranched, angular, widely spaced, some with prominent radial tubercles near the umbilical margin and with conical tubercles on the ventro-lateral shoulder. Stanton's pl. XLII, fig. 7 has some ribs more elevated, and some micromorphs from McLennan County show the same feature. These ammonites are micromorphs, less than 5 mm. in diameter.

Eagle Ford: McLennan County, Bosque Escarpment near Speegleville road (hematite micromorphs from ant hills); "Austin," exact locality unknown.

Prionotropis aff. **woolgari** STANTON 1893, U. S. Geol. Surv. Bull. 106, 174, pl. XLII, figs. 1–2. MEEK 1876, **71,** pl. 7, figs. 1 c–d.

Specimens at hand resemble somewhat these figures. The species is doubtless not identical with that of Mantell.

Eagle Ford: "Austin," exact locality unknown.

Prionotropis eaglensis n. sp. .... **Plate XXXII, figures 1–2**

The holotype is a fragment of the outer whorl of an ammonite of about 330 mm. diameter, and shows clearly the form, ornamentation and suture. Another very eroded ammonite of 430 mm. diameter, from the same locality, may be this species. The dimensions of the holotype are:

Diameter (estimated)	330 mm.	
Height of last whorl	88 mm.	=26.7%
Thickness[49] of last whorl	89 mm.	=27 %
Umbilicus	135 mm.	=41 %

Form discoidal, inflated, evolute, sublatumbilicate, cross-section of whorl quadrate-trapezoidal on ribs, short oval on interspaces, flanks

[49]Thickness including the prominent shoulder tubercles is 96 mm.

convex on interspaces, widening towards ventral shoulder on ribs; umbilical wall vertical; keel low, broad, continuous. Ribs unbranched, remote, low and broad, obsolete towards umbilical margin, expanded at ventro-lateral margin to form elevated, broad, upwardly and outwardly directed shoulder tubercles. There are 2 ribs on the holotype (fragment of 170 mm. length), apparently about 6 ribs per half volution. The coiling is evolute: the whorl apparently embraces the preceding one only slightly, about 12 per cent in the large example, less than 5 per cent in the holotype. This species lacks umbilical nodes.

The general form resembles that of *Prionotropis* in several features; degree of evoluteness, ribbing, strong marginal node, no umbilical node, and cross-section. The suture agrees in general with that of *Prionotropis* (type: *P. woolgari* MEEK 1876, **71**, pl. VII), but is rather undiagnostic, in that it has features in common with *Acanthoceras* and other genera. Specifically however, it is peculiar in having the inflections of the lobes very slender and pointed. The ammonite differs from *Mammites* in the greater persistence of the keel, which is low, broad and continuous, in the nodose, quadrate, depressed cross-section, the absence of umbilical tubercles, and the very evolute coiling (in *Mammites* about one-third of a whorl overlaps on the next inner one); the main differing character of the suture is the broad third saddle.

The suture in general resembles that of *Mammites*,[50] especially in the breadth of the first saddle, which although it lies more on the truncate venter and less on the flank, still occupies almost half the breadth from venter to umbilical wall. The first lateral lobe is at least as long as the siphonal lobe, and is irregularly quadrifid with pointed and spreading lobules. The second saddle is tall, narrow and bifid. The third saddle is unusually broad, even broader than the second, and is nearly symmetrically bifid; in this feature it differs from *Mammites*. The fourth lobe is bifid, shorter than the third, and lies on the edge of the umbilical wall.

Eagle Ford: Culberson County, Chispa sheet, east flank of Eagle Mountains, southeast of Oxford Mountains, 10 miles south of Dalberg station (type locality). Holotype and other specimen mentioned were collected here by Baker. Another example comes from topmost Eagle Ford, Bouldin Creek, South Austin, within a few inches of the Austin chalk contact (coll. Stephenson, 1928). These individuals may not all be specifically identical.

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[50]Laube and Bruder, 1887, Ammoniten der böhmischen Kreide, Paleontogr., Vol. XXXIII, pp. 229–232, text figs. on pp. 118–119. Böse, 1920, Univ. Texas Bull. 1856, p. 206, pl. 12.

MORTONICERATIDAE Spath 1925, Ann. Transv. Mus., XI, 199

MORTONICERAS MEEK 1876

Discoidal, sublatumbilicate ammonites with flattened flanks bearing three or more rows of prominent tubercles on the ribs; a prominent carina, and on either side of it a row of circularly elongated ventral tubercles, giving in some species the effect of three closely spaced keels. Cross-section tall. Genotype: *Ammonites texanus* ROEMER 1852, **78**, pl. III, figs. 1 a–c.

Mortoniceras americanum (LASSWITZ).

Schloenbachia bourgeoisi D'ORBIGNY, emend. GROSSOUVRE, var. *americana* LASSWITZ 1904, **67**, p. 32, pl. VIII, fig. 1.

Austin chalk: Austin (Capitol, and Shoal Creek, type localities).

Mortoniceras minutum (LASSWITZ).

Schloenbachia quinquenodosa REDTENBACHER, var. *minuta* LASSWITZ 1904, **67**, 31, pl. VIII, fig. 4.

Mortoniceras lasswitzi YABE AND SHIMIZU 1923, **116**, p. 30.

Austin chalk: Capitol, Austin (type locality).

Mortoniceras quattuornodosum (LASSWITZ) 1904, **67**, 31, pl. VII, fig. 3, and text figure 7 (on page 31) *(Schloenbachia)*.

Austin chalk: Capitol at Austin (type locality).

Mortoniceras quattuornodosum var. **planatum** (LASSWITZ) 1904, **67**, 32, pl. VII, fig. 4 *(Schloenbachia)*..........**Plate XXXIV, figure 3**

Austin chalk: Capitol at Austin (type locality).

Mortoniceras roemeri YABE AND SHIMIZU 1923, **116**, p. 30.

Schloenbachia texana LASSWITZ (not ROEMER 1852), **67**, 30, pl. VII, fig. 2.

Austin chalk: Capitol at Austin (type locality); another individual stated to come from "Torresburgh, Montague County."

Mortoniceras texanum (ROEMER) 1852, **78**, 31, pl. III, figs. 1 a–c *(Ammonites)*.

Austin chalk: Austin, and waterfall of Guadalupe River below New Braunfels (type localities).

Barroisiceras dentatocarinatum (ROEMER) 1852, **78**, 33, pl. I, fig. 2.

Austin chalk: Below New Braunfels, waterfall of Guadalupe River (type locality).

PARAHOPLITIDAE

Parahoplites sp.

Glen Rose: Western Travis County.

Dufrenoya texana BURCKHARDT 1925, Faunas del Aptiano de Nazas (Durango). Inst. Geol. Mexico, Bol. 45, pp. 18, 20, 61, pl. IX, figs. 2–15. LASSWITZ 1904, **67**, p. 4 (text fig. 1).

Travis Peak: Western Travis County (Cow Creek).

Dufrenoya justinae (HILL) 1893, **55**, 38, pl. VII, figs. 1–3 *(Ammonites)*. BURCKHARDT 1925, *op. cit.*, pp. 17, 61, pl. X, figs. 14–15.

Travis Peak: Western Travis County.

Upper Aptian: Durango.

Dufrenoya roemeri (CRAGIN) 1893, **21**, 234, pl. XLIV, figs. 4–5. BURCKHARDT 1925, *op. cit.*, pp. 18, 61.

Travis Peak: Western Travis County.

Dufrenoya hoplitoides (LASSWITZ) 1904, **67**, 19, pl. III, figs. 3 a–b *(Acanthoceras)*. BURCKHARDT 1925, *op. cit.*, pp. 18, 61.

Horizon?: Austin, and Shoal Creek (type localities). Burckhardt lists this fossil from the Trinity beds, but this assignment is by no means certain. In some ways it suggests *Eucalycoceras* from the Eagle Ford. Holotype was examined and photographed at Breslau.

PLACENTICERATIDAE Hyatt 1903, 61, 188

No true keel; venter concave, flat, rounded, or even acute; principal lateral saddles bifid in young, or becoming trifid in adult; secondary inflections may be numerous.

PLACENTICERAS MEEK 1870

"Shell with the very narrow periphery truncated, and often provided with a row of compressed alternating nodes along each margin; volutions each about three-fourths embraced by the next succeeding outer one; septa with the lateral sinuses provided with more or less branched and digitate terminal divisions; umbilicus small or moderate." Genotype: *Ammonites placenta* Dekay.

Placenticeras guadalupae (ROEMER) 1852, **78**. HYATT 1903 **61**, 197, pl. XXIX, figs. 1–4.

San Carlos beds: San Carlos.

Placenticeras pseudoplacenta HYATT 1903. MOREMAN 1927, **73**, pp. 92, 95.

Eagle Ford: Locality not stated.

Placenticeras cumminsi CRAGIN 1893, **21**, 237.

Eagle Ford:

Placenticeras sancarlosense HYATT 1903, **61**, 200, pl. XXX, figs. 1–3; pl. XXXI, figs. 1–2.

San Carlos beds: San Carlos.

Placenticeras sancarlosense var. **pseudosyrtale** HYATT 1903, **61**, 200, pl. XXXII; pl. XXXIII, fig. 1.

Upper Cretaceous: Locality unknown, stated to be Fort Worth, Texas.

Placenticeras planum HYATT 1903, **61**, 202, pl. XXIII, figs. 2–4; pl. XXXIV.

San Carlos beds: San Carlos; Presidio del Norte, Chihuahua.

Placenticeras newberryi HYATT 1903, **61**, 203, pl. XXXI, figs. 3–5.

San Carlos beds?: Presidio del Norte, Chihuahua.

Placenticeras syrtale (MORTON). HYATT 1903, **61**, 205, pl. XXVII, figs. 15–17; pl. XXVIII, figs. 1–6. BÖSE 1928, **10**, 272, pl. XII, figs. 1–7.

Upper Taylor (Upper Santonian): Northern Mexico (Böse); Hyatt gives it from Fort Worth, Texas, an erroneous locality designation.

Placenticeras stantoni var. **bolli** HYATT 1903, **61**, 214, pl. XL, figs. 3–7; pl. XLI; pl. XLII; pl. XLIII, figs. 1–2.

Eagle Ford: Elm Fork and West Fork, Dallas and Tarrant counties.

Placenticeras pseudoplacenta var. **occidentale** HYATT 1903, **61**, 217, pl. XLV, figs. 1–2. MOREMAN 1927, **73**, pp. 92, 95.

Eagle Ford: Dallas County, Elm Fork, and West Fork (Horton's Mill).

Placenticeras whitfieldi HYATT 1903, **61**, 221, pl. XLV, figs. 3–16; pl. XLVI; pl. XLVII, figs. 1–4. BÖSE 1928, **10**, 276, pl. XIII, figs. 1–3.

San Miguel beds: Near Piedras Negras, Coahuila.

SPHENODISCIDAE Hyatt 1903, 61, 56

"Keeled venters; 3 principal lateral lobes and saddles, and numerous auxiliary lobes and saddles which are more distinctly phylliform than is usual in the Tissotidae."

SPHENODISCUS MEEK 1876, 70, 463

"Shell with periphery cuneate; umbilicus very small; volutions each almost entirely embraced by the succeeding one; septa with the first 5 or 6 lateral sinuses provided with only a few short, nearly simple, obtuse divisions, while the others are simple, and usually broadly reniform at the ends." (MEEK 1876, **70**, 463) Genotype: *Ammonites lobatus* Toumey.

Sphenodiscus pleurisepta (CONRAD) 1857, **18**, 159, pl. XV, figs. 1 a–c. HYATT 1903, **61**, 59, pl. III, figs. 7–15; pl. IV; pl. V, figs. 1–3; pl. VI, fig. 6. BÖSE 1928, **10**, 304, pl. XVII, figs. 2–5.

Eagle Pass beds: Near Laredo, near Eagle Pass, "Rio Pecos" (doubtful); Arroyo Caballero, near Hda. Cerro Prieto, Coahuila.

Sphenodiscus stantoni HYATT 1903, **61**, 70, pl. V, fig. 4; pl. VI, fig. 5.

Eagle Pass beds: Eighteen and one-half miles southeast of Eagle Pass.

Sphenodiscus lenticularis OWEN. HYATT 1903, **61**, 71, pl. VIII, figs. 1–2; pl. IX, figs. 1–6. BÖSE 1928, **10**, 293, pl. XIV, figs. 9–11.

Basal Escondido (basal Maestrichtian): Mesa de los Cartujanos, near Lampazos, Nuevo Leon; Rancho Jabalí, near Lampazos; near Progreso, Coahuila; road between Rancho Azulejo and Rancho Longoria, Coahuila; western interior Cretaceous.

SPHENODISCUS INTERMEDIUS BÖSE 1928, **10**, 295, pl. XV, figs. 1–5.

Lower Escondido (lower Maestrichtian): Near Jabalí ranch; near Azulejo ranch; road from Progreso to Saltillito, northern Mexico.

SPHENODISCUS PREPLEURISEPTA BÖSE 1928, **10**, 298, pl. XV, figs. 6–10.

Lower Escondido beds (lower Maestrichtian): Localities near Lampazos and Villa de Juarez, Coahuila.

SPHENODISCUS ABERRANS BÖSE 1928, **10**, 301, pl. XVI, figs. 1–3; pl. XVII, fig. 1.

Highest Escondido (upper Maestrichtian): Arroyo Caballero, Coahuila, and 4 miles northwest of the Nuevo Laredo-Piedras Negras road crossing of this arroyo.

COAHUILITES BÖSE 1928, 10, 279

Form discoidal, whorls higher than broad, very involute; young stage with sagittal cross-section and sharp keel; medium stage subhexagonal, its cross-section with roof-like venter and a keel-like line in middle; mature stage subrectangular, with slightly convex almost flat, venter with relatively sharp shoulders. Two rows of tubercles, one in middle of flank, the other near ventral shoulder.

Suture straight; a broad siphonal lobe with two branches forming a very wide angle and the siphonal saddle low and broad; external saddle divided into two branches by deep adventive lobe; first and second saddles indented, others entire. First lateral lobe taller than others, with narrow stem, irregularly bifid. Genotype: *C. sheltoni* BÖSE. *Maestrichtian (Escondido).*

Coahuilites differs from *Sphenodiscus* in having one adventive lobe in the external saddle instead of two, and in having the saddles simpler; and from *Placenticeras* in the features just mentioned, and in form and ornamentation.

COAHUILITES SHELTONI BÖSE 1928, **10**, 283, pl. XIII, figs. 4–11.

Early stages sagittal in cross-section, with sharp keel; later becomes subhexagonal, tall, with rather rounded venter with the keel remaining as a raised line. Large individuals with 2 rows of tubercles, 7–8 in the umbilical row and about 16 in the shoulder row. Ventral branch of external saddle undivided (in other species it has a deep secondary lobe).

Basal Escondido: Near Alamo Viejo, San Patricio, and Mesillas, Nuevo Leon, Mexico (type localities). Not yet reported from Texas.

COAHUILITES ORYNSKII BÖSE 1928, **10**, 287, pl. XIV, figs. 1–3.

Adult section rounded-subrectangular; 2 rows of tubercles; tubercles much less numerous than in *C. cavinsi;* ventral branch of external saddle divided; has strong tubercles like *C. sheltoni,* but tubercles not alternate, and differently arranged.

Basal Escondido: Las Mesillas, Nuevo Leon (type locality); holotype, Bureau of Economic Geology; unknown from Texas.

COAHUILITES CAVINSI BÖSE 1928, **10**, 290, pl. XIV, figs. 4–8.

Lower Escondido: Near Santa Cruz and Progreso, Nuevo Leon (type localities).

CRIOCERATIDAE Hyatt[51]

" . . . with only two lines of tubercles on either side of the median line of the venter. The latter may have a smooth zone or be crossed by the costae, which are either single or double between the tubercles" (HYATT).

CRIOCERAS D'ORBIGNY

Genotype: *C. duvali* LEVEILLE.

Crioceras n. sp. (*"cf.* latus GABB," UDDEN 1907, **100**, p. 33).

Open spiral, with widely spaced, prominently elevated ribs which exteriorly become stronger and are ornamented with spines.

Terlingua beds (Austin chalk?): Fossil Knobs, north of Terlingua. Udden says: "This fossil is quite common on the upper surface of one or two somewhat indurated ledges a little above the middle of the [Terlingua] formation." Numerous localities in Terlingua quadrangle: Terlingua Creek, north of Crenshaw Camp; east quadrant of Solitario rim, outside Left Hand Shut-up; one-half mile west of Black Tinaja. Chisos sheet: West slope of Mariscal Mountain.

STEPEOCERATIDAE Neumayr

SCAPHITINAE Meek

Following Reeside's revision of this group, most species of the Texas Comanchean so far reported are placed in *Scaphites* Parkinson.

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[51]Etheridge, R., Jr., Lower Cretaceous fossils from the sources of the Barcoo, Ward and Nive Rivers, Southern-Central Queensland. Rec. Austr. Mus., VII, no. 3, 135–165, pls. XXX–XLIX, and fig. 8. Sarasin and Schöndelmayer, 1902, Mém. Soc. Pal. Suisse, Vol. XXIX.

Several undescribed upper Cretaceous species from Texas are insufficiently known to permit their generic assignment.

SCAPHITES PARKINSON

Shell with discoid portion thickened in most species, and an unrolled straight limb ending in a hook. Ribs irregularly split on the flank subequal over the venter. Tubercles or nodes reduced or absent. Suture with trifid lobes, becoming bifid in later stages; internal lobe trifid. Genotype: *Scaphites aequalis* SOWERBY. Range: Albian-Cenomanian-Upper Cretaceous.

Scaphites (?) worthensis ADKINS AND WINTON.

Scaphites worthensis ADKINS AND WINTON 1920, **3**, 36, pl. VII, figs. 1–2.

Scaphites sp. B. WINTON AND ADKINS 1920, Univ. Texas Bull. 1931, p. 46.

Scaphites aequalis ("et *Scaphites obliquus*") SCOTT 1926 (not *Sc. aequalis* SOWERBY), **85, p. 149.**

Macroscaphites ? *worthensis* REESIDE 1927, U. S. Geol. Surv. Prof. Paper 150-B, p. 36.

The suture of this species has not been published but it seems similar to that of the *S. hugardianus* group, and is entirely different from the suture of *Macroscaphites ivani.* It is likewise distinct from *Scaphites aequalis,* unless one considers all scaphites to belong to the same species.

Upper Duck Creek: Three miles southwest of Fort Worth; 2 miles north of Denison; near Fink.

Scaphites hilli ADKINS AND WINTON.

Scaphites hilli ADKINS AND WINTON 1920, **1**, 37, pl. VII, figs. 3–6. WINTON AND ADKINS 1920, Univ. Texas Bull. 1931, p. 21. ADKINS 1920, **1**, 79, pl. II, figs. 1–2. REESIDE 1927, U. S. Geol. Surv. Prof. Paper, 150-B, p. 30.

Scaphites sp. A. WINTON AND ADKINS 1920, Univ. Texas Bull. 1931, pp. 21, 69.

Scaphites aequalis SCOTT (not SOWERBY) 1926, **85**, p. 149 .... **Plate XX, figures 1–3, 7**

This species is rather obese and has a prominent umbilical swelling and a mid-ventral groove; it cannot be characterized by its suture until the sutures of related species are better known.

Pawpaw: Near Fort Worth (714, type locality). Holotype: Bureau of Economic Geology.

Scaphites bosquensis BÖSE 1928, **10**, p. 224, pl. VII, figs. 1–6.

"*Scaphites bosquensis* belongs to the group of *Scaphites aequalis,* but differs from the original type by its ornamentation and by its relatively much greater width and the wide umbilicus. The species has some similarity with *Scaphites hilli* ADKINS AND WINTON. In this latter species the undivided ribs on the umbilical border are long, while such are not developed on our specimen. The suture is different. The adventive lobe which divides the external saddle is much deeper than in *S. bosquensis*, the first lateral lobe is much broader and clearly bifid. There is no doubt that in larger specimens of this species the first lateral lobe will also become bifid, but in our individual which is a little larger than the one from which the suture illustrated by Adkins is taken, the first lateral lobe is not yet in a mature stage, while this is the case in the fossil from the Pawpaw beds."

Del Rio: McLennan County, Locality 964, type locality (holotype in Bureau of Economic Geology).

Scaphites sp. aff. **aequalis** var. **turonensis** ROMAN AND MAZERIN 1920, Faune turon. basin d'Uchaux, 12, pl. IV, figs. 10–14..**Plate XXIV, figures 1–2**

This species is very similar in form to the real *Scaphites aequalis* as found in the Upper Cenomanian at Rouen, on the Isle of Wight and elsewhere in western Europe (D'ORBIGNY, Pal. franç., terr. crét., Céph., pl. CXXIX, fig. 1, also this paper, pl. XXIV, figs. 4–5), but differs in having sparser ribs over the venter, both on the coiled portion and on the extended limb. The secondary ribs on the flank also appear to be fewer.

Upper Eagle Ford: Bouldin Creek, South Austin, at a level about 1.5 feet below the Austin chalk contact (Dr. L. W. Stephenson, 1928, two individuals, one showing the extended portion). Near Midlothian (in the "*Prionotropis woolgari*" zone, about 100 feet below the top of the Eagle Ford; fragment showing coiled portion; Dr. Gayle Scott). McLennan County, Blue Cut of the Santa Fe Railway (Professor W. M. Winton).

Scaphites verrucosus SHUMARD 1862, **90**, 189. HILL 1889, **52**, p. 24. REESIDE 1927, U. S. Geol. Surv. Prof. Paper, 150-B, 27, 36.

Medium-sized species (about 62 mm. long). Coil with volutions slightly embracing (umbilicus wide); hook short, one-fourth the entire length of shell, terminal end recurved so as to bring the aperture near the coil; aperture semi-elliptical. Ornamented with small, moderately distinct, rounded costae with 3 or 4 revolving rows of small nodes on living chamber.

Navarro (?): Dresden. Shumard says "in strata supposed to be of the age of the Austin limestone." He presumably confused a limestone in the Navarro formation with the Austin chalk.

Scaphites sp.

Navarro: Near Corsicana.

Scaphites hippocrepis (DEKAY) 1827. REESIDE in STEPHENSON 1923, **96**, p. 58.

Anacacho: McKinney County (Coll. Dr. J. A. Udden).

Scaphites subevolutus BÖSE..............................**Plate XXIII, figure 10**

BÖSE 1928, **10**, p. 225, pl. VII, figs. 7–30. *Scaphites* aff. *evolutus* ADKINS 1924, Univ. Texas Bull. 2340, pp. 56, 57.

Volution higher than wide in young, wider than high in later stages, very evolute. About 20 strong primary ribs on the flank which over the venter becomes thin and similar to the 3 or 4 secondary ribs intercalated between every two primaries. Closest to *S. evolutus* and *S. peroni* of northern Africa, and unlike any other American species.

Del Rio: McLennan County, numerous localities; Terlingua.

Scaphites septem-seriatus CRAGIN.

Scaphites septem-seriatus CRAGIN 1893, **21**, p. 240.

Scaphites septem-costatus REESIDE 1927, U. S. Geol. Surv. Prof. Paper 150-B, pp. 27, 34.

Suture unknown; ornamentation consists of 1 primary and 2 secondary close-set ribs with compressed tubercles.

Eagle Ford: Dallas County, Keenan's Crossing of Trinity River (holotype).

Scaphites texanus ROEMER 1852, **78**, 35, pl. I, figs. 4 a–c.

Discoidal portion with rather thick oval volution; narrow umbilicus; about 16 straight, thick primary ribs ending in ventro-lateral nodes, and over the venter about 18 subequal fine ribs, 2 secondaries being intercalated between each 2 primaries.

Eagle Ford: New Braunfels (holotype).

Scaphites semicostatus ROEMER 1852, **78**, 35, pl. I, figs. 5 a–b.

Somewhat like preceding species, but volution more square; and primary ribs obscure with 3 rows of nodes on the flank.

Austin chalk (?): New Braunfels (type locality).

Uncertain position

Scaphites vermiculus SHUMARD 1860, **90**, 594. REESIDE 1927, U. S. Geol. Surv. Prof. Paper 150-B, p. 35. HILL 1889, **52**, p. 24. WHITE, C. A., 1883, **106**, 39, pl. XVIII, fig. 8. MEEK 1876, **70**, p. 419 (as *Macroscaphites).*

Meek says: "At one time I was inclined to think a very small species described by Dr. Shumard from the Cretaceous rocks of

Texas, under the name *Scaphites vermiculus*, might be identical with this [*S. larvaeformis* MEEK AND HAYDEN]; but a sketch of that species sent to me some years back by Dr. Shumard shows it to be entirely distinct, being even a more slender, differently marked shell, with a proportionately much larger umbilicus, and a longer deflected body portion; that is to say, it presents the characters of the distinct section *Macroscaphites*." Generic assignment of White's figure is impossible, and awaits further fossils.

Eagle Ford, in septaria: Four miles north of Sherman (type locality). Fossils of the same size and shape occur at Fossil Knobs just north of Terlingua in limestone slabs in the Terlingua formation (?Austin chalk equivalent), with *Crioceras* and a belemnite. Apparently the same species in road cuts between McGregor and Moody.

Scaphites sp. HILL 1901, **57**, p. 302.

Woodbine: Pine Bluff, Lamar County. This species has not been rediscovered.

ENGONOCERATIDAE Hyatt 1903, 61, p. 153

The following genera have been placed in this family:

Engonoceras Neumayr 1875	Genotype:	E. pierdenale v. Buch
Metengonoceras Hyatt 1903		inscriptum Hyatt
Protengonoceras Hyatt 1903		gabbi Böhm
Parengonoceras Spath 1924		Amaltheus ebrayi de Loriol
Epengonoceras Spath 1924		dumblei Cragin
Hypengonoceras Spath 1921		Placenticeras warthi Kossmat
Neolobites Fischer 1887		Amm. vibrayeanus d'Orbigny

Of the recorded North American species and varieties, one (*Engonoceras belviderense* Cragin, and some varieties) was described from the Belvidere beds of Kansas; one (*Protengonoceras gabbi* Böhm) is from the Fredericksburg Cretaceous of Arivechi, Sonora; and the other 21, listed below, have been recorded from the Texan Cretaceous at the following horizons (complete ranges not yet known):

Glen Rose: Eng. roemeri Cragin
Fredericksburg: Eng. pierdenale v. Buch
Eng. gibbosum Hyatt
Eng. stolleyi Böhm

Eng. complicatum Hyatt
Met. inscriptum Hyatt
Met. inscriptum var. Hyatt
Walnut: Met. hilli Böhm
Prot. emarginatum Cragin
Comanche Peak: Met. ambiguum Hyatt
Eng. belviderense var. mons-comancheanum Cragin
Eng. belviderense var. clavatum Cragin
Goodland: Eng. pierdenale var. commune Hyatt
Washita: Eng. serpentinum Cragin
Eng. subjectum Hyatt
Grayson-Del Rio: Eng. uddeni Cragin
Eng. retardum Hyatt
Eng. bravoense Böse
Eagle Ford: Met. acutum Hyatt
Prot. planum Hyatt
Ep. dumblei Cragin

Venter flat or with nodose edges, in later stages often with zig-zag outline; flank with as many as three lines of nodes...... **Engonoceras**
Venter concave, broad; flank generally smooth, but with ridges in later stages........ **Protengonoceras**
Venter acute in ephebic stage, later rounded; flanks generally without nodes........ **Metengonoceras; Epengonoceras**

PROTENGONOCERAS Hyatt

Protengonoceras planum Hyatt 1903, **61**, 156, pl. XVIII, figs. 6–9.

Flat, smooth flanks; attenuated venter; about 10 saddles.

Horizon and locality unknown; matrix similar to that of the Eagle Ford at Horton's Mill, Dallas County.

Protengonoceras? emarginatum (Cragin).

Sphenodiscus ? emarginatum Cragin 1893, **21**, p. 245.
Protengonoceras ? emarginatum Hyatt 1903, **61**, p. 157.

Umbilical and median tubercles present; saddles bifid.

Walnut: Two miles south of Pleasant Point (type locality).

ENGONOCERAS Neumayr

Engonoceras roemeri (Cragin).

Sphenodiscus roemeri Cragin 1903, **21**, pl. XLVI, fig. 1.
Engonoceras roemeri Hyatt 1903, **61**, p. 177.

Venter sharply truncate, later sinuous and tuberculate; principal saddles bifid, trifid, or quadrifid.

Glen Rose: Near Iredell (type locality).

Engonoceras belviderense var. **mons-comancheanum** (CRAGIN).

Sphenodiscus belviderensis var. *mons-comancheanus* CRAGIN 1900, **26**, p. 9, pl. I, fig. 5.

Saddles simple or bifid; umbilical tubercles present.

Comanche Peak: Tarrant County (type locality).

Engonoceras belviderense var. **clavatum** (CRAGIN).

Sphenodiscus belviderensis var. *clavatus* CRAGIN 1900, **26**, p. 11, pl. II, figs. 1–3.

Suture simpler than preceding.

Comanche Peak: Tarrant County (type locality; two cotypes).

Engonoceras uddeni (CRAGIN).

Sphenodiscus belviderensis var. *uddeni* CRAGIN 1900, **26**, 10, pl. I, figs. 3–4 (from Kiowa shale, near Lindsbourg, Kansas, type locality).

Engonoceras uddeni HYATT 1903, **61**, 159, pl. XIX, figs. 1–6.

Umbilical tubercles present; venter flattened to an advanced stage; 10 lobes and 11 saddles present.

Grayson: North of Pottsboro.

Engonoceras serpentinum (CRAGIN)........................**Plate XIX, figure 1**

Sphenodiscus belviderensis var. *serpentinus* CRAGIN 1900, **26**, 11, pl. II, figs. 4–6. HYATT 1903, **61**, 162, pl. XIX, figs. 7–14; pl. XX, figs. 1–5.

Protengonoceran type of venter (concave bounded by two sharp ridges) retained to late stage, followed by rounded venter with alternate (zig-zag) nodes.

Pawpaw: Near Denison (type locality); and 4.5 miles northeast of Gainesville; Brickyards, east of Gainesville.

Engonoceras pierdenale (VON BUCH)........................**Plate III, figure 4**

Ammonites pierdenalis VON BUCH 1848, Abh. K. Akad. Wiss. Berlin, 31, pl. VI, figs. 8–10. HYATT 1903, **61**, 165, pl. XX, figs. 6–13. LASSWITZ 1904, **67**, p. 12. ROEMER 1852, **78**, 34, pl. I, fig. 3.

Fredericksburg: Austin, Lampasas; Fredericksburg (type locality).

Engonoceras pierdenale var. **commune** HYATT 1903, **61**, 165, pl. XXI, fig. 1.

Glen Rose: Seven Knobs and Chalk Mountain, near Glen Rose.

Goodland: "Choctaw Nation, about 100 miles east of Preston, Texas."

Fredericksburg?: Towash, Hill County. *Horizon unknown:* Bell County.

Engonoceras subjectum HYATT 1903, **61**, 168, pl. XXI, figs. 2–6; pl. XXII, figs. 1–5.

More elongated and phylliform saddles and lobes than in other species.

Washita: Gabriel, Williamson County (?type locality); Grayson, Texas; Tarrant County.

Duck Creek: Near Denison.

Engonoceras gibbosum HYATT 1903, **61**, 171, pl. XXII, figs. 6–10; pl. XXIII, figs. 1–6.

"The more gibbous sides, the prolonged stage during which the nodes persist and are sharply defined, and the large number of bifid saddles characterize this species. The sutures are the most complex, with the exception of *Eng. roemeri*, of any that have been so far described in the genus."

Fredericksburg: Cooke County; 15 miles west of Denison; 15 miles southwest of Gainesville; Bell County.

Engonoceras stolleyi BÖHM..**Plate III, figure 5**

Engonoceras stolleyi BÖHM 1898, **7**, Vol. L, pl. V. HYATT 1903, **61**, 175, pl. XXIII, figs. 7–9; pl. XXIV, figs. 1–5. LASSWITZ 1904, **67**, 13, pl. I, fig. 3. ADKINS 1927, **2**, pl. II, fig. 5. BÖSE 1910, **8**, 81, pl. XI, figs. 4–16.

Flattened venter, becoming alternately nodose and zig-zag in old age; like *E. piedernale* except for sutures, which have the lateral saddles and lobes smaller than in any other species of the genus, and the first lateral saddles are apt to have the inner marginal saddles tongue shaped.

"Fredericksburg group?" (HYATT).

Comanche Peak: Valley Mills.

Horizon unknown: Austin and Lampasas (type localities?; co-types, Museum of University of Breslau).

Engonoceras complicatum HYATT 1903, **61**, 175, pl. XXIV, figs. 6–8.

Sutures crowded; ventral lobe narrower and deeper than in other species.

Fredericksburg: Austin (type locality); Benbrook.

Engonoceras retardum HYATT 1903, **61**, p. 160 (and footnote), pl. XV, figs. 15–17.

Grayson: North of Pottsboro (type locality).

Engonoceras bravoense BÖSE 1928, **10**, p. 229, pl. VII, figs. 31–35; pl. VIII, figs. 1–8.

Distinguished by the narrow lobes and the great number of incisions on the umbilical branch of the external saddle; flank smooth pyritic micromorph.

Del Rio: McLennan County (several localities); near Del Rio and Villa Acuña, Coahuila.

METENGONOCERAS HYATT

Metengonoceras inscriptum HYATT 1903, **61**, 180, pl. XXV, figs. 5–9; pl. XXVI, figs. 1–4.

Fredericksburg: Twelve miles northeast of Decatur.

Metengonoceras inscriptum var. HYATT 1903, **61**, 182.

Fredericksburg: Walnut Springs; 15 miles west of Denison; Bee Caves road, 9 miles from Austin.

Trinity: Cow Creek, Travis County.

Metengonoceras ambiguum HYATT 1903, **61**, 183, pl. XXVI, figs. 5–7.

"The sutures have smaller saddles than at the same age in *Met. inscriptum*, are also less distant throughout, become still more approximate in later stages, and are straighter. There are 30 septa in this specimen to 24 in *inscriptum* at the same diameter."

Comanche Peak limestone: Bee Caves road, 9 miles from Austin.

Metengonoceras hilli BÖHM 1898, **7**, 50, 189, text fig. 5. LASSWITZ 1904, **67**, 13, pl. I, fig. 4, text fig. 2. ADKINS 1927, **2**, pl. II, fig. 3..**Plate III, figure 3**

Saddles entire, lobes considerably dissected.

Fredericksburg?: Lampasas (type locality).

Walnut: Austin.

EPENGONOCERAS SPATH

Spath suggests placing these Eagle Ford species in this special genus.

Epengonoceras dumbli (CRAGIN).

Sphenodiscus dumbli CRAGIN 1893, **21**, 243, pl. XLIV, fig. 6.

Engonoceras dumbli LASSWITZ 1904, **67**, 12, pl. I, fig. 2.

Epengonoceras dumbli SPATH 1924, Amm. Gault Folkestone, 508.

Metengonoceras dumbli HYATT 1903, **61**, 185, pl. XXVII, figs. 3–14.

Eagle Ford: Four miles east of Whitesboro, in septaria; Hackberry Creek, Dallas County; and Keenan's Crossing of the Trinity River, Dallas County (type localities).

Epengonoceras (?) acutum HYATT 1903, **61**, 184, pl. XXVI, fig. 8; pl. XXVII, figs. 1–2.

Saddles entire, lobes prominently digitate, sutures less numerous than in *Epeng. dumbli.*

Eagle Ford?: Elm Fork, and West Fork (Horton's Mill), Dallas County.

Grayson: One-half to three-fourths mile southeast of Union Station, Denison.

Subclass DIBRANCHIATA OWEN

Order BELEMNOIDEA

BELEMNITIDAE de Blainville

BELEMNITELLA D'ORBIGNY

Belemnitella americana MORTON 1830. STEPHENSON 1923, **96**, 398, pl. XCIX, figs. 1–3.

Nacatoch sand: One mile northeast of Quinlan (Dr. Gayle Scott); cotypes in Academy of Natural Sciences, Philadelphia. An unidentified belemnite occurs in the limestone flags of the Boquillas formation (?Eagle Ford level) at Fossil Knobs north of Terlingua; Dr. Udden reports them also from the Boquillas flags on the crest of the north end, and on the west side, of Mariscal Mountain.

Phylum ECHINODERMATA

Subphylum ASTEROZOA

Class ASTEROIDEA[52]

GONIASTERIDAE Forbes 1841, emend. FISHER 1911
(Pentagonasteridae)

Pentagonaster (?) texensis ADKINS AND WINTON 1920, **3**, 47, pl. X, figs. 5–6. WINTON AND ADKINS 1920, Univ. Texas Bull. 1931, p. 22. ADKINS 1920, **1**, 95, pl. VII, fig. 7.

Two complete individuals in slabs, the holotype showing the oral side and another showing the aboral side have been found; a few fragments exist. The species probably represent a new genus, but

[52]Recent starfishes: Fisher, Walter Kenrick, 1911. Asteroidea of the North Pacific and adjacent waters. U. S. Nat. Mus. Bull. 76.* Perrier, Edmond, 1875. Revision des stellérides du Museum d'Histoire Naturelle de Paris. Paris. Verrill, A. E., 1899. Revision of certain genera and species of starfishes with descriptions of new forms. Trans. Conn. Acad. Sci., Vol. X, 145–234, pls. XXV–XXX. Verrill, A. E., 1919. Report on the starfishes of the West Indies, Florida and Brazil. Univ. Iowa Monogr., Bull. Lab. Nat. His., Vol. VII, 1–232, pls. I–XXIX.

Cretaceous starfishes: Adkins, W. S., and Winton, W. M., 1920, **3**, 46–49. Adkins, W. S., 1920, **1**, 95–101. Sladen, W. P., and Spencer, W. K., 1907. A monograph of the British fossil Echinodermata, Asteroidea. Paleontogr. Soc. London. Vol. II. Spencer, W. K., 1913. The evolution of the Cretaceous Asteroidea. Phil. Trans. Royal Soc., London, series B, Vol. 204, 99–177, pls. X–XVI. **De Loriol, P., 1909. Quelques stellérides du Santonien d'Abou Roach. Ann. Inst. Egyptien, ser. Vol. II, 169–184, pls. X–XII. Wade, Bruce, 1926, **103**, p. 27. Weller, Stuart, 1905. A fossil starfish from the Cretaceous of Wyoming. Jour. Geol. 13. 257–258, text fig. Clark and Twitchell, 1915, **15**. *Gabb, W. M., 1876. Acad. Nat. Sci. Phila., Proc. for 1876, 178, pl. V, figs. 2 a–b.

its definition will not be attempted in this paper. Fisher and others have shown that *Pentagonaster* Gray (genotype *P. pulchellus*, monotypic), a recent genus, has characters which do not likely refer to the known Cretaceous species, and the English Cretaceous "Pentagonasters" have been removed to other genera (*Crateraster, Ophryaster).*

Upper Weno: Sycamore Creek, southeast of Fort Worth (type locality; holotype in Museum of Texas Christian University).

Metopaster (?) hortensae ADKINS AND WINTON 1920, **3**, 46, pl. X, figs. 2–4. WINTON AND ADKINS 1920, Univ. Texas Bull. 1931, pp. 21, 69. ADKINS 1920, **1**, 97, pl. VII, fig. 8....**Plate XX, figures 16–17**

One complete, but distorted and poorly preserved individual is the holotype; another complete interradial area is known; recently at the type locality there was found a well preserved tip of a ray, showing that all the marginalia are finely punctate and lack the depressed margin. The species therefore is not a *Metopaster*, and does not fit into any published genus known to me.

Pawpaw: Near Fort Worth, Glen Garden Country Club (type locality; holotype in Museum of Texas Christian University).

Comptonia (?) wintoni ADKINS 1920, **1**, 97, pl. VII, figs. 4–5. ADKINS AND WINTON 1920, **3**, 49, pl. X, fig. 1......**Plate XX, figure 18**

This species compares in some features with *Comptonia schlumbergeri* and *Comptonia fourtaui* De Loriol, described from the Santonian of Abou Roach near Cairo.

Pawpaw: Near Fort Worth (type locality; holotype in Museum of Texas Christian University).

"Pentaceros" (?) americanus ADKINS 1920, **1**, 99, pl. VII, figs. 1–3..**Plate XXI, figure 8**

This insufficiently studied starfish may belong to the family Oreasteridae; *Oreaster*, of which "Pentaceros" is a synonym, is a Recent genus and is not applied to Cretaceous forms.

Pawpaw: Near Fort Worth, Sycamore Creek, loc. 714 (type locality; holotype in Museum of Texas Christian University).

AUSTINASTER new genus

Outline stellate-pentagonal, interradial arcs moderately deep; form depressed, disk thin over center, thickened at marginalia. Infero- and supero-marginalia set at angle to each other, the inferior ones projecting, reducing gradually in size toward tip of ray. Both marginalia tuberculate tubercles of medium size and somewhat irregularly distributed; marginalia devoid of ridges, grooves or other irregularities, and margins not depressed. Actinal interradial plates triangular, large; abactinal plates small, hexagonal. Genotype:

Austinaster mc-carteri n. sp. Horizon as known: Austin chalk. Holotype and paratypes in Bureau of Economic Geology.

Austinaster mc-carteri n. sp...**Plate XXXIII, figure 1**

Size small, disk depressed, very thin, nearly plane on both surfaces. Outline stellate-pentagonal, generally regular, rays terminally sharply rounded, interarcs of medium depth and broadly rounded at middle, major and minor radii have the ratio of about 2.15:1.

Aboral face.—Supero-marginalia flattened, in contour from above subquadrate to trapezoidal (wider at inner end), in side view somewhat trapezoidal with the elongate-ovoid infero-marginalia projecting from beneath them. Marginalia rather evenly and coarsely tuberculate (worn smooth in most individuals). Superomarginalia 14 in each interarc, gradually reducing in size towards the ends of the rays.

Radialia

Adradialia

Interradialia characteristically small, subequal, hexagonal plates forming a close mosaic, with no spaces or openings between them. *Madreporite* small, ovoid, with longitudinal meanders.

Oral face.—Inferomarginalia flattened on outer surface, trapezoidal and elongate contour, elongate ovate-rectangular in vertical profile, bear small, subequal, numerous, distinctly elevated tubercles.

Admarginalia (?)

Ambulacralia consist of a single row, on each side of ambulacral furrow, of small, equal, rectangular, radially elongate plates. Intermediate plates *(interradialia)*, characteristically large, mainly triangular in contrast to the small hexagonal aboral plates, occupy the triangular interradial area, which contains typically (pl. XXIII, fig. 1) 28 plates arranged in four outwardly convex rows of (from the center outwards) 1, 3, 5, and 7 plates and, in each outer corner of the triangular interradial area near the tip of the ray, a group of about 6 plates. This arrangement is almost invariable. Ambulacral furrows straight, narrower than the bounding plates, open at tip of ray. Mouth small, bounded by 10 prominent radial, cuneate plates.

Basalmost Austin chalk: Type material in a slab of float, which weighed about 1,200 pounds; about 25 starfish and numerous fragments are visible on a surface of a portion of the slab, and many others are buried in it, mainly at a shallow depth, so far as could be seen. There is a thin surface layer of whitish material which contains most of the starfishes; a few are in a contorted position in the bottoms of small cavities. The slab is not far out of place.

Type locality: Travis County, branch of Bouldin Creek just east of the M. K. & T.-M. P. Ry. track one and one-third miles west of south of the Colorado River, Austin; level apparently the basal ledge of the Austin chalk. Holotype and paratypes in Bureau of Economic Geology, Austin.

Class OPHIUROIDEA (Brittle Stars)

Ophioglypha texana CLARK 1893, 14, 30, pl. IV, figs. 1 a–c. CLARK 1915, **15**, 43, pl. VIII, figs. 3 a–c.

Disk round; composition indistinct. Arms long, with wedge-shaped under-arm plates about as wide as long; upper arm-plates about twice as wide as long.

Weno: Tarrant County, Big Fossil Creek, about 6 miles north of Fort Worth, associated with *Alectryonia quadriplicata, Remondia robbinsi,* and *Leiocidaris hemigranosus* (type locality, holotype 21884, United States National Museum). Ophiuroids have been found in various Upper Washita levels near Fort Worth.

Class ECHINOIDEA[52a]

The following is an outline of the larger groups of echinoids represented in the Texas Cretaceous, using the classification of LAMBERT AND THIÉRY, 1909–25, **66.**

Class: ECHINOIDEA d'Orbigny

A. Sub-class GNATHOSTOMATA Pomel. Echinoids with masticatory apparatus.
   Order 1: ENDOCYSTA Lambert. Periproct surrounded by apical plates.

[52a]Glossary, Echinoids.—*Ambitus,* the circumference separating oral from aboral faces. *Ambulacra,* five radial zones of pore-bearing plates: the *anterior unpaired ambulacrum,* the *anterior paired ambulacra,* and the *posterior paired ambulacra.* Each ambulacrum consists of two zones, each having two rows of *pore pairs (slit-pairs* or *circular pairs).* The ambulacral plates are primitively single *(majors, primaries)* but may be multiple at the pore-bearing end; the pores are arranged in one *(uniserial)* or more *(bi-, triserial)* radial rows. *Apical system,* near center or aboral side, a central system of plates, generally four *genitals,* with *genital pores;* outside of them, four *oculars;* a *madreporite,* finely perforate, elongated genital, serving as strainers, for the water-vascular system. Faces: *aboral* (abactinal), the face opposite the mouth, and bearing the apical system; *oral* (actinal), the face on which the mouth is located. *Fascioles,* narrow, granulated, non-tuberculate bands encircling or surrounding portions of test. *Peripetalous fasciole,* a fasciole surrounding the ends of the prominently pored part (petaloid portion) of the ambulacra. Fascioles may be diffuse, multiple, or reduplicated. *Interambulacra,* areas between the ambulacra. *Periproct,* anus. *Peristome,* mouth. *Branchial incisions,* notches in margin of peristome for extrusion of oral branchiae. *Plastron,* area on oral face between the posterior ambulacra; its plates are paired on either side of the mid-line *(amphisternous),* or unpaired, with a row lying on the mid-line, at least initially *(meridosternous). Tubercles,* rounded symmetrical organs for insertion of spines; occur on ambulacral and interambulacral plates; there are *primaries* and *secondaries,* according to size. The base *(boss)* bears a rounded knob *(mameleon),* which is *perforate* or *imperforate,* around which is a sunken space *(areola),* limited by a raised ring with granules *(scrobiculae),* crenulations *(crenulate),* or else smooth *(non-crenulate).*

Section I. HOMALOSTOMATA: No branchial incisions.
Sub-order CIDAROIDA Duncan. Two series of interambulacral plates, at least aborally.
Family 1. CIDARIDAE Gray. Same characters.
Genus 1. Dorocidaris.
2. Leiocidaris.
Section II. GLYPHOSTOMATA: With branchial incisions.
Sub-order STEREOSOMATA Duncan. Test rigid.
Family 2. PHYMATRESIDAE Lambert and Thiéry. Tubercles perforated.
Genus 3. Pseudocidaris.
4. Loriolia
5. Echinopsis.
6. Tetragramma.
7. Polydiadema.
8. Leptarbacia.
9. Orthopsis.
10. Micropedina.
Family 3. OLOPHYMIDAE Lambert and Thiéry. Tubercles imperforate; plates of periproct numerous, distinct from the anal valvular plates.
Genus 11. Salenia.
12. Goniophorus.
13. Peltastes.
14. Phymosoma.
15. Cottaldia.
Family 4. HABROCIDARIDAE Lambert and Thiéry. Interambulacra mainly with 3 rows of plates, one of them frequently resorbed; tubercles imperforate, non-crenulate.
Genus 16. Codiopsis.
17. Goniopygus.
Order 2: EXOCYSTA Lambert. Periproct located behind apex.
Sub-order PILEATOIDA Lambert. With orthognathous jaws.
Family 5. PYGASTERIDAE Lambert. Branchial incisions distinct.
Genus 18. Holectypus.
Family 6. CONULUSIDAE Lambert. Branchial incisions obsolete.
Genus 19. Pyrina.
B. Sub-class ATELOSTOMATA Pomel. Jaws imperfect, temporary or absent.
Order 3: BRACHYGNATHA Lambert. Jaws imperfect or ephemeral, disappearing in adult.

Sub-order GLOBATOROIDA Lambert. Same characters.
Family 7. ECHINONEIDAE Agassiz. Ambulacra simple; peristome without phyllodes.
Genus 20. Pseudopyrina Lambert.
Order 4: NODOSTOMATA Lambert. Peristome completely deprived of jaws.
Sub-order PROCASSIDULOIDA Lambert. Peristome without labrum or supporting branches, but with phyllode; plastron rudimentary or absent.
Family 8. ECHINOBRISSIDAE Wright. Ambulacra petaloid, with biporiferous plates; apex monocentric.
Genus 21. Porobrissus.
22. Procassidulus.
Sub-order SPATANGOIDA Agassiz. Test bilateral; peristome variable; plastron present; periproct posterior to apex.
Family 9. ANANCHITIDAE A. Gras. Apex elongated; plastron meridosternous; ambulacra apetalous or subpetalous (not in grooves).
Genus 23. Holaster.
24. Pseudananchys.
25. Echinocorys.
Family 10. PROSPATANGIDAE Lambert. Apex compact; plastron amphisternous; paired ambulacra petaloid but superficial.
Genus 26. Heteraster.
27. Washitaster.
Family 11. BRISSIDAE Cotteau. Apex compact; plastron amphisternous; paired ambulacra pettaloid, mostly situated in grooves.
Genus 28. Macraster.
29. Epiaster
30. Hemiaster.
31. Proraster.

CIDARIDAE Gray

DOROCIDARIS A. Agassiz 1869

Test almost spherical with subcircular peristome. Apex dicyclic. Sutures depressed. Interambulacral tubercles perforate, with deep scrobicula. Miliary zones with transverse rows of granules often separated by linear impressions. Spines long, cylindrical, with rows of elevations. Aptian-Recent. Genotype: *D. papillata* Leske.

Dorocidaris texanus (CLARK) 1891, Johns Hopkins Univ. Circ., 10, no. 87, p. 75. CLARK 1983, Johns Hopkins Univ. Circ. 12, no. 103, p. 61 *(Cidaris)*. CLARK 1893, **14**, 36–37, pl. VII, figs. 1 a–e. CLARK AND TWICHELL 1915, **15**, 45, pl. IX, figs. 2 a–f *(Cidaris)*. LAMBERT 1927, **64**, 265.

Washita division: Bexar County (type locality). Holotype U.S.N.M. 8381.

Cidaris dixiensis CRAGIN 1893, **21**, 146, pl. XLVI, figs. 15–16. CLARK 1915, **15**, 47, pl. IX, figs. 7 a–b. LAMBERT 1927, **64**, 265.

Unidentifiable plates.

Taylor: Nine miles northeast of Dallas (type locality).

LEIOCIDARIS DESOR 1856

Test medium-sized, more or less depressed; small peristome. Apex dicyclic. Ambulacra composed of equal, granulated primaries, pores connected by groove. Interambulacral plates large, their tubercles perforated. Spines variable, generally cylindrical. Oxfordian-Recent. Genotype: *L. imperialis* Lamarck.

Leiocidaris hemigranosus (SHUMARD) 1860, **89**, 609 *(Cidaris)*. HILL 1889, **52**, p. 2. WHITE 1883, **106**, 38, pl. XVIII, figs. 2 a–b (Shumard's original types). CRAGIN 1893, **21**, 160. CLARK AND TWICHELL 1915, **15**, 48, pl. X, figs. 1 a–g; pl. XI, figs. 1 a–b. ADKINS AND WINTON 1920, **3**, 24, 49, pl. XX, fig. 3. WINTON 1925, **115**, pl. XIII, fig. 2................................**Plate XIV, figure 2**

Upper Washita, Denton, and possibly higher formations. "Washita limestone, bluffs of Red River, Lamar County; and 10 miles above the mouth of Kiamesha Creek" *(i.e.,* near Sawyer, Choctaw County, Oklahoma), are the type localities. The Texas (Shumard) Survey in 1860 at Austin possessed several fragments, of which the best showed a double row of interambulacral plates and one series of ambulacral pores. The presumable types of Shumard, from his original drawings, were figured by White. Cragin (**21**, 160) and Clark (**15**, 49) record it from the I. & G. N. Ry. cut on West Sixth Street, Austin. The other records are from north of Fort Worth. Denton County: One individual from Grayson Bluff, east of Roanoke (Texas Christian University Museum, Nelson Collection; figured in Winton 1925, **115**, pl. XIII, fig. 2). Professor Strecker reports having seen one destroyed in Denton County. One individual now lost, from an unknown locality, was on display in the Oil Exchange, Fort Worth, in 1919. Grayson County: Three miles west of Denison (Clark **15**, pls. X–XI, U.S.N.M. 21768); Denton clay on Pawpaw Creek, 1.25 miles below Denison (Cragin **21**, 160); Pawpaw beds above the Quarry limestone, on upper Pawpaw Creek, Denison, a crushed specimen (found by Dr. McGregor, of Denison;

now in Bureau of Economic Geology); one large individual remaining in Denison until last year, could not be traced. Southern Oklahoma: One-fifth of a test from Kingston, Oklahoma, Fort Worth or Denton level (found by Dr. Böse; now in Bureau of Economic Geology); a large specimen is known from a creek southeast of Colbert, Oklahoma. The Department of Geology, University of Texas, has a specimen from the Dumble Survey; and a large specimen, possibly of another species, from the Finlay Mountains (collected by Dr. Beede). Several specimens of this, the largest and most striking of the Texan Cretaceous echinoids, have been lost or destroyed, and persons finding new specimens should take the trouble to place them in some museum for safe keeping.

Horizon: "Four feet below the base of the **Denton** marl" (Cragin **21,** 160); **Pawpaw,** above Quarry limestone (see above discussion). **Grayson,** at Grayson Bluff. It has not been proved that all these individuals represent the same species, but if they do, it ranges throughout the **upper Washita** division.

PHYMATRESIDAE

Interambulacral tubercles larger than ambulacral tubercles:
- Interambulacral tubercles few, prominent; test of medium height .... **Pseudocidaris elegans**
- Interambulacral tubercles numerous, not prominent .... **Loriolia ornatum**

Interambulacral and ambulacral tubercles of about the same size:
- About 4 rows of primary ambulacral tubercles, about 8 rows of interambulacral tubercles; tubercles non-crenulate; test globular .... **Micropedina symmetrica**
- Two rows of primary ambulacral tubercles (one per plate)
  - One interambulacral tubercle per plate (total 2 rows)
    - Ambulacral pore-pairs alternate; apical opening not produced behind .... **Tetragramma hilli**
    - Ambulacral pore-pairs in line
      - Apical opening produced behind .... **Loriolia texana**
      - Apical opening not produced behind .... **Polydiadema texana**
  - Three or more interambulacral tubercles per plate (total 6 rows)
    - Ambulacral plates with 2 rows of pores; apical opening small, circular
      - Ambulacral plates compound at edge .... **Leptarbacia arguta**
      - Ambulacral plates simple
        - Tubercles crenulate .... **Echinopsis lineatus**
        - Tubercles non-crenulate .... **Orthopsis occidentalis; Orthopsis planulata**

Ambulacral plates with 4 rows of pores; apical opening large, pentagonal..............**Tetragramma taffi; T. streeruwitzi**

PSEUDOCIDARIS ETALLON 1859

Small to medium-sized, inflated tests; peristome large, decagonal. Ambulacra narrow, undulate, with simple, equal, granulated primaries with some semitubercled plates near peristome. Spines thick, glanduliform. Bathonian-Cenomanian. Genotype: *P. thurmanni* Agassiz.

PSEUDOCIDARIS ELEGANS (CLARK) 1915, **15**, 52, pl. XIV, figs. 2 a–b *(Hypodiadema)*. LAMBERT AND THIERY 1909–1925, **66**, 562 *(Hypodiadema)*. LAMBERT 1927, **64**, *(Pseudocidaris)*.

Trinity division: Three miles west of Murfreesboro, Pike County, Arkansas (type locality).

LORIOLIA NEUMAYR 1881

Loriolia texana (CLARK) 1915....................................**Plate I, figures 6–7**

Pseudodiadema texana CLARK 1915, **15**, 55, pl. XVIII, figs. 1 a–i (not *Diadema texana* ROEMER 1852).

Loriolia texana LAMBERT 1927, **64**, 266.

Test small, circular, depressed, sides inflated, diameter considerably greater than height, oral and aboral faces flattened and parallel. Ambulacra narrow, with 2 rows of primary tubercles, 11–12 in each row. Interambulacra wide, with 2 rows of primary tubercles of larger size than the ambulacral tubercles. Peristome wide, nearly one-half the diameter of test. Periproct subcircular, but with a deep incision in right anterior ambulacrum.

Glen Rose, Walnut: Travis County, Barton Creek between Oatmanville and Bee Caves (type locality; holotype U.S.N.M. No. 31197).

Loriolia ornata (CLARK). LAMBERT 1927, **64**, 266.

Heterodiadema ornata CLARK 1915, **15**, 56, pl. XVIII, figs. 2 a–f.

Heterodiadema ornata LAMBERT AND THIERY 1909–1925, **66**.

Test small, subconical, rather flattened on both faces but orally slightly convex; ambulacra narrow, with 2 rows of perforate, crenulate tubercles. Interambulacra wider, with 2 rows of tubercles which are similar to those of the ambulacra. Peristome small; periproct wide, distinctly 5-angled, with a prominent incision on one side.

Washita: Fort Worth (type locality; holotype Johns Hopkins Univ., T3006).

ECHINOPSIS

Echinopsis lineatus (CLARK) 1915, **15,** 63, pl. XXV, figs. 1 a–c *(Micropsis).* LAMBERT AND THIERY 1909–1925, **66,** 568 *(Micropsis).* LAMBERT 1927, **64,** 266.

Test of medium size, sides inflated, ambital outline slightly polygonal, tumid apically, somewhat concave below. Ambulacra with 2 compound plates bearing 2 rows of perforate, crenulate tubercles. Interambulacra wider, with six rows of primary tubercles, similar in size to ambulacral tubercles but decreasing in size away from ambitus. Peristome medium-sized, circular, with small branchial incisions.

Grayson: Southeast edge of Denison, cut on Bonham road (type locality; holotype U.S.N.M. No. 31198).

TETRAGRAMMA

Tetragramma taffi (CRAGIN) 1893, **21,** 148, pl. XLVI, fig. 3 *(Diplopodia). Diplopodia taffi* CLARK 1915, **15,** 58, pl. XX, figs. 2 a–e. LAMBERT AND THIERY 1909–1925, **66,** 564.

Tetragramma taffi LAMBERT AND THIERY 1909–1925, **66,** 188.

Tetragramma malbosi LAMBERT 1927, **64,** 266.

Test large, subcircular, low, more flattened below; ambulacra with 2 rows of primary perforate, crenulate tubercles, slightly smaller than interambulacral tubercles, pore-pairs biserial above ambitus, uniserial below; interambulacral plates with 8 rows of primary tubercles at ambitus, two of these rows smaller, the largest being about the same size as ambulacral tubercles. Peristome medium-sized, 10-pointed, with prominent branchial incisions; apical opening medium-sized, 5-pointed.

Comanche Peak: North San Gabriel River, 3 miles above Georgetown (type locality); Benbrook; Blum.

Tetragramma streeruwitzi (CRAGIN) 1893, **21,** 147, pl. XXIV, fig. **11**; pl. XXV, figs. 9–10 *(Diplopodia).* CLARK 1915, **15,** 58, pl. XX, figs. 3 a–c *(Diplopodia).* LAMBERT AND THIERY 1909–1925, **66,** 188 *(Tetragramma).* LAMBERT 1927, **64,** 266 *(Tetragramma).*

Test medium-sized, subcircular, rather flattened; ambulacral plates with 2 rows of primary perforate, crenulate tubercles of about the same size as the interambulacral tubercles; interambulacra with about 6 primary tubercles (3 per plate), the outer ones smaller, and irregular or absent away from ambitus. Peristome small; apical opening medium-sized, 5-pointed.

Washita: Sierra Blanca Peaks (type locality); Kent.

Tetragramma (?) hilli (CLARK) 1893, U. S. Geol. Surv. Bull. 97, 50, pl. XVI, figs. 2 a–g *(Diplopodia)*. CLARK 1915, **15**, 59, pl. XIX, figs. 2 a–g *(Cyphosoma)*. LAMBERT AND THIERY 1909–1925, **66**, 187 *(Tetragramma)*.

Test small to medium, low, outline subcircular, sides inflated, top and bottom flattened and parallel. Apical opening pentagonal; oral opening subcircular, with distinct branchial incisions. Ambulacra prominent, straight, with 2 rows of primary tubercles, 12–13 in each row; interambulacra with 2 rows of primary tubercles (one per plate), of same size as ambulacral tubercles. Lambert and Thiéry assign this species to *Tetragramma;* it differs from the other species notably in having only one primary interambulacral tubercle per plate.

Austin chalk: Austin (type locality; holotype U.S.N.M. No. 8311).

POLYDIADEMA

Polydiadema texanum (ROEMER) 1852, **78**, 83, pl. X, fig. 5 *(Diadema)*. LAMBERT 1927, **64**, 266. LAMBERT AND THIERY 1900–1925, **66**, 183 *(Trochotiara)*. Not *Pseudodiadema texana* CLARK 1915, **15**, 55, pl. XVIII, fig. 1.

Differs from *Loriolia texana*, from the Glen Rose, in being of smaller size, with test less depressed, apical opening lacking lateral incision, and with granules more abundant.

Fredericksburg: Fredericksburg and San Saba Valley (type localities).

LEPTARBACIA CLARK 1915, 15, 53

"Test small, circular in ambital outline, subhemispherical, upper surface depressed, lower surface flat. Ambulacral plates are simple primaries near the apical system and compound at the ambitus. Compound plates consist largely of 1 primary and 3 demi-plates, two above and one below. Interambulacra with large plates and with 6 rows of small, perforated and crenulated tubercles on lower surface which become reduced. Peristome of medium size. Periproct small." Genotype: *L. arguta* Clark.

Leptarbacia arguta CLARK 1915, **15**, 53 pl. XVI, fig. 1. LAMBERT AND THIERY 1909–1925, **66**, 565. LAMBERT 1927, **64**, 266.

Test small, circular, rather tall, somewhat flattened below. Peristome medium, periproct small, circular. Ambulacra straight, wide below and at ambitus, narrow above; plates compound except near apex. Interambulacra with long, bare median areas on upper surface approaching ambitus, and on lower surface with 6 rows of small, perforated, crenulated tubercles.

Washita: Fort Worth (type locality; holotype Johns Hopkins University T3004).

Del Rio: Between Orégano and San Carlos, Coahuila (Böse 1928, **10**).

ORTHOPSIS

Orthopsis occidentalis CRAGIN 1893, **21**, 160, pl. XXV, figs. 1–3; pl. XXVII, fig. 2. CLARK 1915, **15**, 54, pl. XVI, fig. 1. LAMBERT AND THIERY 1909–1925, **66**, 200. LAMBERT 1927, **64**, 266.

"Test large, depressed, slightly pentagonal in ambital outline, upper surface tumid, lower surface concave; 5 perforated genitals, one a large madreporite, some of the oculars reaching the periproctal margin. Ambulacra narrow, straight; pore-pairs in simple, straight series; primary tubercles small, perforate and smooth; interambulacra broad, with several vertical rows of small primary tubercles, similar to the ambulacral. Peristome of medium size." The tubercles are uncrenulated.

Washita: Sierra Blanca Peak (type locality).

Orthopsis planulata CLARK 1915, **15**, 54, pl. XVI, figs. 2 a–c.

Test small, depressed, circular in ambital outline, upper surface flattened, lower surface concave. Ambulacra narrow, pore-pairs simple, primary tubercles small. Interambulacra broad, with several rows of vertical primary tubercles slightly larger than the ambulacral. Peristome of medium size. Test smaller, less elevated, and less pentagonal, than *O. occidentalis*.

Grayson: Southeast edge of Denison, cut on Bonham road (type locality; holotype Johns Hopkins University 73005).

MICROPEDINA COTTEAU 1866; LAMBERT AND THIÉRY 1909–25, **66**, 206, 566.

Micropedina symmetrica (CRAGIN).

Dumblea symmetrica CRAGIN 1893, **21**, 149, pl. XXIV, fig. 12; pl. XXV, figs. 4–7; pl. XXVII, fig. 1. LAMBERT AND THIERY 1909–1925, **66**, 207, 566.

Pedinopsis symmetrica CLARK 1915, **15**, 64, pl. XXIII, figs. 1 a–h.

Micropedina olisponensis FORBES. LAMBERT 1927, **64**, 267.

Differs from *Pedinopsis* in having non-crenulate tubercles, a subfamily characteristic; it also differs in the details of compounding in the ambulacral plates.

Washita: Sierra Blanca peaks (type locality); Kent.

Duck Creek: About 5 miles southeast of Fort Stockton.

Weno: Four miles southeast of Fort Worth.

OLOPHYMIDAE Lambert and Thiéry

Central disc persistent (forming a "cap") .... **s. f. Salenidae**
periproct posterior, in mid-line (opposite an interambulacrum)
Test small; disc pentagonal, straight-sided; sutures not depressed .... **Goniophorus**
Test larger; disc with scalloped sides .... **Peltastes**
Periproct posterior, to right of mid-line (opposite an ambulacrum); disc with scalloped sides .... **Salenia**
Central disc transformed
Tubercles crenulate .... **s. f. Phymosomidae (Phymosoma)**
Tubercles non-crenulate .... **s. f. Echinometridae (Cottaldia)**

SALENIA[53]

SALENIA PRESTENSIS AGASSIZ. LAMBERT 1927, **64**, 267.

Lambert considers that *Salenia mexicana* Schlüter is identical with this species; and that *Salenia texana* Credner is a variety of this species.

Goodland: ?Fort Worth (LAMBERT 1927, **64**, 267). Lambert Collection, Paris.

Selenia texana CREDNER 1875, **23,** 105–106, pl. V, figs. 1–6. CLARK 1915, **15,** 49, pl. XII, figs. 1 a–i; pl. XIV, figs. 1 a–c.

According to Lambert, *Salenia texana* differs from *S. prestensis* in having somewhat wider ambulacra, scrobicula of the interambulacral tubercles more nearly equal, more prominent above and below the ambitus, scrobicular granules smaller and more numerous, resulting in a more prominent miliary zone.

Fredericksburg and **Washita:** Cileola; Comanche Spring; Bexar County; Round Rock; Fort Worth; Benbrook; 2.5 miles north of Denison; Kent.

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[53]Literature: Salenidae: Agassiz, L., 1838. Monographie d'Echinodermes: Sélénics Arnaud, H., 1897. Arnaud, H., 1897. Quelques observations sur les Salénia crétacés du sud-ouest. Actes Soc. Linn. Bordeaux, Vol. LII. Cotteau, G., 1861. Note sur la famille des Salénidées. Bull. Soc. Géol. France (2), XVIII. Cotteau, G., 1878 Sur les Salénidées du terrain jurassique de France. C. R. Acad. Sci., for 1878. Cotteau, G., 1890. Note sur quelques échinides du terrain crétacé du Mexique. Bull. Soc. Géol. France (3), XVII *(Salenia mexicana).* Credner, G. R., 1875. *Ceratites fastigiatus* und *Salenia texana.* Zts. d. ges. Naturwiss., Bd. 46. Duncan, 1877. On the Saleniidae. Observations on the morphology of Recent Saleniae and description of a new species. Ann. Mag. Nat. Hist. (4), XX. Duncan, 1878. On the Saleniidae. On a third form of Recent Salenidae, and on the Salenidae from the Tertiary deposits. Ann. Mag. Nat. Hist. (5), II. Duncan and Sladen, 1877. On some points in the morphology and classification of the Saleniidae. Ann. Mag. Nat. Hist. (5), XIX. Schlüter, C., 1887, **82.** Strombeck, 1863. Uber *Peltastes clathratus.* Zts. deutsch. Geol. Ges., for 1863.

SALENIA MEXICANA SCHLÜTER 1887, **82**, p. 41. BÖSE 1910, **8**, 152, pl. XXXII, figs. 4–19. LAMBERT 1927, **64**, 267 (as *S. prestensis*).

Fredericksburg (zone of *Oxytropidoceras chihuahuense*): Placer de Guadalupe, Chihuahua; Hda. de Cañas, Chihuahua.

Salenia volana WHITNEY 1916, **112**, 4, pl. 1, figs. 1–9. LAMBERT 1927, **64**, 267.

This species is stated to differ from *Salenia texana* as follows: it is less elevated; has fewer ambulacral and interambulacral plates; interambulacral lips of peristome straight, instead of bilobate; periproct of different shape. It differs from *S. mexicana* in being more depressed, and in having 16 ambulacral tubercles instead of 20. It differs from *S. prestensis* in having 5, instead of 7, interambulacral plates.

Lower Buda: Austin (Shoal Creek), and Manchaca (type localities; types in University of Texas).

GONIOPHORUS

Goniophorus scotti LAMBERT 1926, in SCOTT, **85**, p. 185. LAMBERT 1927, **64**, 268, text fig. 1...**Plate XII, figure 8**

Small species (4 mm. diameter, 2.5 mm. height); differs from *G. lunulatus* Agassiz, the genotype, from the Cenomanian of Le Havre, in having its ambulacral tubercles more regular and more crowded, sub-tubercular pores less prominent, disc pentagonal, with apices more projecting, oculars more distinct, and periproct better developed.

Upper Duck Creek: Cut of military road, one-third mile north of Texas Christian University, Fort Worth (type locality). The genus is known also from the Denton clay and from the Grayson-Del Rio clay.

PELTASTES

Peltastes sp. ADKINS 1920, **1**, 102.

Basal Grayson: Railway cut in southeast Denison; near Fort Worth; Middle Bosque River, about a mile southwest of South Bosque station.

PHYMOSOMA

Phymosoma texanum (ROEMER) 1852, **78**, 82, pl. X, fig. 6 *(Cyphosoma)*. CLARK 1915, **15**, 60, pl. XXI, figs. 1 a–g *(Cyphosoma)*. LAMBERT 1927, **64**, 268.

Test large, subcircular, sides inflated, upper surface elevated, lower surface depressed, concave. Ambulacra prominent, with 2 rows of primary tubercles; poriferous zones broad above, narrow below; pores uniserial from near peristome to ambitus, beyond which to the apical system they are biserial. Interambulacra wide, with 4 rows of primary tubercles at the ambitus, which orally and aborally become reduced to 2 rows. Peristome wide, about two-fifths the diameter of test, with distinct branchial incisions. Periproct large, subpentagonal. The tubercles are crenulate and imperforate, as was noted by Roemer and by Lambert.

Comanche Peak: Fredericksburg and San Saba Valley (type localities); Leon Springs; Austin.

Phymosoma mexicanum BÖSE 1910, **8**, 158, pl. XXXIII, figs. 7–10; pl. XXXIV, fig. 3; pl. XXXV, figs. 1–3, 7–8.

Test of medium size (diameter 39 mm.), rather flattened on both faces but more convex above; inflated at ambitus; peristomal opening large, pentagonal, with distinct branchial incisions; apical opening star-shaped with points extended. Pores distinctly biserial above, uniserial near peristome. Two rows of primary ambulacral tubercles, 12–13 in each row; 4 rows of primary interambulacral tubercles, the two central rows being larger than the ambulacral, 12–14 per row; near ambitus a few extra, scattered tubercles. The more flattened test, and the finer tubercles, will help to distinguish this species from *P. texanum* and *P. volanum.*

Fort Worth-Denton (subd. 5, with *Pervinquieria trinodosa):* El Paso section.

Phymosoma volanum (CRAGIN) 1893, **21**, 147 *(Cyphosoma)*. CRAGIN 1894, Colo. Coll. Stud., 4, pp. 45, 47. CLARK 1915, **15**, 61, pl. XXI, figs. 2 a–b, 3 *(Cyphosoma)*. WHITNEY 1916, **112**, 11, pl. VI, fig. 1 *(Cyphosoma volanum?)*.

Test small, subcircular; upper surface slightly elevated; lower surface depressed, concave. Ambulacra slightly prominent, with 2 rows of primary tubercles; poriferous zones sinuous; pores uniserial from peristome nearly to apical system. Interambulacra wide, each with 2 rows of primary tubercles, similar to those of ambulacra, adjoining which are smaller primary or secondary tubercles. Peristome small. Periproct large.

Denison group of Washita division: Denton County, Big Elm Creek, below M. K. & T. bridge (type locality); Denison.

Upper Buda: Austin.

COTTALDIA DESOR *(Cotteaudia* Lambert)

Cottaldia (?) **rotula** CLARK 1915, **15**, 57, pl. XX, figs. 1 a–d. WHITNEY 1916, **112**, 9, pl. IV, figs. 1–10; pl. V, figs. 1–2 ....**Plate XXIII, figure 3**

Lambert 1927, **64**, 268, replaces the generic name by *Cotteaudia,* and considers *C. rotula* to be a synonym of *C. benettiae* König, a species from the Cenomanian of France and England. The tubercles are described by Clark and by Whitney as being perforate and non-crenulate, features of the subfamily Pedinidae rather than of the family Olophymidae.

Buda: Travis County, Shoal Creek (type locality; holotype Johns Hopkins University T3007).

Lower and **Upper Buda:** Austin, Manchaca.

HABROCIDARIDAE Lambert and Thiéry

Tubercles more reduced aborally; test of some species subpentagonal; genitals not conspicuously elongated .... **Codiopsis**

Tubercles not reduced aborally; test subcircular; genital plates elongated .... **Goniopygus**

CODIOPSIS

Codiopsis texanus WHITNEY 1916, **112,** 7, pl. III, figs. 1–4; pl. VI, fig. 2.

Lower Buda: Austin (type locality; holotype University of Texas).

Codiopsis sp. aff. **valotairei** LAMBERT 1903, Note sur un *Codiopsis* nouveau de la craie de Touraine. Bull. Soc. Géol. France (4), III, 89–92, pl. III, figs. 12–17.

Lower Austin chalk: Near Austin. Limit between the Turonian and the Senonian, Saumur.

GONIOPYGUS ZITTEL

Goniopygus zitteli CLARK 1891. CLARK 1915, **15,** 52, pl. XIV, figs. 3 a–c; pl. XV, figs. 1 a–h. LAMBERT 1927, **64,** 268.

Test subconical, circular in outline; upper surface elevated; base flattened. Ambulacra broad, with a double row of alternating tubercles, 18 to 20 in each series; poriferous zones, with double row of pores, multiplied at the peristome. Interambulacra broader than the ambulacra, with a double row of primary tubercles, 10 to 12 in each row. Apical system prominent, compact. Peristome large, with shallow incisions.

Edwards: Round Rock (type locality; holotype U.S.N.M. No. 12334; Spanish Oak Branch, Williamson County).

Goniopygus budaensis WHITNEY 1916, **112,** 6, pl. II, figs. 1–8.

Small species (diameter 4.5 mm.), with relatively large apical disc and large peristome. Differs from *G. zitteli* in many features; in being smaller, with relatively larger peristome and much larger apical system; upper surface less pointed and more evenly rounded; genital plates less elongated and their tubercles more central, plates of apex differently arranged; interambulacral primary tubercles fewer.

Upper Buda: Austin (type locality; type University of Texas).

Order EXOCYSTA

Sub-order PILEATOIDA

PYGASTERIDAE Lambert 1900

Ambulacra simple; peristome with distinct branchial incisions (notches for passage of oral branchia).

HOLECTYPUS Desor 1842

Small or medium size, more or less conical test; genital 5 perforate in Cretaceous species. Ambulacra with simple primaries above, below with plates composed of three elements. Tubercles crenulate. Periproct inframarginal or marginal. Toarcian-Senonian. Genotype: *H. depressus* Leske.

Periproct large, occupies practically entire radius:
- Test tall, sub-pentagonal, edge thin; periproct oval, rounded at both ends........ **H. engerrandi**
- Test lower, pentagonal, edge thicker; periproct pointed at inner end
  - Test taller, flatter below; tubercles on lower surface less numerous........ **H. planatus**
  - Test lower, very concave below; tubercles of lower surface more numerous........ **H. planus**

Periproct short and small:
- Periproct in middle of radius
  - Test pentagonal, tall; periproct small, broadly rounded at inner end........ **H. transpecosensis**
  - Test nearly circular; periproct larger (⅓+ of radius), slightly pointed at both ends........ **H. limitis**
- Periproct located in outer half of radius
  - Test round; periproct pointed at both ends........ **H. castilloi**
  - Test pentagonal; periproct rounded at inner end........ **H. charltoni**

Holectypus engerrandi Lambert 1927, **64**, 269. Clark 1915, **15**, 65, pl. XXV, fig. 2 *(H. planatus)*.

Medium to small species, tall, rather pentagonal, with large periproct rounded at both ends.

Trinity division (?): Travis County, Cow Creek (type locality; holotype U.S.N.M. 12236).

Holectypus planatus ROEMER 1852, **78**, 84, pl. X, figs. 2 a–c. GIEBEL 1853, **46**, 373. CONRAD 1857, **18**, pl. I, figs. 4 a–c. ROEMER 1888, **80**, 9, pl. I, figs. 6 a–c. LAMBERT 1927, **64**, 268. CLARK 1915, **15**, pl. XXV, figs. 3–4 (?)......**Plate VIII, figure 5; plate XIV, figure 6**

Shell rather pentagonal, apparently of variable height; periproct large, variable in width and outline, but pointed at inner end and rounded at outer end.

Fredericksburg and **Washita divisions:** Central and West Texas, widespread.

Holectypus planus GIEBEL 1853, **46**, 373..................**Plate III, figure 2**

Giebel states that this species differs from *H. planatus* Roemer in (a) being less tall; (b) having the lower surface strongly concave; (c) in having tubercles of ambulacral and interambulacral areas similar; (d) in having tubercles of lower surface more numerous and arranged parallel to the margin; (e) in having at ambitus 8 ambulacral and 22 interambulacral rows of tubercles, continued beneath in gradually decreasing size. Otherwise it is stated to be similar to *H. planatus*.

Horizon and type locality not stated. Most of the collection comes from Cibolo, 8 miles from Comanche Springs, some from "Texas," some from Hendenon between New Braunfels and Guadalupe. The author states that all his fossils represent the same horizon, but both *Exogyra arietina* and *Orbitolina texana* are listed. The horizon may be the Fredericksburg division.

Holectypus transpecosensis CRAGIN 1893, **21**, 160, pl. XXVII, figs. 3–5. LAMBERT 1927, **64**, 269.

Medium to large, pentagonal species; periproct small, located near middle of radius.

Comanchean: Sierra Blanca (type locality).

Holectypus limitis BÖSE 1910, **8**, 159, pl. XXXVI, figs. 3–6; pl. XXXVII, figs. 1–8; pl. XXXVIII, figs. 1–2. ADKINS AND WINTON 1920, **3**, 51, pl. IX, figs. 1, 3..**Plate VIII, figure 7; plate XIV, figure 7**

Medium-sized species, nearly circular or subpentagonal, fairly low; periproct near middle of radius, somewhat pointed at both ends.

Upper Washita: Central and West Texas, widespread; Subd. 5 **(Fort Worth-Denton)**, El Paso section (type locality).

HOLECTYPUS CASTILLOI COTTEAU 1890, **20**, 295, pl. I.

Test fairly high but not pointed at apex, subcircular; periproct small, located in outer half of radius, somewhat pointed at both ends.

Cretaceous: Mexico, Jalpa (Jalisco), type locality.

Holectypus charltoni CRAGIN 1893, **21**, 158, pl. XXIV, figs. 8–9. CLARK 1915, **15**, pl. XXVI, fig. 1 *(H. planatus)*. LAMBERT 1927, **64**, 269 .... **Plate VIII, figure 8**

Large species; small elliptical periproct situated near border of test, periproct rounded at inner end.

Grayson: Denton County, 1 mile east of Roanoke.

Main Street: Grayson County, one-half mile southeast of Cedar Mills (type localities). Denton County.

CONULUSIDAE Lambert

PYRINA DESMOULINS

Pyrina inaudita BÖSE 1910, **8**, 162, pl. XXXVIII, figs. 3–8; pl. XXXIX, figs. 1, 2, 4; LAMBERT AND THIERY, 1909–1925, **64**, 576.

Fort Worth- Denton (subd. 5): Cerro de Muleros (type locality).

B. Subclass ATELOSTOMATA POMEL

Peristome with jaws imperfect, temporary or absent.

Order BRACHYGNATHA

Peristome having jaws imperfect or ephemeral and disappearing in adult.

Sub-order GLOBATOROIDA LAMBERT

ECHINONEIDAE Agassiz 1847

PSEUDOPYRINA LAMBERT 1908

Test ovoid in outline, less inflated than *Globator;* no jaws in adult. *Pyrina* and *Pseudopyrina* belong to different sub-classes: the former has jaws, the latter none. There is some doubt about the generic assignment of the Texan species.

Pseudopyrina clarki (BÖSE) 1910, **8**, 163, pl. XXXIX, figs. 3, 5–8; pl. XL, figs. 1–3. LAMBERT AND THIERY 1909–1925, **64**, 329.

P. inaudita is circular in outline, tall, and evenly rounded above. *P. clarki* is elliptical in outline, lower, and pointed apically.

Fort Worth-Denton (subd. 5): Cerro de Muleros (type locality).

Pseudopyrina parryi (HALL) 1857, in EMORY, Mex. Bdry Surv., **18**, 144, pl. I, figs. 1 a–d *(Pyrina)*. CLARK 1915, **15**, 67, pl. XXVII, figs. 1 a–j *(Pyrina)*. BÖSE 1910, **8**, p. 163 *(Pyrina)*.

P. parryi differs from *P. clarki* in being shorter and broader, in outline a very short oval, in having a low test, evenly rounded on top instead of pointed apically; and in having the periproct small and located high on test, instead of large and located low; *P. parryi* has fewer tubercles than *P. clarki*. *P. parryi* differs from *P. inaudita* in being much less elevated and a little more elongate-oval.

Lower Washita: Leon Springs (type locality). Clark records it from near San Antonio; Travis County, Pilot Knob; Kent; Sierra Blanca peaks and other localities from Fredericksburg and Washita divisions.

Pseudopyrina (?) **bulloides** (CRAGIN) 1893, **21**, 162.

Basal contour almost circular, but test so tall as to appear subglobular.

Upper Fredericksburg: Crane County, Castle Mountain, associated with *Exogyra texana, Pyrina parryi, Holectypus planatus, Modiola pedernalis* (type locality).

Order 4: NODOSTOMATA LAMBERT

Peristome completely deprived of jaws.

Sub-order PROCASSIDULOIDA LAMBERT 1915

Peristome without labrum or supporting arms, but with more or less developed phyllodes; plastron rudimentary or none.

ECHINOBRISSIDAE Wright 1856

Petaloid ambulacra, composed of two-pored plates; apex monocentric.

POROBRISSUS LAMBERT 1916, Rev. de Paléozool., 20, 169

Differs from *Nucleopygus* in having posterior sulcus broader and more elongated, and in its very small rounded periproct.

Porobrissus angustatus (CLARK) 1915, **15**, 69, pl. XXVII, fig. 2 *(Echinobrissus)*. WHITNEY 1916, **112**, 14, pl. VII, figs. 6–9; pl. IX, fig. 4 *(Echinobrissus)*. LAMBERT AND THIERY 1909–1925, **66**. 348.

Buda: Shoal Creek, Austin (type locality).

Procassidulus sp. *(Cassidulus* of authors).

Escondido: Medina County, D'Hanis.

Sub-order SPATANGOIDA AGASSIZ 1840

Test bilateral; peristome variable, often labiate and with internal supporting arm, invariably without phyllodes; plates of unpaired interambulacrum forming a plastron on lower surface of test; adult periproct not in contact with apex.

ANANCHITIDAE A. Gras 1848

Apex elongated; plastron meridosternous; ambulacra apetalous or subpetalous.

HOLASTER Agassiz 1836

Test subcordiform, with anterior groove more or less deep; paired ambulacral petals superficial, often unequal, starting (from apex) with round pores, then elongated, often circumflex; tubercles small, variably developed according to species. Genotype: *H. nodulosus* Goldfuss.

Holaster simplex SHUMARD 1854, **87**, 184, pl. III, fig. 2. CLARK 1915, **15**, 85, pl. XXXIV, fig. 3; pl. XXXVIII, fig. 1. LAMBERT 1927, **64**, 269 .... **Plate XIV, figures 1, 3**

Two shapes of test are common, one with the greatest perimeter at the base ("low phase"), the other with the greatest perimeter above the base ("tall phase").

Duck Creek-Fort Worth: Central and northern Trans-Pecos Texas, widespread; Fort Washita, Bryan County, Oklahoma (type locality).
Weno: North-Central Texas (specific identification uncertain).

Holaster comanchesi MARCOU 1858, **68**, 40, pl. III, figs. 3–3 a–3 b.

Marcou states that this species differs from *H. simplex* in (a) being pointed apically instead of evenly rounded; and (b) having straight, instead of flexuous, ambulacra.

Duck Creek (?): Grayson County, near Preston (type locality; holotype BM 12675, British Museum Natural History, South Kensington; plaster replica in Bureau of Economic Geology); Munson Park, Denison.

Holaster nanus CRAGIN 1893, **21**, 156, pl. XXIV, fig. 14; pl. XXV, fig. 11.

Shorter and more constricted posteriorly than *H. simplex*, straighter ambulacra with nearly equal zones and similar pores.

"Vola bed" **(Grayson?):** Grayson County, Choctaw Creek at Denison-Bonham road (type locality).

HOLASTER NODULOSUS GOLDFUSS. LAMBERT 1927, **64**, 269.

Small species; Lambert considers it identical with *H. nodulosus* Goldfuss from the French Cenomanian.
Middle Weno: Fort Worth (?).

PSEUDANANCHYS Pomel 1883 (*Craginaster* Lambert 1903)

Ovoid, but usually sinuous at ambitus; ambulacra consist of low plates with closely spaced zygopores and elongated pores. Differs from *Holaster* in having the periproct inframarginal instead of on the posterior face. Genotype: *P. algirus* Coquand.

Pseudanachys completus (CRAGIN) 1893, **21,** 155, pl. XXIV, fig. 5; pl. XXV, fig. 14; pl. XXVII, figs. 6–8. *(Holaster)* CLARK 1915, **15,** pl. XXXIX, fig. 1 (as *Holaster simplex)*. LAMBERT 1927, **64,** 270.

Medium-sized species, ambulacra similar, no anterior groove.

Denison beds and **Main Street:** Grayson County, one specimen from south of Cedar Mills (type locality).

Pseudananchys supernus (CRAGIN) 1893, **21,** 157 *(Holaster)*.

"Like *H. completus,* but large, elevated and top-heavy."

Grayson (?): Denton County, 7 miles south of Denton and 2 miles east of Argyle.

ECHINOCORYS BREYNIUS 1732 *(Ananchytes* Lamarck 1816)

Ovoid, no anterior groove; ambulacra similar, formed of variable pores. Periproct inframarginal. Genotype: *E. vulgaris* Breynius.

Echinocorys texanus (CRAGIN) 1893, **21,** 145, pl. XXVI, figs. 1–2; pl. XXV, fig. 12 *(Ananchytes)*............**Plate XXXVII, figures 5–6**

Large test, ovate in basal outline, base flattish, test elevated, somewhat conical; peristome and periproct inframarginal; large plates, coarsely perforated in apical region.

Anacacho: Medina County, on Seco Creek, 2.5 miles northwest of D'Hanis (type locality).

Echinocorys cf. **texanus** (CRAGIN). DANE AND STEPHENSON 1928, **118,** 44, 53.

Taylor (marl above Wolf City sand): Kaufman County, 2 miles from Forney.

Taylor (Lott chalk member): Falls or Bell County.

Taylor (Marlin chalk): Big Creek, 3.2 miles south by east of Mart.

PROSPATANGIDAE Lambert 1905

Apical system compact, plastron amphisternous *(i.e.,* plates paired along mid-line); paired ambulacra petaloid and superficial.

Unpaired ambulacrum with pores similar, separated by tubercle; test high posteriorly, thinned anteriorly; multiple fasciole............**Washitaster**

Unpaired ambulacra with pores of alternating lengths, not separated by tubercle; test generally less wedge-shaped anteriorly; fasciole bands rare or lacking............**Heteraster**

HETERASTER D'ORBIGNY 1853 (*Enallaster* d'Orbigny 1853)

Unpaired ambulacra with dissimilar zygopores, round and slit like pore-pairs alternating (irregularly, in some species). Paired ambulacra flexuous, posterior ones short, anterior ones long and with their anterior pores small and circular, at least in part. Entire **Comanchean.** Genotype: *H. oblongus* Brongniart.

Test evenly convex anteriorly and posteriorly.......................**H. inflatus**
Test declivous anteriorly
  Test exceptionally low, flattened; outline broadly oval
    Pores in 1:1 alternation.......................................**H. obliquatus**
    Pores in irregular alteration.......................................{**H. traski**, **H. sapperi**}
  Test taller or more narrowed
    Apical system subcentral or at least not far posterior
      Test constricted behind
        Pores of unpaired ambulacrum in a 2:1 alternation.......................................**H. bravoensis**
        Pores in 1:1 alternation.......................**H. texasus** d'Orbigny
      Test broad behind and sharply truncate
        Pores of unpaired ambulacrum in simple alternation
          Test low; periproct transverse..............**H. texanus** Roemer
          Test elevated; periproct vertically elongate or subcircular.......................**H. mexicanus** Böse; **H. böhmi**
        Pores of unpaired ambulacrum in irregular alternation.......................................**H. wenoensis**
    Apical system distinctly posterior
      Test low, very constricted behind; periproct distinctly transverse.......................................**H. texanus** Hall
      Test elevated, broad behind; periproct nearly circular.......................**H. mexicanus** Cotteau and **H. adkinsi** Lambert

	Length mm.	%	H %	W %	A %	P %	Type of unpaired	Alternation Ambulacrum
H. texanus Roemer, **78** pl. X, figs. 3 a–c	34.	1.00	.53	.91	.56	.67	1:1	Fbg.
H. texanus Hall, **18** pl. I, figs. 2 a–c	29.– 30.5	1.00	.50	.83– .85	.66	.67	?	
H. texanus Böse, **8** pl. XL, figs. 6–10	25.	1.00	.64	.91	.56	—	2:1	Fbg.
H. texanus Loriol, **121** pl. IV, fig. 5	31.	1.00	.55	.94	.55	.65 ?	1:1	Fbg.?
H. texanus Loriol, **121** pl. IV, fig. 6	30.	1.00	.62	.92	.52	.65	1:1	
H. böhmi Loriol, **121** pl. IV, figs. 7–8	19.	1.00	.61	.89	.53	.80	1–2:1	
H. sapperi Loriol, **121** pl. IV, fig. 4	61.	1.00	.38	.93	.54	—	3–6:1	
H. obliquatus Clark, **15** pl. XL, figs. 1 a–d	48.	1.00	.54	.93	.60	.54	1:1	Tr.
H. traski Whitney, **112**	35.5	1.00	.45	.97– 1.0	—	—	2, 5, 3:1	Wash
H. bravoensis Böse, **8** pl. XLII, figs. 2–12	27.	1.00	.62	.98	.52	.43	2:1	Wash.
H. adkinsi Lambert, **15** pl. XXXIX, fig. 2	30.	1.00	.67	.93	.63	.70	1:1	Fbg.
H. wenoensis Adkins, **1** pl. V, fig. 3	48.	1.00	.57	.95	.64	—	1:1 and 1:2	Wash.
H. mexicanus Cotteau, **20** pl. II, figs. 1–3	41.	1.00	.62	.96	.68	.61	1:1	Fbg.?
H. mexicanus Böse, **8** XXXIX, 9, 11; XL, 4	39.	1.00	.64	.92	.53	.60	1:1	Fbg.
H. inflatus, Cragin, **21**	31.5	1.00	.68	.95	—	—	?	
H. texasus, d'Orbigny pl. DCCCL, figs. 1–7	18.5	1.00	.59	.94	.5	—	1:1	Fbg.

H % = greatest height of test as a per cent of the total length.
W% = greatest width of test as a per cent of the total length.
A % = distance from anterior margin to apical system as a per cent of the total length.
P % = distance of periproct above base, as a per cent of the total height.

The tabulation is intended mainly to present clearly the relative proportions of the test in species of this genus. Valuable differential features not so easily measured are:

contour and profile of test, broadening or narrowing of posterior end, degree of truncation of posterior end, shape of periproct, details of surface marking, nature and arrangement of pores in unpaired ambulacrum, whether paired ambulacra are in grooves, presence and nature of pseudofascioles. It is unlikely that all the species in the above table are valid; but DE LORIOL (in 1904), and later LAMBERT, perceived clearly that there are several Texan species of *Heteraster* which are usually misidentified as "*Enallaster texanus.*" From the table, the following distinctions will be noted:

Low species (H=.38–.45): *H. sapperi, H. traski.*

Tall species (H=.64–.68): *H. texanus* Böse, *H. mexicanus* Böse, *H. inflatus.*

Apical system subcentral (A=.52–.53): *H. texanus* de Loriol, *H. bravoensis, H. böhmi, H. mexicanus* Böse.

Apical system far posterior (A=.66–.68): *H. texanus* Hall, *H. mexicanus* Cotteau.

Periproct low (P=.43): *H. bravoensis.*

Periproct high (P=.7–.8): *H. adkinsi, H. böhmi.*

The pre-Washita species have almost invariably the 1:1 type of alternation, probably the primitive condition in the genus; the Washita species have the 2:1 and irregular types.

Heteraster texanus (ROEMER) 1852, **78**, 85, pl. X, figs. 3 a–c *(Toxaster)*. LAMBERT AND THIERY 1909–1925, **66**, 438. LAMBERT 1927, **64**, 270. BÖSE 1910, **8**, 166, pl. XL, figs. 6–10; pl. XLI, figs. 2–4; pl. XLII, fig. 1 .... **Plate III, figure 1**

Typically not very tall nor inflated; test rather broad, not conspicuously narrowing posteriorly; pores of unpaired ambulacrum alternating rather regularly; periproct transversely oval; plastron widened posteriorly.

Heteraster texanus (HALL) 1857, in EMORY, Mex. Bdry. Surv., **18**, 145, pl. I, figs. 2 a–c, is entirely different from *Heteraster texanus* Roemer: it has the apical system far posterior, the test is much constricted posteriorly; and it considerably resembles *H. bravoensis*, which however has the apical system subcentral.

Fredericksburg: Widely distributed, Central and West Texas; Fredericksburg (type locality).

Washita: North-Central Texas.

Heteraster obliquatus (CLARK) 1915, **15**, 87, pl. XL, figs. 1 a–l. LAMBERT AND THIERY 1909–1925, **66**, 438. LAMBERT 1927, **64**, 270. BÖSE 1910, **8**, 165, pl. XXXIX, fig. 10................**Plate VIII, figure 3**

Broad, low test; larger and much lower and broader than *H. texanus*, with apical system located more posteriorly, and paired ambulacra narrower; periproct small, transversely oval, situated in an oval, vertical depression which is more narrowed at the bottom.

Glen Rose: Near Austin (type locality); Glen Rose; Kerr County.

Heteraster böhmi DE LORIOL 1904, **121**, 49, **pl.** IV, figs. 7–10 *(Enallaster)*. LAMBERT AND THIERY 1909–1925, **66**, p. 438.

H=.58–.65; W=.9–1.0; apical system subcentral (A=.53); periproct high (P=.8). Unpaired ambulacrum in deep groove, a pore-pair alternating with one (or two) slit-pairs. Anterior paired ambulacra with posterior zone in a groove, with about 25 slit-pairs; anterior zone is flush with surface, has widely spaced pore-pairs. Posterior paired ambulacra short, depressed, with about 13 pore-pairs. Peristome subcircular, distant from margin; plastron narrow, convex. Periproct slightly transverse-oval, on indistinct truncation.

"I have received from America, under the name of *Enallaster texanus*, two specimens from the chalk of Texas, one of which, 23 mm. long, comes from Fort Worth, and shows quite precisely all the features of *Enallaster böhmi*, including the depressed paired ambulacra." De Loriol states that Conrad's [Hall's] figure of *Toxaster texanus* (**18**, 145, pl. I, fig. 2) differs from *H. böhmi* in being narrow, with wide shallow anterior groove, and apical system far back. Clark's figure (U. S. Geol. Surv. Bull. 97, pl. XXXIX, fig. 2=U.S.N.M. 9857), which was later made the holotype of *Heteraster adkinsi* Lambert, differs from *H. böhmi* in having its paired ambulacra narrower, more curved and longer, its anterior groove deeper, narrower and more vertical-sided, and its apical system farther posterior.

Lower Cretaceous (horizon not stated): Fort Worth. Type locality: Esquias, dept. Comayagua, Honduras (horizon not stated).

HETERASTER SAPPERI DE LORIOL 1904, **121**, 47, pl. IV, figs. 4–4 a–4 b *(Enallaster)*. LAMBERT AND THIERY 1909–1925, **66**, p. 438.

Large, extremely depressed species, contour broad and subcircular. H=.38; W=.93. Apical system subcentral. Unpaired ambulacrum in a deep, wide, expanding groove, with wide pore-zones. Paired ambulacra long and wide, flush with surface, anterior ones with about 61, posterior ones with about 44, pore-pairs. Peristome slightly pentagonal, distant from margin. Periproct transverse oval, high on posterior face but invisible from above.

The unpaired ambulacrum has an alternation of 3 to 6 slit-pairs with one round pair, but in *H. obliquatus* Clark there is mostly a simple (1–1) alternation. In *H. obliquatus* the paired ambulacra are notably narrower, the apical system is farther posterior, the posterior slope has a more inclined truncation, making the periproct visible from above. *H. sapperi* is more depressed and more elongate than *H. traski,* and is not similar to any other described Texan species (see table). It has the extreme type of pore alternation (3–5:1) of the unpaired ambulacrum, which occurs in the similar species *H. traski.*

Cretaceous (Lower?): Las Cuevas, Carizel, Esquias (Honduras), type localities. It has not yet been reported from Texas.

Heteraster texasus (D'ORBIGNY) 1853, Pal. franç., Terr. Crét., VI, 184, pl. DCCCL, figs. 1–7 *(Enallaster).*

This echinoid, donated to d'Orbigny by F. Roemer, is very close to *H. bravoensis* Böse if not identical with it: it has the same elevated test, subcentral apical system, and posterior constriction and narrow truncation of the test; it appears to differ mainly in having the pore-pairs of the unpaired ambulacrum in simple (1–1) alternation. It is apparently a different species from *H. texanus* Roemer, but is probably identical with de Loriol's *E. texanus* (**121**, pl. IV, fig. 6, not fig. 5).

Fredericksburg: Near Fredericksburg (type locality). D'Orbigny erroneously referred the locality to the Senonian, "on account of its fauna and the presence of *Ostrea vesicularis.*"

Heteraster bravoensis (BÖSE) 1910, **8**, 168, pl. 41, figs. 5–10; pl. XLII, figs. 2–12; pl. XLIII, figs. 1–2, 6–7. LAMBERT AND THIERY 1909–1925, **66**, 438. LAMBERT 1927, **64**, 270. WHITNEY 1916, **112**, 16, pl. VI, figs. 3–5.

Differs from *H. texanus* in being a taller test, more prominently narrowed behind, with paired ambulacra narrower, and with a diffuse peripetalous (pseudo?)-fasciole posteriorly; periproct transverse.

Fort Worth to Pawpaw (subd. 5–6): El Paso section, Cerro de Muleros (type locality).

Upper Washita: North-Central Texas, widely distributed.

Heteraster wenoensis (ADKINS) 1920, **1**, 112, pl. V, fig. 3 *(Enallaster).* LAMBERT 1927, **64**, 271.

Broad, rather low test, not prominently constricted behind, apical system well back; differs from *H. bravoensis* in its lower and less inflated test, with anterior slope less abrupt and paired ambulacra depressed in slight grooves, with pores of unpaired ambulacrum more irregular; has faint peripetalous pseudo-fasciole.

Weno: One mile south of Riovista (type locality); Tarrant County, numerous localities.

Pawpaw: Tarrant County.

Heteraster traski (WHITNEY) 1916, **112**, 15, pl. VIII, figs. 1–3 *(Enallaster).*

Very broad, low and flat species; lower, more rounded, and anterior slope steeper than in *H. obliquatus.*

Upper Buda: Travis County, Shoal Creek (type locality).

HETERASTER MEXICANUS (COTTEAU) 1890, **20**, 296, pl. II. LAMBERT 1927, **64**, 270 (as *H. texanus)*............**Plate VIII, figure 2**

Elevated, broadly oval species, not prominently constricted posteriorly, with apical system placed far back, unpaired ambulacrum long with simple pore alternation; periproct a very short, transverse oval.

Heteraster mexicanus BÖSE 1910, **8**, 165, pl. XXXIX, figs. 9, 11; pl. XL, figs. 4–5; pl. XLI, fig. 1, is a different species from *H. mexicanus* COTTEAU in that its apical system is subcentral instead of far back, and its periproct is vertically rounded instead of transversely oval; in its shape and amount of inflation, and in other features, it seems rather similar.

Albian: Southern Mexico (Jalapa).

Heteraster adkinsi LAMBERT 1927, **64**, 270. CLARK 1915, **15**, 86–87, pl. XXXIX, figs. 2 a–g (as *Enallaster texanus)*..**Plate VIII, figure 6**

This species is very different from *H. texanus*, but has close relations to *H. mexicanus* COTTEAU. The test is more inflated than *H. texanus*, the ambulacra narrower, peristome subrounded, plastron narrower posteriorly, periproct small, situated high on test. It differs only slightly from *H. mexicanus* COTTEAU: the ambulacra are narrower, the test is more narrowed posteriorly, the periproct is less transversely oval.

Duck Creek: Pecos County, Leon Springs (type locality; holotype U.S.N.M., No. 9857).

Heteraster inflatus (CRAGIN) 1893, **21**, 150, pl. XXIV, fig. 13 *(Enallaster).* LAMBERT 1927, **64**, 270.................**Plate VIII, figure 1**

Anterior-posterior profile high, equally high and evenly rounded at both ends; periproct narrower than in *H. texanus;* unpaired ambulacrum with one pore-pair and 2–3 slit-pairs alternating.

Grayson: Denton Creek, 1 mile east of Roanoke, and Choctaw Creek, east of Denison (type localities).

WASHITASTER LAMBERT 1927

Generally low, elongated, subcordiform test, sharply sloping anteriorly to a thin edge; peristome subpentagonal, periproct rounded, high on posterior face; unpaired ambulacrum very long, apical system consequently posterior, and posterior ambulacra quite short;

anterior ambulacra long, flexuous; unpaired ambulacrum with similar, slit-like pores separated by a tubercle; paired ambulacra superficial, anterior ones with round pores; multiple peripetalous fasciole.

Upper Washita: Fort Worth to Pawpaw. Genotype: *W. riovistae* (Adkins).

Washitaster longisulcus (ADKINS AND WINTON) 1920, **3**, 55, pl. IX, figs. 4, 8–10 *(Enallaster)*. ADKINS 1920, **1**, 111, pl. VIII, fig. 1. LAMBERT 1927, **64**, 271.................................... **Plate XIII, figure 6**

Test more depressed, unpaired ambulacrum longer and more excavated and prominently grooved, apical system farther posterior, anterior ambulacra diverge at smaller angle, and posterior ambulacra shorter, than in *W. riovistae*.

Upper Fort Worth limestone: Tarrant County; Johnson County, near Blum (type locality); Grayson County, 3 miles north of Denison; and elsewhere in North-Central Texas, but rare.

Washitaster riovistae (ADKINS) 1920, **1**, 115, pl. VI, fig. 4; pl. VIII, figs. 3, 5 *(Hemiaster)*; LAMBERT 1927, **64**, 271. LAMBERT 1926, in SCOTT, **85**, p, 180 *(Miotoxaster)*......................... **Plate XIX, figure 2**

General shape of *Heteraster wenoensis*, more elevated than *W. longisulcus*, and with the apical system placed farther forwards, anterior groove shorter, posterior ambulacra longer. Discontinuous, reduplicated peripetalous fasciole.

Weno: One mile south of Riovista (type locality); Tarrant County, numerous localities; North-Central Texas, scattered localities.

Washitaster sp.

Pawpaw: Fort Worth, Glen Garden Country Club; Loc. 714; and elsewhere.

There is another species, *Washitaster humphreysanus* (MEEK AND HAYDEN) 1857 *(Hemiaster?)* from the Pierre shale of Montana, CLARK 1915, **15**, 95, pl. XLIX, figs. 2 a–f.

BRISSIDAE Cotteau, in: Lambert, Ann. Univ. Lyon, fasc. 17, p. 25, 1905.

Apex compact; plastron amphisternous *(i.e.,* plates paired along mid-line); paired ambulacra petaloid, mainly situated in grooves.

Peripetalous fasciole not distinct:
 Unpaired ambulacrum with circular pores......................... **Epiaster**
 Unpaired ambulacrum with elongated-oval pores.......... **Macraster**
Peripetalous fasciole distinct:
 Ambulacra, especially the unpaired one, in deep grooves..........
 .... **Proraster**
 Ambulacra in pronounced but not deep grooves............ **Hemiaster**

MACRASTER ROEMER 1888

Test cordiform, paired ambulacra wide and straight; unpaired ambulacrum with pores *en chevron*, at least in adult. Some individuals show traces of a peripetalous pseudo-fasciole, which is more or less diffuse. Genotype: *Macraster texanus* ROEMER 1888.

Form elevated, rotund; ambulacral grooves deep
- Smaller species, prominently granulated, ambulacra short .... **M. washitae**
- Large species, sparsely granulated, ambulacra longer
  - Test rounded posteriorly .... **M. elegans**
  - Test prominently narrowed posteriorly .... **M. subobesus**

Form low or medium; ambulacral grooves more shallow
- Test low (H=.46)
  - Ambulacra short; posterior truncated area bordered with vertical rows of prominent granules .... **M. nodopyga**
  - Ambulacra long; no prominent granules on truncation .... **M. texanus**
- Test higher (H=.57)
  - Posterior face of test vertical; ambulacral grooves distinctly excavated .... **M. aguilerae**
  - Posterior face rounded; ambulacral grooves shallow .... **M. wenoensis**

	Length	Width	Height	Ap. Syst.	Periproct	Peristome
(a) ROEMER, **81**, pl. VI, figs. 1–2 (M. texanus, type)	81. (=1.0)	.93	.46	.395	----	----
(b) SHUMARD, **87**, pl. II, figs. 4 a–c (M. elegans, type)	47. (=1.0)	.96	.51?	.49	.62	.22
(c) M. aguilerae (A)	66.	.96	.57	.46	----	----
(d) M. aguilerae (B)	65.	.93	.57	.43	----	----
(e) BULLARD, B2710, pl. VI, figs. 2–3	70.	.91	.48	.43	----	----
(f) Ind. *a* near Kent	78.	.9	.5	.41	----	----
(g) ADKINS AND WINTON, **3**, pl. VIII, figs. 3–4 (M. elegans)	68.5	.92	.64	.43	.57	.22
(h) M. nodopyga (type) CLARK, pl. XLII	50.5	.9	.475	.44	.44	.17

M. elegans type (b) differs from *M. texanus* type (a) in having ambulacra in deeper grooves, in its taller test, which is more constricted posteriorly, and in its less anterior apical system. The tall inflated species (g) commonly called *elegans* is seen to agree essentially with Shumard's type (b). *M. aguilerae* (c, d) differs from *M. texanus* (a) in having a taller test and less anterior apical system. Individuals (e) and (f) agree essentially with *M. texanus* type.

Macraster elegans (SHUMARD) 1854, **87**, 184, pl. II, figs. 4 a–c *(Hemiaster)*. BÖSE 1910, **8**, 172–174. ADKINS AND WINTON 1920, **3**, 53, pl. VIII, figs. 3–4. LAMBERT AND THIERY 1909–1925, **66**, 472. LAMBERT 1927, **64**, 272. .... **Plate XIV, figure 4**

Shumard's description and poor figures do not make clear exactly which species he had in mind; later writers have confused several species under the name *elegans*. One very common species figured by Adkins and Winton as just cited, agrees fairly well with Shumard's indications. It is medium-sized or large, rotund, with the interambulacral areas characteristically elevated and rounded, and should not be confused with such species as *texanus, aguilerae, wenoensis*. The final identification of *elegans* awaits a study of the type, if it is still in existence.

The following features may be gathered with some assurance from Shumard's figures of *M. elegans* (**87**, pl. II, figs. 4 a–c): The ambulacral grooves are intended to be narrow and deep, test is of medium elevation, in contour a short, broad oval, somewhat constricted and truncated behind, periproct vertically elongated and situated fairly high on posterior truncation, peristome reniform. Dimensions as percentages: Length 47 mm. (=1.0); width 0.96; height 0.51; apical system 0.49; periproct 0.62; peristome 0.22.

Upper Duck Creek, entire **Fort Worth:** Fort Washita (type locality); Central Texas and Trans-Pecos Texas generally; northern Mexico, scattered localities. The Fort Worth limestone was the era of the greatest development of the genus *Macraster* (several species) in Texas; another less abundant group of species of the genus occurs in the Weno.

Macraster texanus ROEMER 1888, **81**, 191–195, pl. VI. BÖSE 1910, **8**, 172, pl. XLVII, fig. 5; pl. XLVIII, figs. 3, 5. LAMBERT AND THIERY 1909–1925, **66**, 472 (as *M. elegans*). LAMBERT 1927, **64**, 271. BULLARD 1928, Univ. Texas Bull. 2710, pl. V, figs. 2–3 (as *Hemiaster elegans*)........................ **Plate XIII, figures 4–5**

M. texanus is distinguished from *M. elegans* in (a) having the posterior ambulacra longer and wider; (b) having the ambulacral pores larger and more linear; (c) in longitudinal section the upper surface of the test is more uniformly curved and is lower; (d) the ambulacral grooves are shallower; (e) apex is more anterior. The posterior ambulacra diverge at less than right angle; in *M. aguilerae* they diverge at an angle of about 65°; this species, as also *M. aguilerae*, is less prominently granulated than *M. elegans*.

"**Fredericksburg** (with *Exogyra texana* and *Natica pedernalis*): Georgetown" (type locality). In spite of this statement, the horizon is probably Fort Worth limestone.

Fort Worth limestone: Southern Oklahoma; Boracho; Kent; Fort Stockton. Subd. 5: Cerro de Muleros.

Macraster washitae LAMBERT 1920, **68,** 28. LAMBERT 1927, **64,** 272. LAMBERT AND THIERY 1909–1925, **66,** 472. CLARK 1915, **15,** 89, pl. XLV, figs. 1 a–c (as *Hemiaster whitei*).

No fasciole; pores of unpaired ambulacrum transverse; paired ambulacra short and located in rather deep grooves.

Holotype: U.S.N.M. 31202, locality not stated.

Macraster nodopyga LAMBERT 1920, **65,** 28. LAMBERT 1927, **84,** 272. LAMBERT AND THIERY 1909–1925, **66,** 272. CLARK 1915, **15,** pl. XLII, figs. 1 a–h (as *Hemiaster elegans*)........**Plate VIII, figure 4**

It is distinguished from *M. elegans* in (a) its more depressed form; (b) ambulacra much shorter and narrower; (c) in having two rows of nodules on its posterior face.

Fort Worth (?): Holotype from "Geological Survey of Texas," locality Fort Worth (?).

Macraster aguilerae (BÖSE) 1910, **8,** 173, pl. XLVII, figs. 2–4, 6–7; pl. XLVIII, figs. 1–2, 4. LAMBERT AND THIERY 1909–1925, **66,** 472. LAMBERT 1927, **64,** 272 (as *M. elegans*). ADKINS 1920, **1,** 109, pl. V, fig. 5; pl. VIII, fig. 7.

Rather rotund, outline oval, sides inflated, form somewhat depressed. The ambulacral grooves are shallow, straight and fairly long; the surface is much more minutely granulated than in *M. elegans,* and thus appears somewhat like *M. wenoensis*. *M. aguilerae* differs from typical *M. elegans* in (a) having a less elevated and more ovate test; (b) periproct is situated lower; (c) ambulacral grooves are shallower, and interambulacral areas are less prominently elevated and less inflated or rounded; (d) ambulacra are narrower; (e) test has fewer and much finer granules and tubercles, producing a rather smooth appearance. Lambert (**64,** 272) erroneously identified it with *M. elegans.*

Fort Worth-Denton (subd. 5): Cerro de Muleros, El Paso section (type locality); near Fort Worth; Hill County, near Aquilla; McLennan County; Fort Stockton; Kent.

Macraster subobesus (ADKINS) 1920, **1,** 110, pl. XI, fig. 3 (*Epiaster*). LAMBERT 1927, **64,** 272........................**Plate XIX, figure 4**

Large, elevated, inflated species, in outline elongate oval but prominently narrowed behind. The ambulacra are long, straight, quite wide for the genus, and situated in shallow grooves. The apical system is slightly anterior to the center of the test. Peristome small, transverse, labiate; periproct quite small, circular, low on narrow posterior face. The obesity and prominent posterior elongation will distinguish this species from all other Texan species so far described, though there is an undescribed species of this general form in the Duck Creek at Kent and Fort Stockton.

Upper Weno: One mile south of Riovista (type locality) Tarrant County; McLennan County; probably widespread at this level.

Macraster wenoensis (ADKINS) 1920, **1**, 105, pl. VI, fig. 6 *(Epiaster)*. LAMBERT 1927, **64**, 272.

This species will scarcely be confused with any other described Texan species except *M. aguilerae*, from which it differs in (a) having the ambulacra slightly narrower and the ambulacral grooves shallower, and (b) form more elongate oval, with the sides more nearly vertical and less inflated. The two species are extremely similar, and may even be identical.

Weno: Three miles southeast of Fort Worth (type locality); Tarrant County, several localities; Denison.

Pawpaw: Fort Worth.

Macraster sp. LAMBERT 1926, in SCOTT, **85**, p. 181. *Hemiaster* sp. B. ADKINS AND WINTON 1920, **3**, 53, pl.VIII, figs. 7–9.

No peripetalous fasciole, pentagonal peristome, paired ambulacra broad, pores of unpaired ambulacrum arranged *en chevron*.

Goodland, Comanche Peak: Fort Worth, Valley Mills; widespread and very abundant.

EPIASTER D'ORBIGNY 1855

Test cordiform, notched by anterior groove, and having a posterior keel. Unpaired ambulacrum with rounded pores separated by granule. Peristome labiated. No distinct fasciole. Genotype: *E. trigonalis* Desor (Albian).

Epiaster bosei LAMBERT 1924, in LAMBERT AND THIERY 1909–1925, **66**, 478, pl. XII, figs. 8–9. LAMBERT 1927, **64**, 272.

Species small (17 mm. long), inflated, rounded, narrowed and truncated behind; apex central; ambulacra short, wide, pore-zones wider than intervening space; unpaired ambulacra with oblique elliptic pores separated by granule; periproct subcircular, located on triangular posterior truncation.

Comanche Peak: Benbrook (type locality; type in Lambert Collection, Paris).

Epiaster whitei (CLARK) 1915, **15**, 89, pl. XLIII, figs. 2 a–c; pl. XLIV, figs. 1 a–h; pl. XLV, figs. 2 a–f, not figs. 1 a–c *(Hemiaster)*. LAMBERT AND THIERY 1909–1925, **66**, 502. LAMBERT 1927, **64**, 272.

The type is a medium-sized echinoid, elongate, anterior ambitus indented by sulcus, posterior end truncated, sides convex, inflated, apex anterior to center and greatest width of test anterior to apex; test proportionately not very elevated. Ambulacra short, in broad grooves. Unpaired ambulacrum with simple pores. Peristome transversely oval (sub-reniform). Periproct small, vertically slightly elongate-oval, situated high on posterior truncated face. No fascioles.

Duck Creek: Duck Creek, near Denison (type locality; holotype U.S.N.M. No. 9732); at the type locality of the Duck Creek formation there is a considerable bed of this species; Tarrant County, numerous localities; probably widely distributed at this level.

Upper Fredericksburg: Tarrant County.

HEMIASTER DESOR 1847

Test subcordiform or globulous, with heterogeneous ambulacra. Apical system ethmolyse or ethmophract, with 2–4 genital pores. Peristome reniform with labrum not very projecting. Genotype: *H. bufo* Brongniart.

Hemiaster calvini CLARK 1915, **15**, 91, pl. XLVII, figs. 2 a–i. LAMBERT 1926, in SCOTT, **85**, p. 184. LAMBERT AND THIERY 1909–1925, **66**, p. 500. LAMBERT 1927, **64**, 272 *(Epiaster)*. BÖSE 1910, **8**, 175, pl. XLIII, figs. 3–5, 8; pl. XLIV, figs. 1–8; pl. XLV, figs. 1–3, 5. BÖSE 1928, **10**, pp. 26, 92. WHITNEY 1916, **112**, 18, pl. VIII, figs. 4–7; pl. IX, figs. 1–3.

Test oval, cordate, inflated; upper surface elevated; lower surface flat; posterior margin obliquely truncated. Ambulacra moderately depressed on the upper surface. Peristome transversely oval; periproct oval, high on posterior tiuncated surface. Peripetalous fasciole distinct.

Buda: Austin, Shoal Creek (type locality; holotype U.S.N.M. No. 12241).

Main Street or **Grayson:** Denison; Tarrant County; Roanoke; Cerro de Muleros (subd. 8=Grayson); between Sanderson and Dryden.

Hemiaster (Leymeriaster) bexari CLARK 1915, **15**, 89, pl. XLVI, figs. 1 a–e. LAMBERT AND THIERY 1909–1925, **66**, 500. LAMBERT 1927, **64**, 273.

Test small, upper surface nearly flat, elevated, lower surface rounded; sides inflated; apex nearly central; posterolateral ambulacra very short, interambulacra prominent. Peristome small, only slightly depressed, near anterior margin. Periproct small, situated high on truncated posterior face. Peripetalous fasciole distinct.

Washita: Bexar County (type locality; holotype U.S.N.M. No. 8330).

Hemiaster (Mecaster) comanchei CLARK 1915, **15,** 90, pl. XLVI, figs. 2 a–d. LAMBERT AND THIERY 1909–1925, **66,** 502. LAMBERT 1927, **64,** 273. LAMBERT 1926, in SCOTT, **85,** p. 184 *(Palhemiaster)*, pl. II, figs. 3′, 3″, 3‴.

Test small to medium size, cordiform, high, lower surface flat, sides inflated, apex forward of the center, peripetalous fasciole broad and clearly marked; ambulacra rather narrow, depressed, petaloidal, the posterolateral considerably shorter than the anterolateral, apical system nearly central; peristome near forward margin; periproct small, high on sloping posterior surface, showing clearly from above.

Glen Rose: Travis County, Santa Monica Springs, 10 miles west of Austin (type locality; holotype, Johns Hopkins University T3012).

Hemiaster texanus ROEMER 1849, **77,** 393; ROEMER 1852, **78,** 85, pl. X, figs. 4 a–c. CLARK 1915, **15,** 94, pl. XLIX, figs. 1 a–j. LAMBERT AND THIERY 1909–1925, **66,** 500. **Plate XXXIV, figures 4–5**

Test oval, cordate, declining anteriorly, slightly elevated posteriorly; anterior sulcus broad and deep, indenting ambitus. Ambulacra broadly depressed on upper surface; antero-lateral pair bent backward in upper part; unpaired ambulacrum very broad. Apical system compact, the four genitals distinctly perforated. Peristome large, transversely oval, bilabiate. Periproct large, oval, at center of truncated surface of posterior margin. Peripetalous fasciole distinct.

Austin chalk: New Braunfels, waterfall of Guadalupe River (type locality). Widespread in Central Texas.

Hemiaster americanus GIEBEL 1853, **45,** p. 372.

Is stated to differ from *H. texanus* in (a) having greatest width in anterior one-third of test, instead of centrally; (b) greatest height at, or in front of, apex instead of on posterior median keel; (c) this keel is absent or represented by a low convexity; (d) peristome is circular to pentagonal, instead of transverse and reniform; (e) periproct circular, instead of vertically elongate, pointed at both ends; (f) posterior truncation not bordered by swellings of test; (g) and in details of tuberculation.

Austin chalk (?): Probably Cibolo Creek, 8 miles from Comanche Spring (or possibly "Hendenon, between New Braunfels and Guadeloupe")—type locality.

PRORASTER LAMBERT 1895

Test *Schizaster*-like, with wide and deep anterior groove; 4 genital pores; paired ambulacra flexuous, deeply excavated; tubercles scrobiulate. Genotype: *P. atavus* Arnaud.

Proraster dalli (CLARK) 1915, **15**, 90, pl. XLVII, figs. 1 a–f. *(Hemiaster)*. LAMBERT AND THIERY 1909–1925, **66**, 506. LAMBERT 1927, **64**, 273.

Washita: Bexar County (type locality; holotype U.S.N.M. No. 19114).

Phylum VERTEBRATA

Class PISCES[54]

Subclass SELACHII

Lamna texana ROEMER 1852, **78**, 29, pl. I, figs. 7 a–b. CRAGIN 1893, **21**, p. 166.

Eagle Ford: One-half mile east of Ector; ford at New Braunfels (type locality).

OXYRHINA EXTENTA MANTELL. PRATHER, J. K., 1901, Trans. Texas Acad. Sci., IV, 85–87.

Eagle Ford: Near Waco.

OXYRHINA MANTELLI AGASSIZ. ROEMER 1852, **78**, 29, pl. I, figs. 6 a–b.

Eagle Ford: Ford at New Braunfels.

OTODUS APPENDICULATUS AGASSIZ. ROEMER 1852, **78**, 30, pl. I, figs. 9 a–b. CRAGIN 1893, **21**, 166.

Eagle Ford: Fannin County one-half mile east of Ector.

Corax heterodon REUSS. ROEMER 1852, **78**, 30, pl. I, figs. 8 a–b.

Eagle Ford: New Braunfels.

MYLIOBATIDAE

Ptychodus whipplei MARCOU 1858, **68**, 33, pl. I, figs. 4–4 a. CRAGIN 1893, **21**, p. 166.

Horizon unknown: Three miles north of Galisteo, New Mexico (type locality).

Eagle Ford: Fannin County, one-half mile east of Ector.

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[54]Cope, E. D., 1872. On the families of fishes of the Cretaceous formation of Kansas. Amer. Phil. Soc. Proc., 327–357. Gidley, J. W., 1913. Some new American Pycnodont fishes. Proc. U. S. Nat. Mus., Vol. 46, 445–449, 6 text figs. Hay, O. P., 1916, **50**. Loomis, F. B., 1900. Die Anatomie und die Verwandschaft der Ganoid und Knockenfische aus der Kreideformation von Kansas. Paleontogr., Vol. XCIV. Cretaceous Fishes: Selachians and Pycnodonts, by S. W. Williston; Teleosts, by Alban Stewart. Univ. Geol. Surv. Kansas, VI, pt. II, 235–403, pls. XXIII–LXXIII, 1900. Eastman, Charles R., 1894. Beiträge zur Kenntniss der Gattung *Oxyrhina* [etc.]. Palaeontographica, XLI, 141–191, pls. XVI–XVIII.

Subclass GANOIDEI

MACROSEMIIDAE

Macrepisteus arenatus COPE. HILL 1901, **57**, 159, pl. XXIV.

Glen Rose: Near Weatherford (type locality).

PYCNODONTIDAE

Pycnodus comminuens HAY 1916, **50**, p. 3, pl. I, fig. 1.

Right splenial and teeth.

Austin chalk?: McLennan County, Walker's Crossing of Bosque River (type locality; holotype in Baylor University Museum).

Pycnodus planidens HAY 1916, **50**, p. 7.

Part of left splenial with a principal and two other rows of teeth.

Lower Cretaceous: Vanderpool, Texas (type locality; holotype in United States National Museum).

Typodus diastematicus (COPE) 1894. HAY 1916, **50**, p. 4.

Species based on vomer.

Fredericksburg: "Texas."

Typodus dumbeli (COPE) 1892, Proc. Am. Phil. Soc., 30, 123–131 (p. 128). COPE 1892, Geol. Surv. Texas, 3d Ann. Rept., p. 256 *(Microdus)*. HAY 1916, **50**, p. 5.

Species based on part of left splenial sent to Professor Cope by Dr. E. T. Dumble, from collections of the Dumble Survey.

Locality: Probably Lower Cretaceous; Texas.

Typodus valens HAY 1916, **50**, p. 5, pl. I, fig. 2.

A portion of the vomer, with teeth.

Lower Cretaceous: McLennan County, Hog Creek near Speegleville (type locality; holotype in Baylor University Museum).

Pycnomicrodon texanus (GIDLEY) 1913, **44**, 445, text figs. 1–2–2 a. HAY 1916, **50**, p. 6.

The type is a vomer.

Cretaceous?: Hamilton County, Texas.

Coelodus fabadens GIDLEY 1913, **44**, 446, text figs. 3–3 a. HAY 1916, **50**, p. 7.

Left splenial.

Lower Cretaceous: Near Gainesville.

Coelodus decaturensis GIDLEY 1913, **44**, 447, text figs. 4–4 a. HAY 1916, **50**, p. 7.

Left splenial.

Lower Cretaceous: Decatur, Wise County.

PROTOSPHYRAENIDAE

Protosphyraena penetrans. PRATHER 1901, Texas Acad. Sci., Proc., IV, 85–87.

Eagle Ford: Near Waco.

Subclass TELEOSTEI

ELOPIDAE

Holcolepis pulchellus COCKERELL 1919, U. S. Geol. Surv., Prof. Paper 120-I, 174, pl. XXXI, figs. 3–4 (based on scales); MOREMAN 1927, **73**, p. 97.

Eagle Ford: Grayson County.

ICHTHYODECTIDAE

Hypsodon audax (LEIDY) COCKERELL 1919, U. S. Geol. Surv., Prof. Paper 120-I, 177, pl. XXXII, fig. 8; pl. XXXIII, figs. 1–2.

Xiphactinus audax Prather 1901, **75**, 85–87.

Eagle Ford: Near Waco.

Ichthyodectes sp. PRATHER 1901, **75**, IV, 85–87.

Eagle Ford: Near Waco.

Portheus sp. GIDLEY.

One side of mandible, identified by Dr. J. W. Gidley, was discovered by Messrs. Arick and McCarter.

Eagle Ford (shale member): McLennan County, Bosqueville road crossing of Bosque River.

Class REPTILIA

PLESIOSAURIDAE[55]

Cimoliasaurus sp. PRATHER 1901, **75**, IV, 85–87.

Eagle Ford: Near Waco.

[55]Compare: Cragin, F. W., 1894, Vertebrata from the Neocomian of Kansas. Colo. Coll. Stud., V, 67–93. Williston, S. W., 1903, North American Plesiosaurs, pt. I. Field Columbian Museum. Publ. 73, pp. 7–12.

Plesiosaurus sp. PRATHER 1901, **75,** IV, 85–87.

Eagle Ford: Near Waco.

Plesiosaurus sp.

Ten large vertebrae found by W. S. Adkins in 1927.

Pawpaw: Near Fort Worth (Glen Garden Country Club).

MOSOSAURINAE

Clidastes sp. PRATHER 1901, **75,** IV, 85–87.

Eagle Ford: Near Waco.

Mososaurus sp. ADKINS 1924, Univ. Texas Bull. 2340, p. 75.

This nearly perfect skull was found by Dr. J. A. Udden about 1918, and was later donated to Dr. Troedsen of Stockholm.

Eagle Ford?: McLennan County, Bosque Escarpment near "fish pond."

Saurian tracks have been described from the Glen Rose limestone near Glen Rose by Shuler[56], and from the Glen Rose in Hamilton County by Wrather[57].

Tracks have been recorded from the Del Rio formation by UDDEN[58] and by ADKINS;[59] and tracks have been verbally reported from the Austin Chalk in Travis County.

Dr. Udden reports having sent "to the University of Chicago a Cretaceous crocodile from the Rattlesnake beds or above, locality Mail Box Tank, northeast of the Chisos Mountains." Reptilian remains have been found in the Taylor in Travis County, vertebrae from a roadside cut a short distance south of Kimbro; and from just east of Cameron road about 1.5 miles northeast of Sprinkle.

The Rattlesnake beds in the Chisos and Terlingua quadrangles contain a large reptilian fauna, partially reported by Williston, in Udden 1907, **100,** pp. 53–54.

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[56]Shuler, Ellis W., 1917. Dinosaur tracks in the Glen Rose limestone near Glen Rose, Texas. Amer. Jour. Sci., xliv, 294–298, figs. 1–3 (the tracks were named: *Eubrontes* (?) *titanopelopatidus* n. sp. Shuler.

[57]Wrather, W. E., 1922. Dinosaur tracks in Hamilton County, Texas. Jour. Geol., xxx, no. 5, 354–360.

[58]Udden, J. A., 1908. Fossil tracks in the Del Rio clay. Trans. Texas Acad. Sci., X, 51–52.

[59]Adkins, W. S., 1924. Univ. Texas Bull. 2340, p. 50.

PLATES I TO XXXVII

Plate I

Figs. 1–4. **Cycadeoidea** sp. (reduced). **Gillespie sands** (Trinity division): About 1.5 miles south of Fredericksburg .... **Page 49**

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Figs. 9–10. **Porocystis globularis** (GIEBEL), × 1.5. **Glen Rose:** Bull Creek road, near Austin .... **Page 57**

Originals of Figs. 1–4 at Fredericksburg; of Figs. 5–9 in Bureau of Economic Geology.

NOTE.—The writer wishes to express his appreciation to Professor W. M. Winton for the use of the photographs of pl. IV, figs. 3, 5, pls. XIV–XVIII, and pl. XX, fig. 3; to Dr. F. L. Whitney for use of the original specimen of pl. XXIII, fig. 1; to Dr. Gayle Scott for the photographs of pl. XII, figs. 1, 3, 5; to Dr. L. W. Stephenson for permission to photograph the original of pl. XXIV, figs. 1–2; to Dr. T. W. Stanton for a plaster replica of the holotype of *Pervinquieria leonensis;* to Dr. Cloos of Bonn for permission to photograph the original of pl. XXXIV, fig. 6; to Dr. Soergel of Breslau for the use of originals of pl. V, fig. 4, pl. XXIII, figs. 2, 4, and pl. XXVII, fig. 1. Plate XIII, figs. 4–5 is reproduced from F. Roemer 1888, **81**; plate XXXIV, fig. 7 is from Airaghi 1904, **124**.

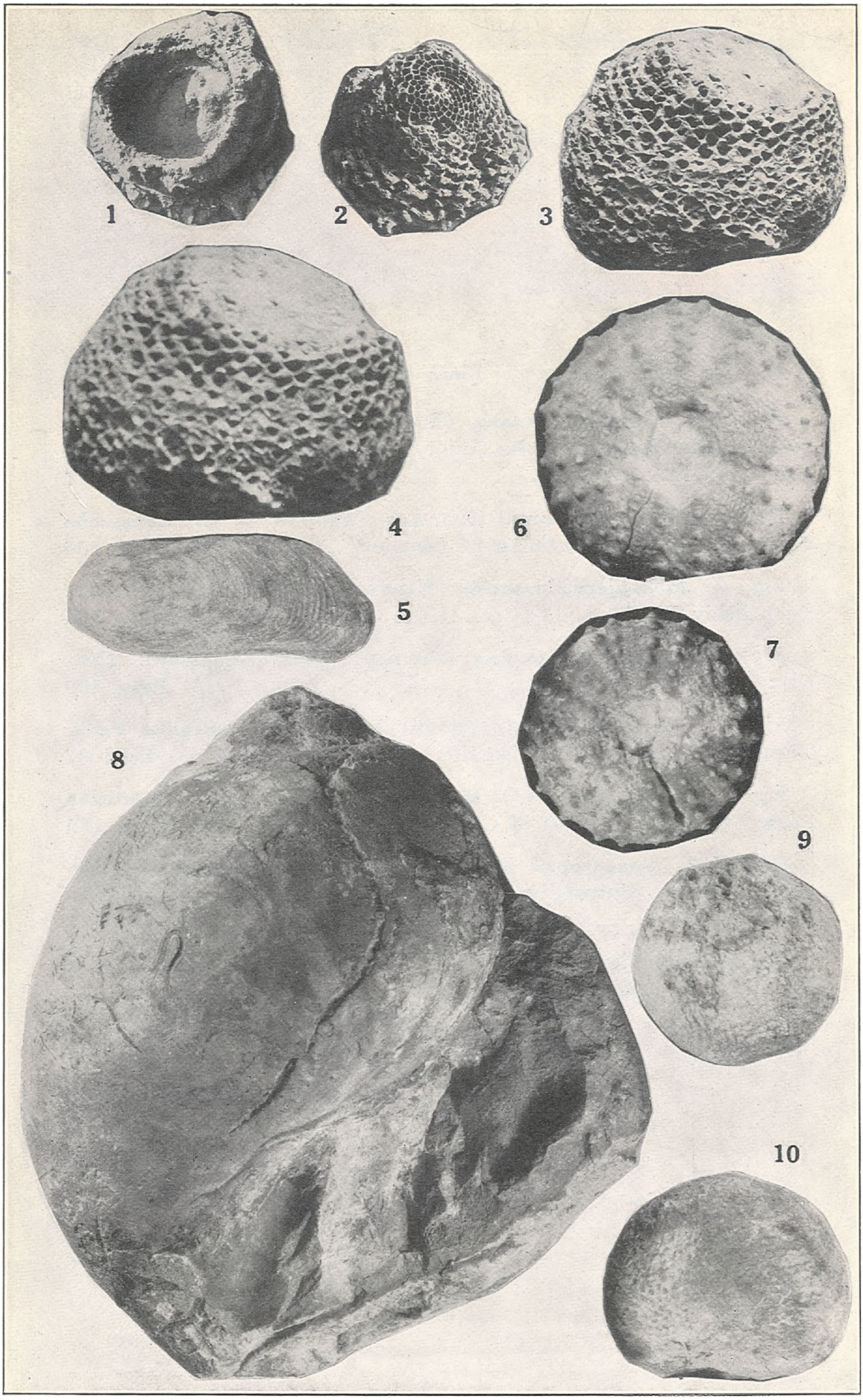
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Plate II

Figs. 1–2. **Exogyra texana** (ROEMER), × ⅔. Fig. 1, showing fossil pearl. **Walnut:** Coke County. Fig. 2, **Walnut:** Austin, Bull Creek road .... **Page 114**

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Figs. 8–9. **Amauropsis pecosensis** n. sp., × ·07. **Upper Fredericksburg clay:** University Mesa, 12 miles northeast of Fort Stockton .... **Page 179**

Originals of Figs. 5, 7 in Texas Christian University; others in Bureau of Economic Geology.

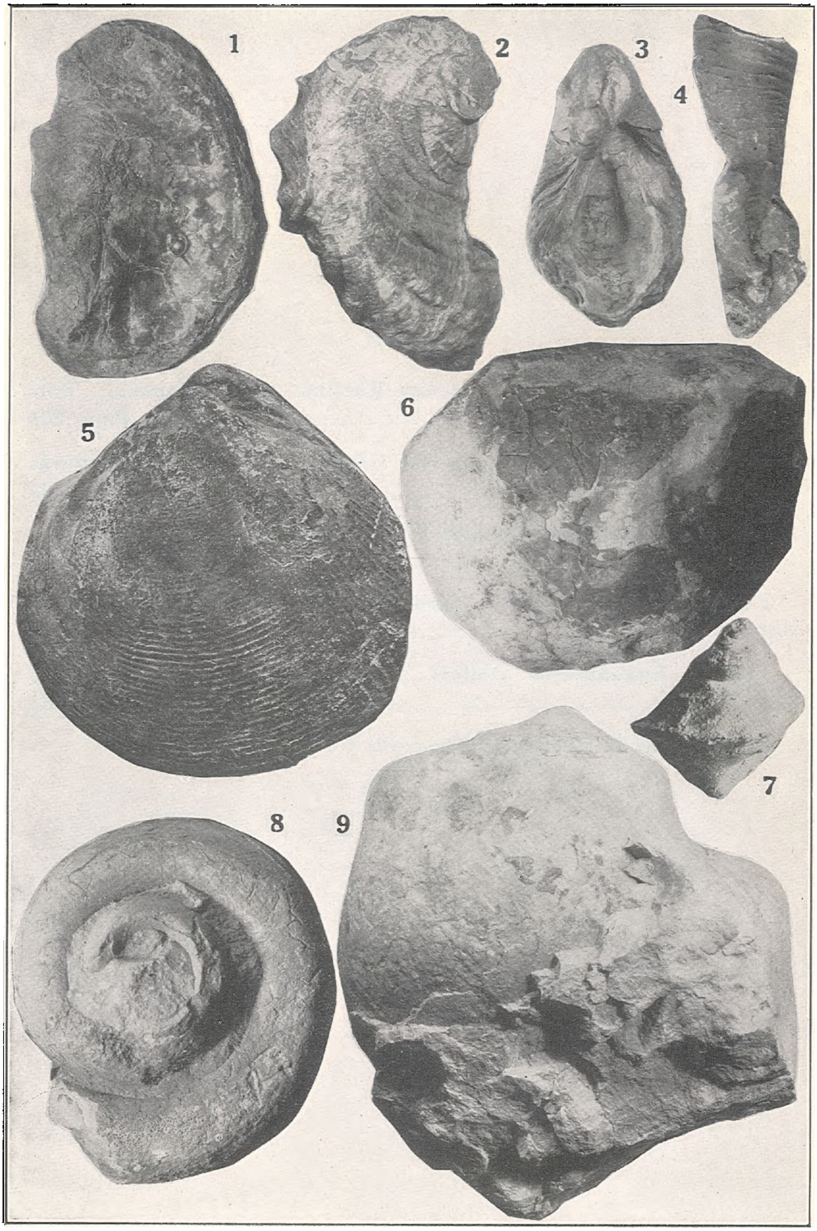
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Plate III

Fig. 1. **Heteraster** aff. **texanus** ROEMER, × 1. **Kiamichi:** Fort Stockton........**Page 289**

Fig. 2. **Holectypus** cf. **planus** GIEBEL, × 1. **Fredericksburg:** Burnet County........**Page 282**

Fig. 3. **Metengonoceras hilli** BÖHM, × 1. **Walnut:** Austin........**Page 264**

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Fig. 5. **Engonoceras stolleyi** BÖHM, × 0.9. **Comanche Peak:** Valley Mills........**Page 263**

All originals in Bureau of Economic Geology.

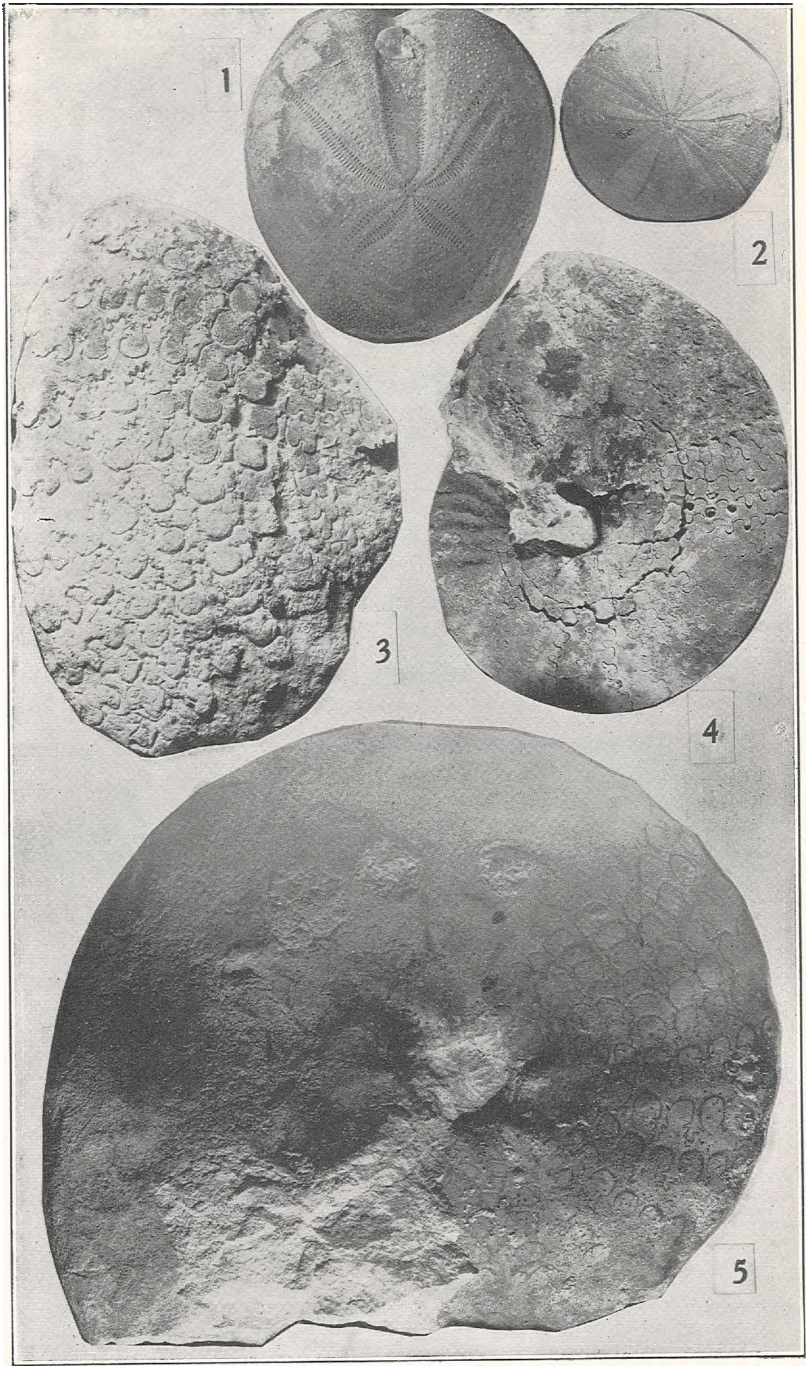
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Plate IV

Fig. 1. **Oxytropidoceras** n. sp., × 1. **Kiamichi:** Fort Stockton .... **Page 226**

Fig. 2. **Oxytropidoceras** sp. aff. **bravoense** (Böse), × ¼. **Upper Fredericksburg:** Pecos County, University Mesa, 12 miles northeast of Fort Stockton .... **Page 227**

Fig. 3. **Oxytropidoceras** sp. aff. **belknapi** Marcou, × 0.2. **Kiamichi:** Fort Worth .... **Page 226**

Fig. 4. **Oxtropidoceras trinitense** (Gabb), × 0.93. **Comanche Peak:** Valley Mills .... **Page 227**

Fig. 5. **Cymatoceras texanum** (Shumard), × ⅓ .... **Page 199**

Figs. 3, 5 by courtesy of Professor W. M. Winton.

Originals of Figs. 3, 5 in Texas Christian University; of Figs. 1, 2, 4 in Bureau of Economic Geology.

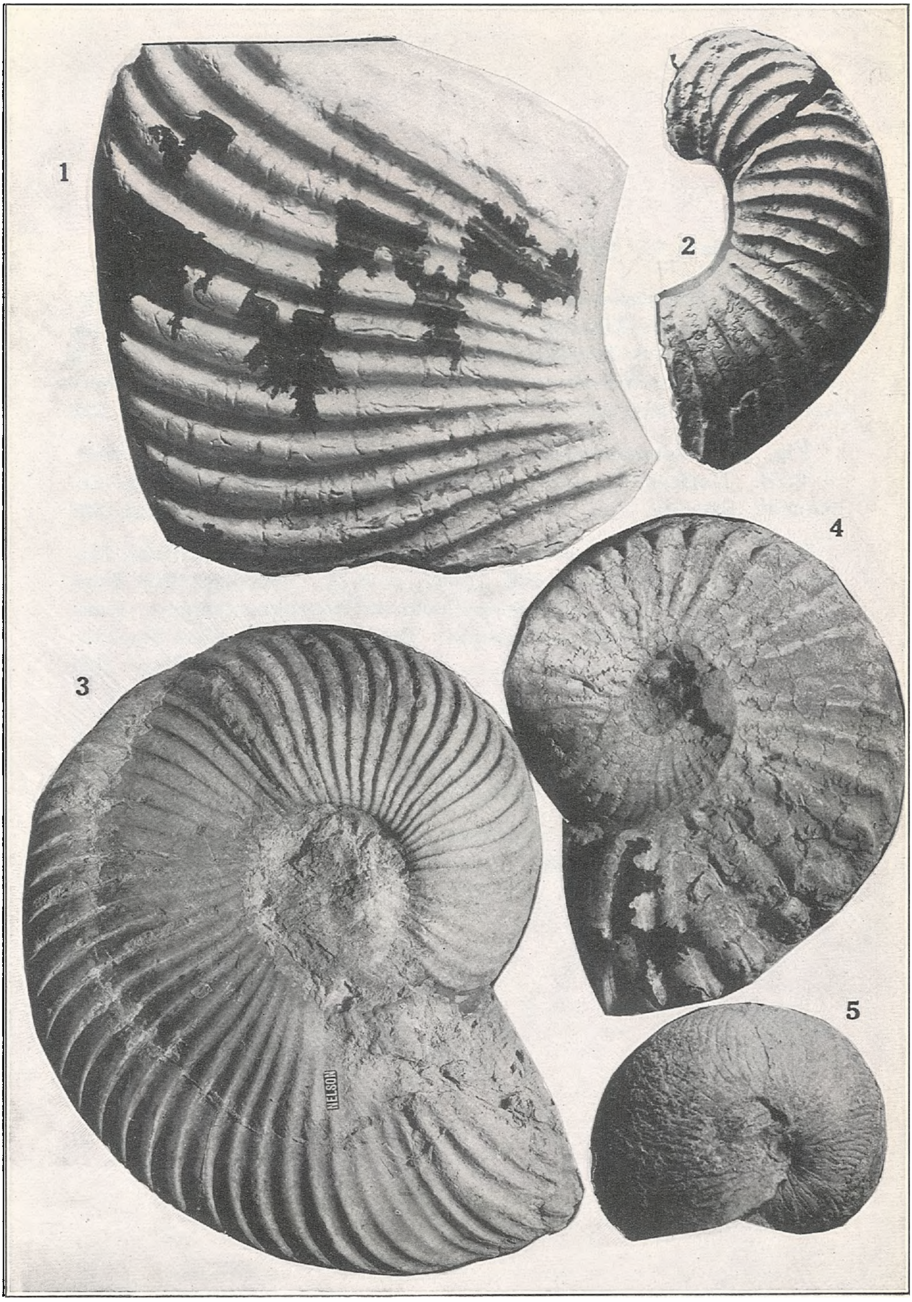
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Plate V. Fredericksburg and Duck Creek Fossils

Fig. 1. **Oxytropidoceras** cf. **acutocarinatum** (SHUMARD, 1854), × 1. Rare in the **Kiamichi**; frequent in the **Fredericksburg clay** beneath the Brown **Trigonia**-limestone seam. In Central Texas it ranges from the **Walnut** to the basal **Duck Creek** limestone. There are several closely related forms .... **Page 226**

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Fig. 4. **Pervinquieria kiliani** (LASSWITZ, 1904), holotype, × 1. Museum, University of Breslau. Horizon: Basal **Duck Creek,** and ?**Fort Worth** limestone. Type locality: I. & G. N. cut, West Sixth Street, Austin. Frequent near Fort Stockton .... **Page 233**

Originals of Figs. 1–2 in Bureau of Economic Geology; of Fig. 3 in British Museum (replica in Bureau of Economic Geology); of Fig 4 in University of Breslau.

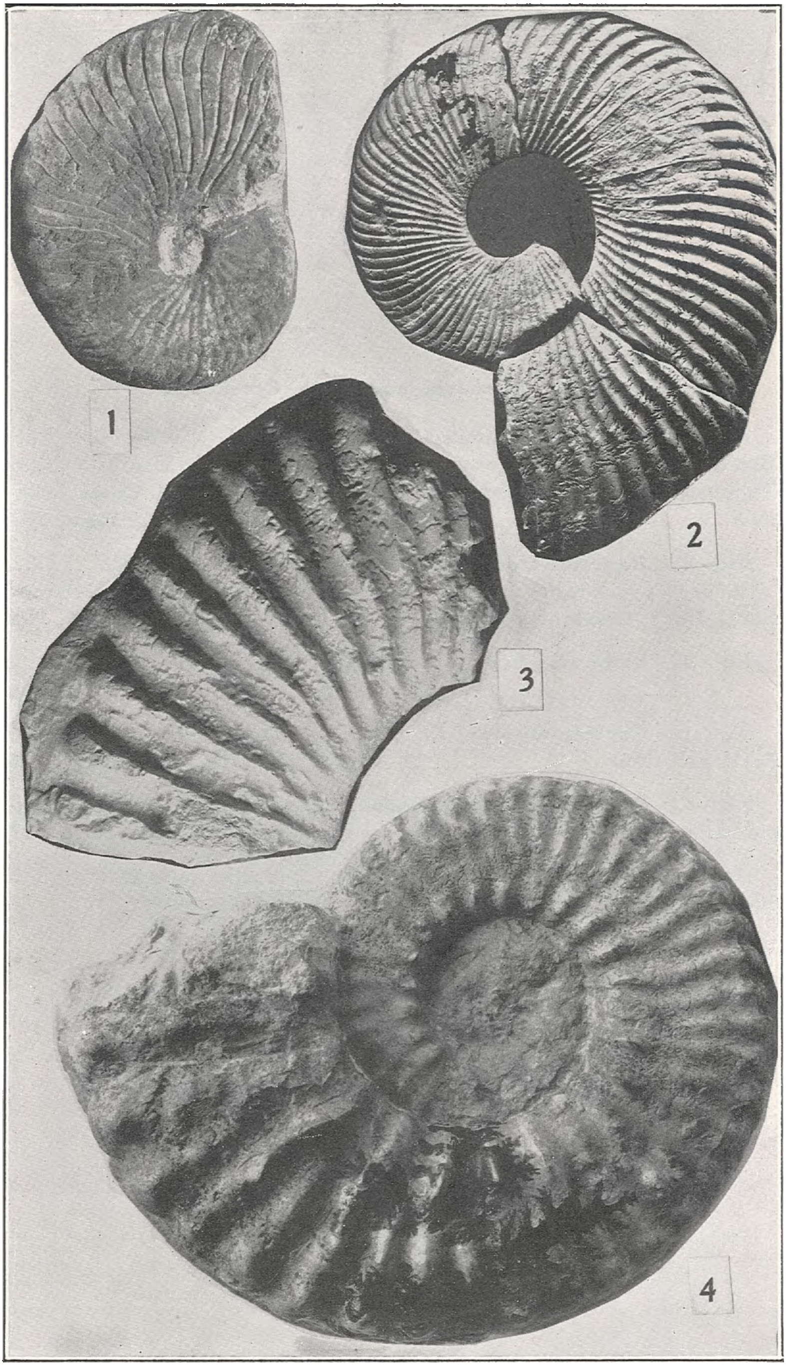
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Plate VI. Kiamichi and Duck Creek Fossils

Fig. 1. **Gryphea tucumcari** MARCOU, 1858, × 0.75, holotype, British Museum, South Kensington, BM 12676. Type locality: Near Tucumcari, N.M. Horizon: **Kiamichi** and Lower **Duck Creek**, common .... **Page 107**

Fig. 2. **Hamites fremonti** MARCOU, 1858, holotype, BM 12667, × 0.75. Type locality: Preston, Grayson County, Texas. Horizon: Basal **Duck Creek**; occasional .... **Page 208**

Fig. 3. **Elobiceras** n. sp., × 1. Rare; Upper **Kiamichi** .... **Page 234**

Fig. 4. **Oxytropidoceras** (?) n. sp., × 0.85. Common; **Comanche Peak** limestone .... **Page 228**

Fig. 5. **Oxytropidoceras** aff. **chihuahuense** (BÖSE), × 0.95. Common; **Fredericksburg** clay, **Comanche Peak** limestone .... **Page 227**

Originals of Figs. 1–2 in British Museum; plaster casts of Figs. 1–2 and originals of Figs. 3–5 in Bureau of Economic Geology.

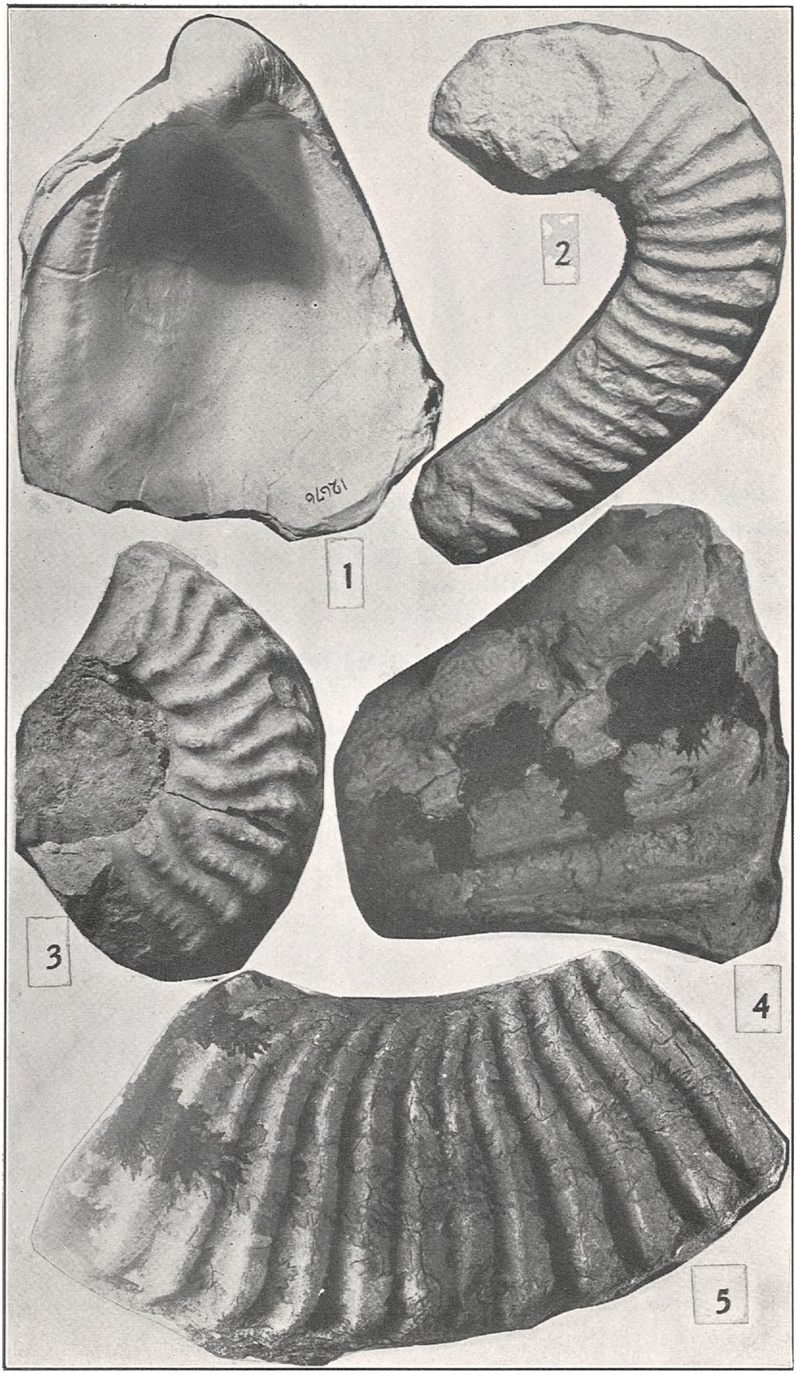
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Plate VII

Figs. 1, 4. **Oxtropidoceras belknapi** (MARCOU). Fig. 1, reduced. **Kiamichi:** Fort Washita, Bryan County, Oklahoma. Fig. 4, holotype, × 0.75, British Museum, Natural History (South Kensington), BM 12663; plaster replica in Bureau of Economic Geology. **Kiamichi:** Near Preston, Grayson County..**Page 226**

Fig. 2. **Inoceramus (Actinoceramus) subsulcatiformis** BÖSE, holotype, × 1. **Edwards:** One mile west of Valley Mills .... **Page 96**

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Originals of Fig. 4 in British Museum; plaster cast of Fig. 4 and originals of others in Bureau of Economic Geology.

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Fig. 4. **Macraster nodopyga** LAMBERT, × 1. **Fort Worth?:** Near Fort Worth .... **Page 296**

Fig. 5. **Holectypus planatus** ROEMER, × 1. **Goodland:** Stove Foundry road, near Fort Worth .... **Page 282**

Fig. 6. **Heteraster adkinsi** LAMBERT, × 1. **Kiamichi:** Triple Peak, Fort Stockton .... **Page 292**

Fig. 7. **Holectypus limitis** BÖSE, × 1. **Main Street:** Near Fort Worth .... **Page 282**

Fig. 8. **Holectypus charltoni** CRAGIN, × 1. **Main Street:** Riovista .... **Page 283**

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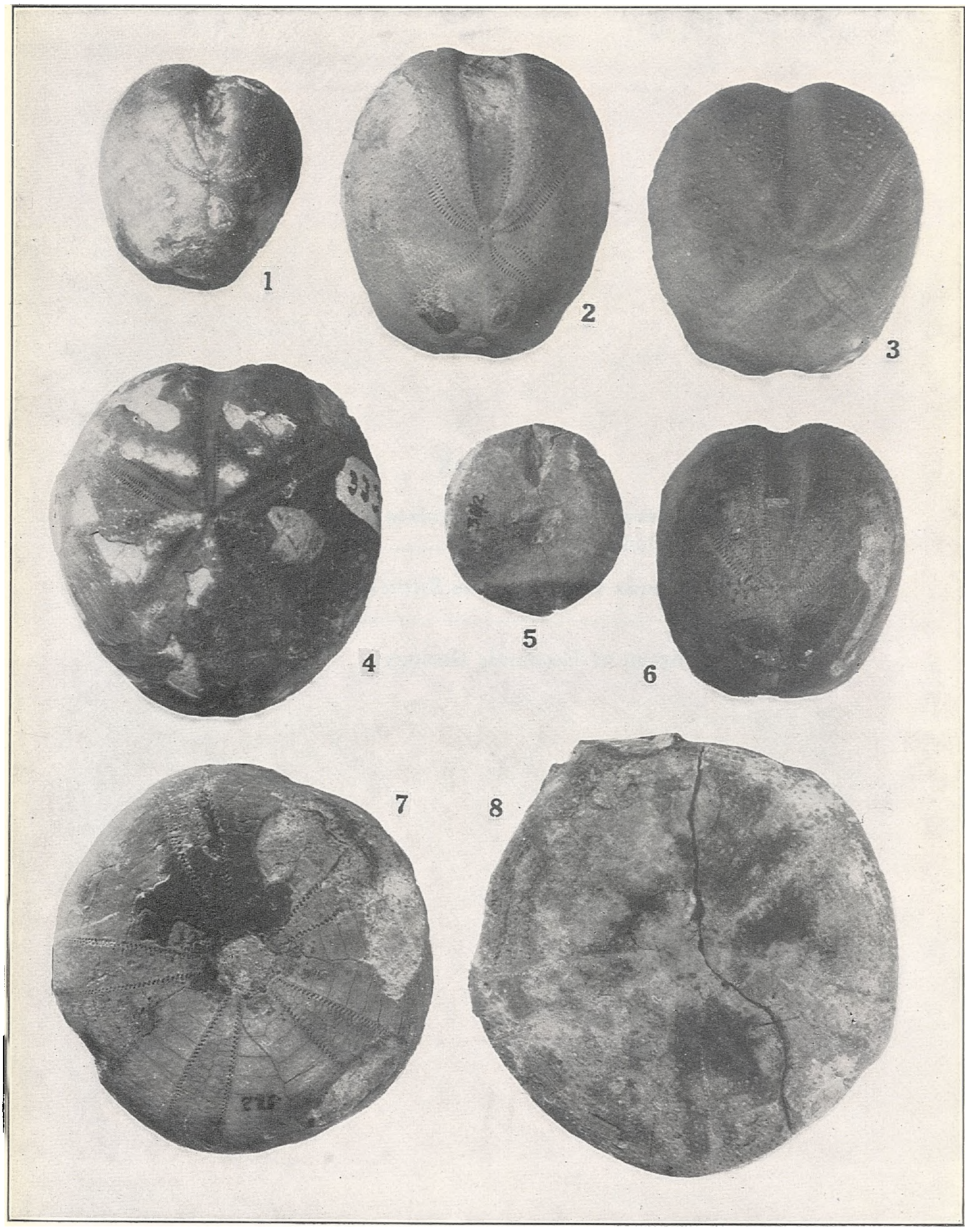
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Plate IX

Fig. 1. **Desmoceras** (?) **laevicaniculatum** ROEMER, × 0.9. **Duck Creek:** North of Denison .... **Page 220**

Fig. 2. **Desmoceras** (?) **brazoense** SHUMARD, × 0.2. **Duck Creek:** Fort Stockton.. **Page 220**

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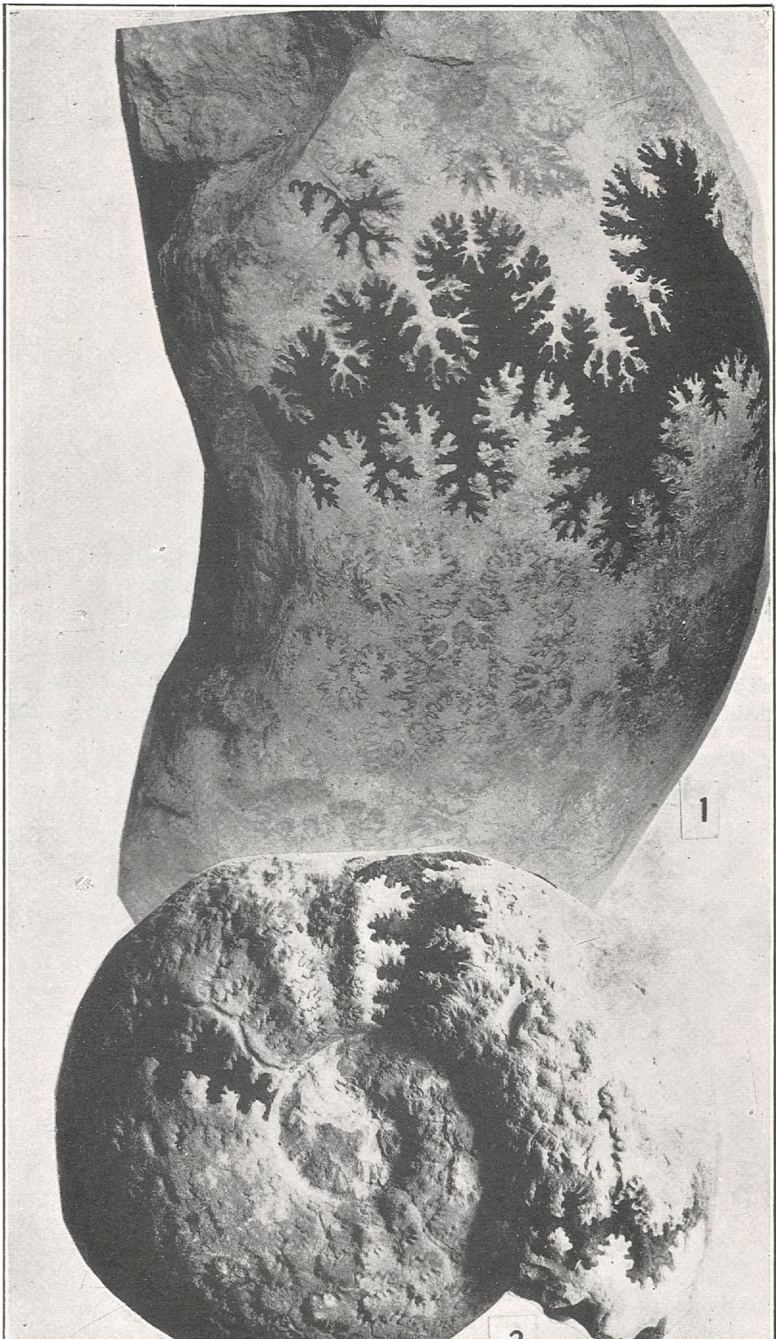
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Plate X

Fig. 1. **Pervinquieria** n. sp., × 0.5. Basal **Duck Creek:** University Mesa, near Fort Stockton. The young whorls have a *kiliani*-ribbing; the later stages show trinodose ornamentation ....**Page 234**

Fig. 2. **Pervinquieria** n. sp., × 0.5. Basal **Duck Creek:** University Mesa, near Fort Stockton. The young whorls have a *leonensis*-ribbing; the later stages show trinodose ornamentation ...... **Page 232**

Originals in Bureau of Economic Geology.


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Plate XI

Fig. 1. **Pervinquieria shumardi** (MARCOU), holotype, × ⅔, British Museum, Natural History, BM 12662, plaster replica in Bureau of Economic Geology. **Duck Creek:** Preston .... **Page 231**

Fig. 2. **Prohysteroceras** sp. aff. **austinense** (ROEMER), × 0.7. **Duck Creek:** University Mesa, near Fort Stockton .... **Page 228**

Original of Fig. 1 in British Museum; plaster cast of Fig. 1 and original of Fig. 2 in Bureau of Economic Geology.

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Plate XII

Figs. 1, 3. **Worthoceras platydorsum** (SCOTT), genholotype, × 10. Fig. 1= Scott 1924, **84**, pl. V, fig. 4. Fig. 2=Scott 1924, **84**, pl. V, fig. 1. **Duck Creek:** Denison .... **Page 219**

Fig. 2. **Hamites nokonis** ADKINS AND WINTON, holotype, × 1. Basal **Duck Creek:** Near Texas Christian University, Fort Worth .... **Page 208**

Fig. 4. **Hamites (?) comanchensis** ADKINS AND WINTON, holotype, × 1. Basal **Duck Creek:** Lake Worth, near Fort Worth........ **Page 209**

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Fig. 7. **Prohysteroceras austinense** (ROEMER), holotype, × 1 (=LASSWITZ 1904, **67**, pl. V, fig. 3), photographed at University of Breslau. **Duck Creek-Fort Worth:** Austin........ **Page 228**

Fig. 8. **Goniophorus scotti** LAMBERT, × 3. Upper **Duck Creek:** Fort Worth........ **Page 278**

Fig. 9. **Gryphea navia** HALL, × 1. **Kiamichi:** Fort Worth........ **Page 106**

Originals of Figs. 1, 3, 5 in Texas Christian University; of Fig. 7 in University of Breslau; others in Bureau of Economic Geology.

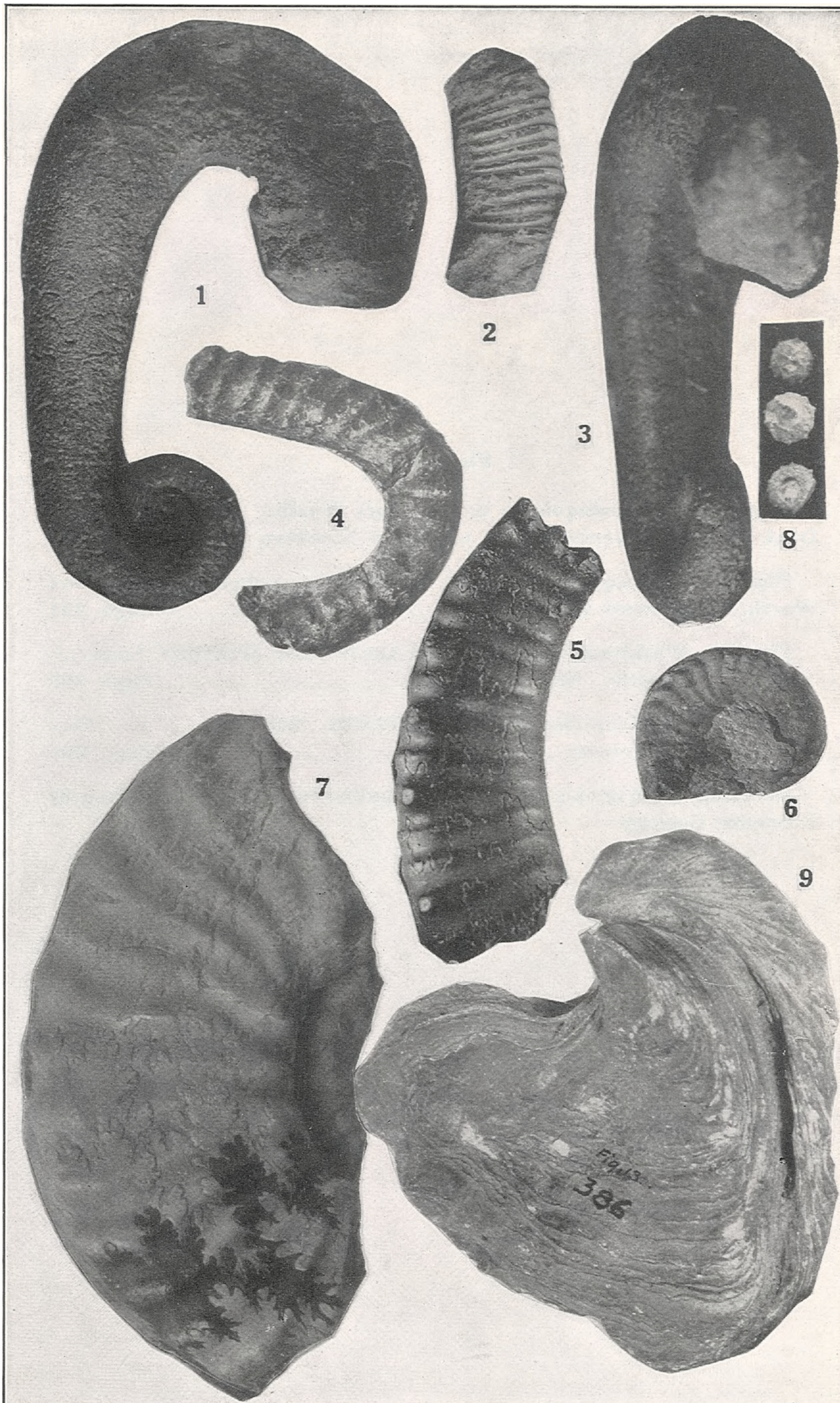
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Plate XIII

Figs. 1–2. **Pervinquieria** n. sp. **Fort Worth:** Bell County; and **Duck Creek** University Mesa, near Fort Stockton .... **Page 232**

Fig. 3. **Pervinquieria maxima** (LASSWITZ), reduced, × ¼. **Fort Worth:** Southwest of Fort Worth .... **Page 231**

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Figs. 4–5. **Macraster texanus** ROEMER, holotype, × 1. **Fort Worth?:** Georgetown .... **Page 295**

Location of originals of Figs. 4–5 unknown; others in Bureau of Economic Geology.

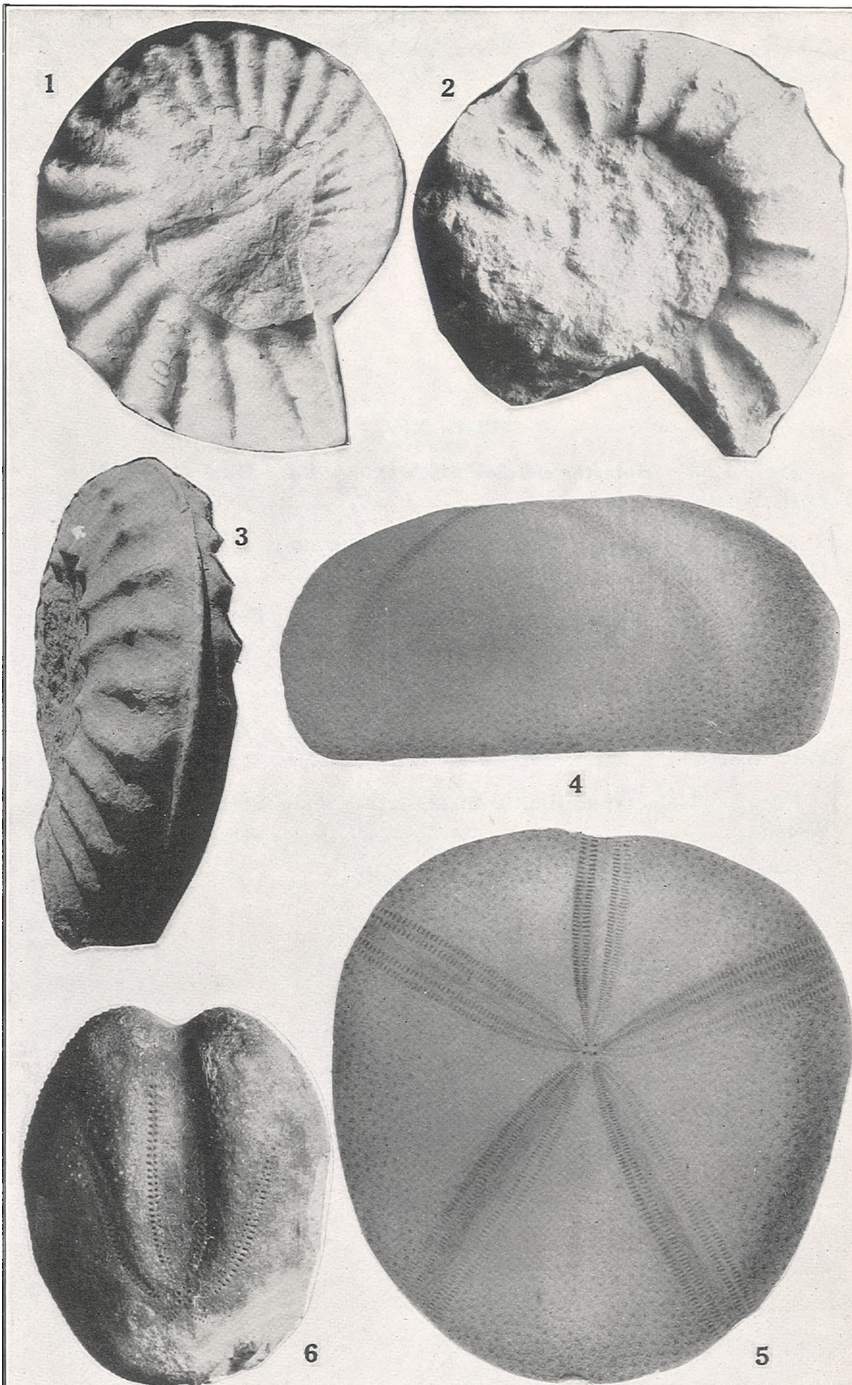
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Plate XIV

Figs. 1, 3. **Holaster simplex** SHUMARD, × 0.5. **Duck Creek:** Near Fort Worth........Page 285

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Fig. 4. **Macraster elegans** (SHUMARD), × 1. **Fort Worth:** Near Fort Worth........Page 295

Fig. 5. **Heteraster** sp., × 1........Page 287

Fig. 6. **Holectypus planatus** (ROEMER), × 1. **Goodland:** Near Fort Worth........Page 282

Fig. 7. **Holectypus limitis** BÖSE, × 1. **Main Street:** Near Fort Worth........Page 282

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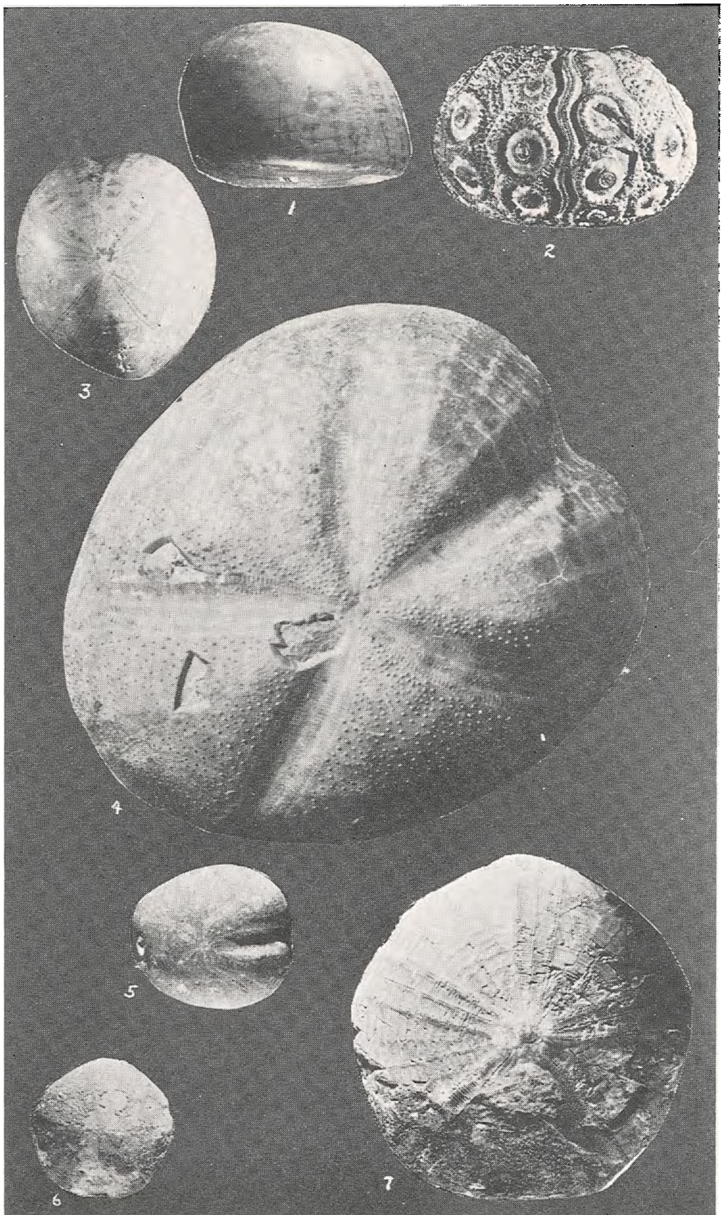
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Fig. 1. **Exogyra arietina** ROEMER, × 1. **Main Street:** Near Fort Worth .... **Page 112**

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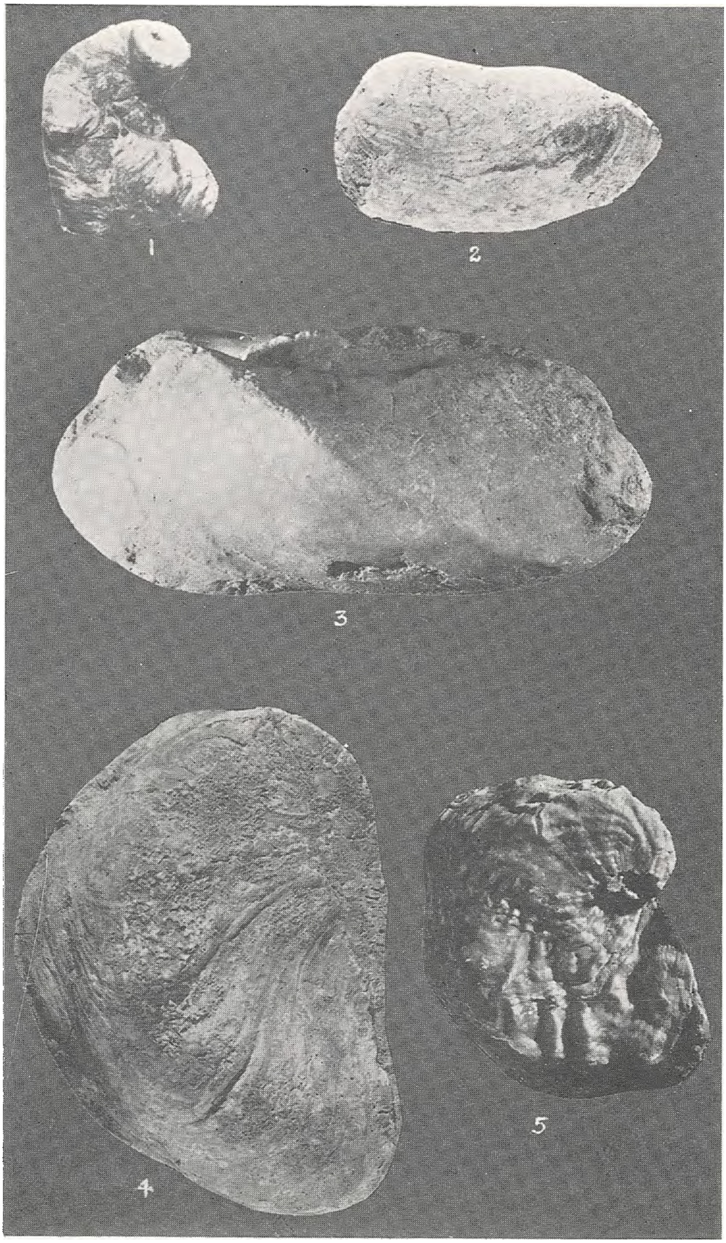
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Plate XVI

Fig. 1. **Alectryonia quadriplicata** (SHUMARD), × 1. Upper **Washita** .... **Page 104**

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Fig. 5. **Alectryonia lugubris (bellaplicata)**, × 1. Top of **Eagle Ford** .... **Page 104**

Fig. 6. **Alectryonia** n. sp., × 0.5. Upper **Fredericksburg; Washita?** .... **Page 103**

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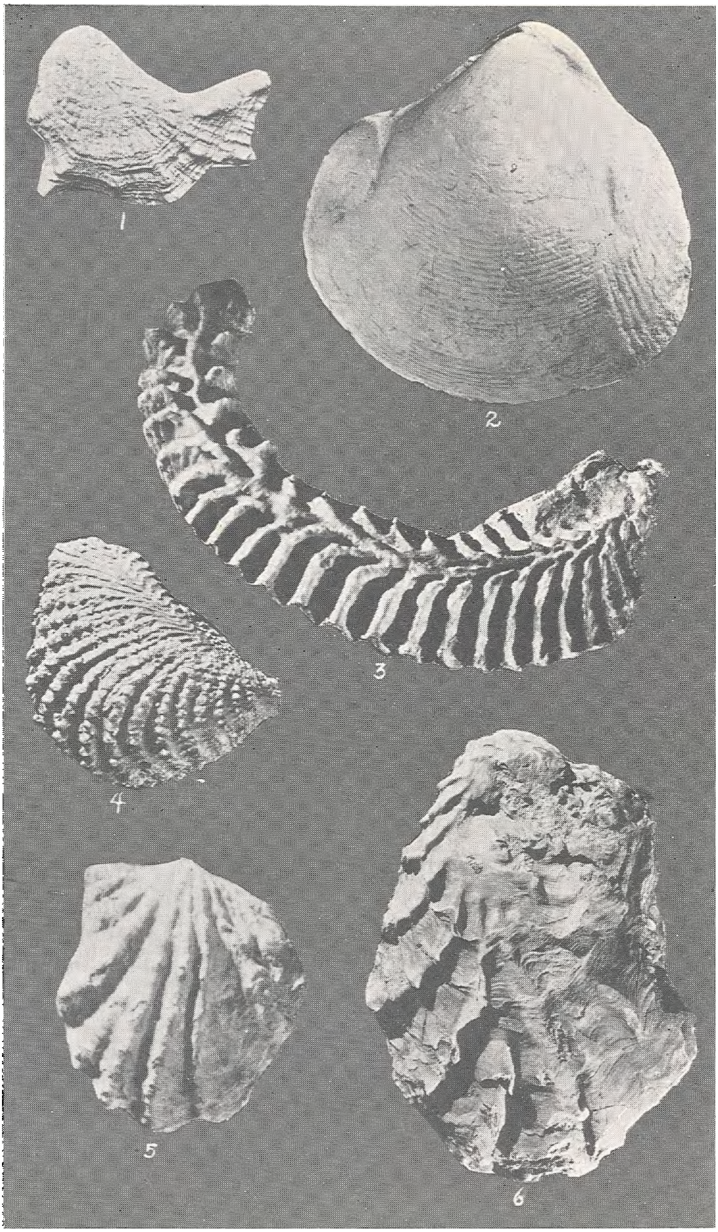
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Plate XVII

Figs. 1, 3. **Pecten (Neithea) subalpinus** BÖSE, × 0.5. Mainly **Washita** division .... **Page 127**

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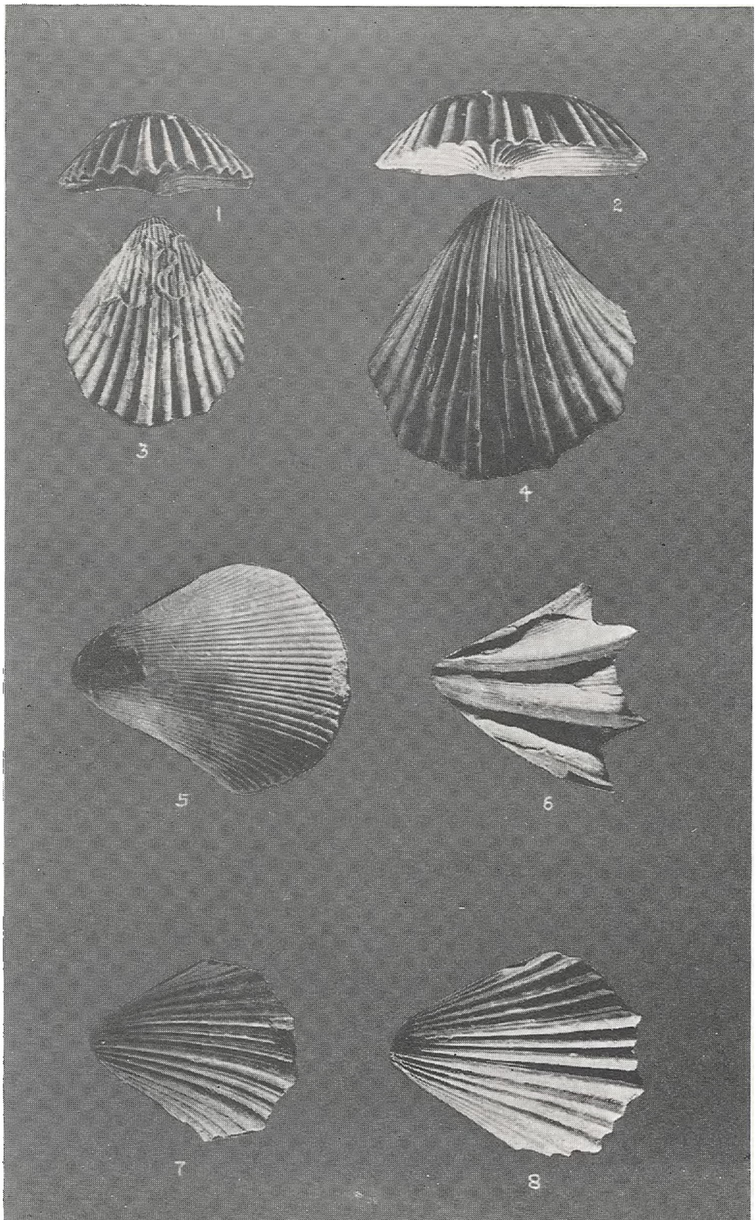
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Plate XVIII

Fig. 1. **Gervilliopsis invaginata** (WHITE), × 1. **Washita** division, abundant in **Weno**.. **Page 91**

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Fig. 6. **Pinna comancheana** CRAGIN, × 0.5. Upper **Fredericksburg**.. **Page 90**

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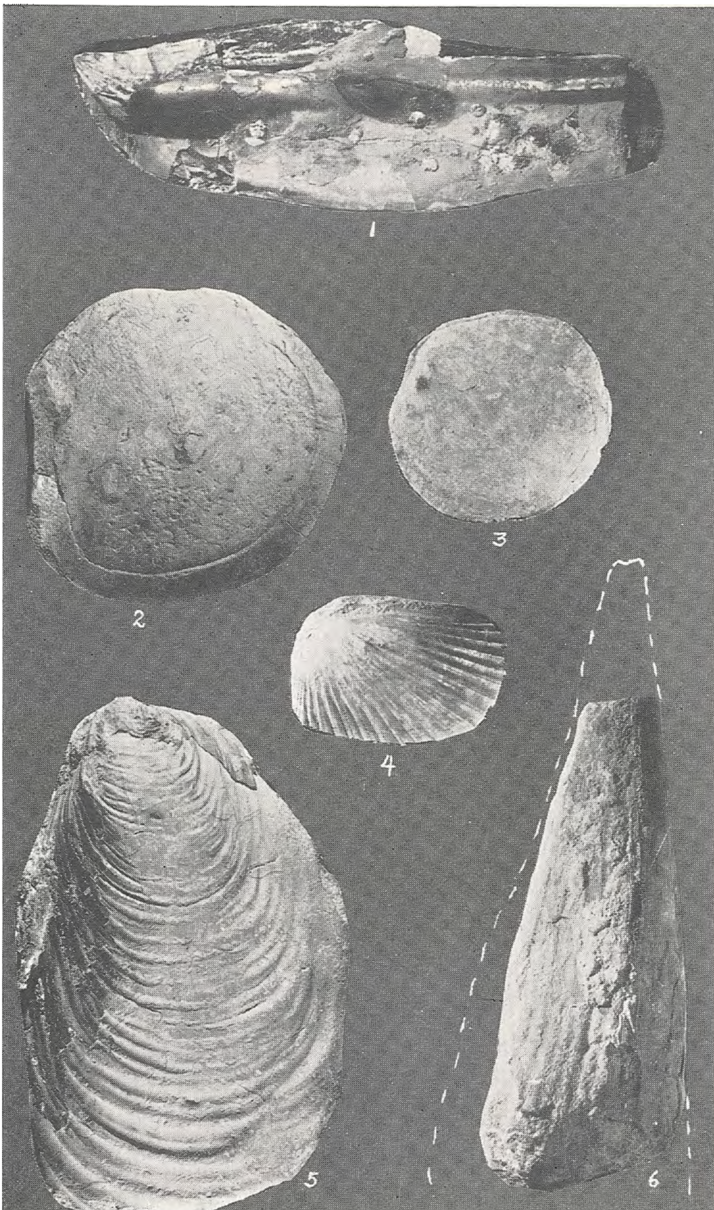
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Plate XIX

Fig. 1. **Engonoceras serpentinum** (CRAGIN), × 1. **Weno:** Denison........**Page 262**

Fig. 2. **Washitaster riovistae** (ADKINS), × 2. **Weno-Pawpaw:** Riovista........**Page 293**

Fig. 3. **Cyprimeria washitaensis** ADKINS, × 1. **Weno:** Denison. Holotype........**Page 163**

Fig. 4. **Macraster subobesus** (ADKINS), × 1. **Weno:** Fort Worth. Holotype........Page 296

Fig. 5. **Pervinquieria wintoni** (ADKINS), × 1. **Weno:** Gainesville........**Page 231**

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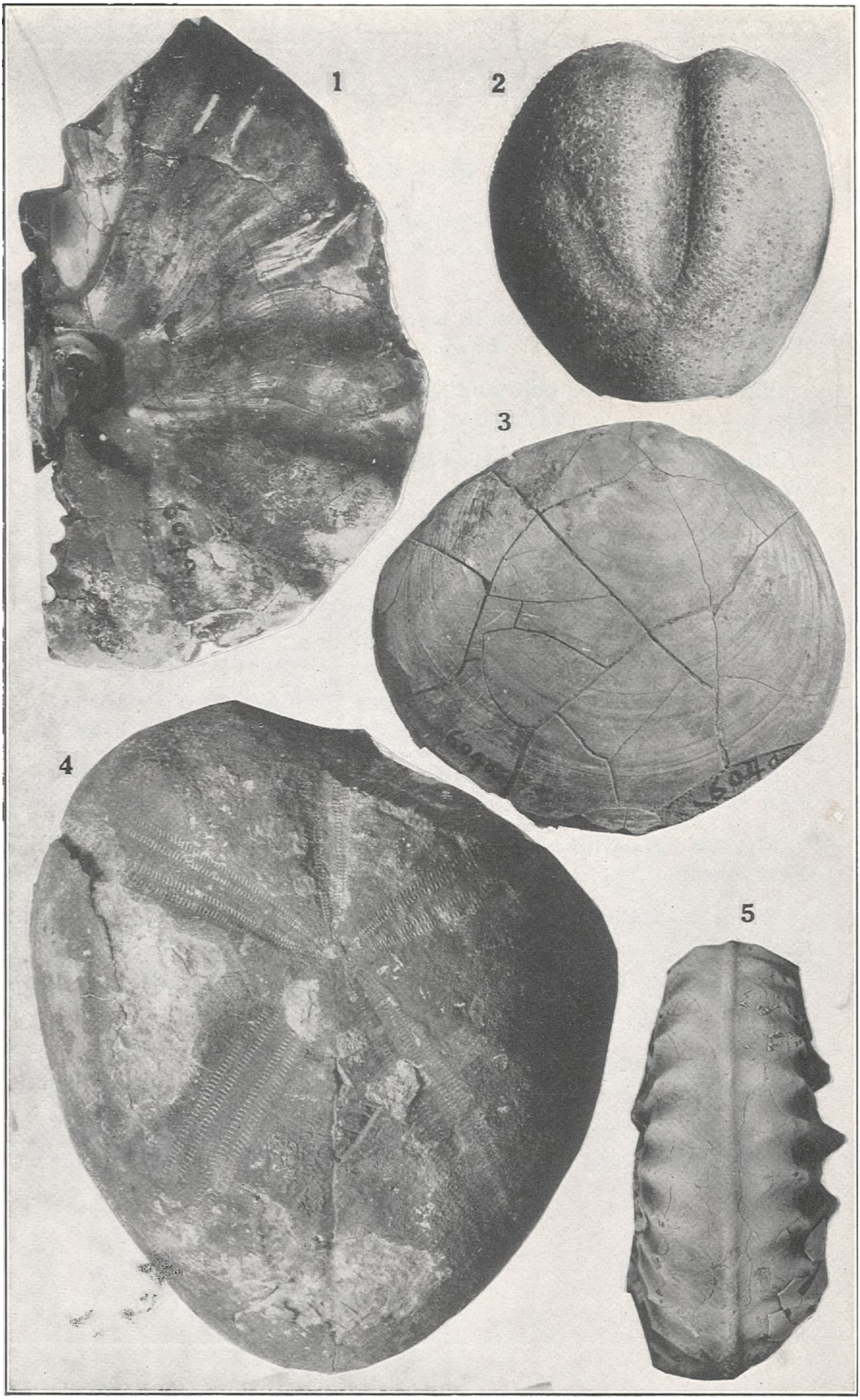
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Plate XX

Figs. 1–3. **Scaphites hilli** ADKINS AND WINTON. Fig. 1, holotype, × 4, from **Pawpaw:** Fort Worth. Fig. 2, × 5. Fig. 3, × 4. **Pawpaw:** Possibly Grayson .... **Page 257**

Figs. 4–6. **Neokentroceras worthense** (ADKINS). Fig. 4, × 4. Fig. 5 × 2. Fig. 6, × 2. **Pawpaw:** Fort Worth .... **Page 235**

Fig. 7. **Scaphites hilli** ADKINS AND WINTON, × 2. **Pawpaw.** .... **Page 257**

Fig. 8. **Worthoceras worthense** (ADKINS), × 5. **Pawpaw:** Fort Worth .... **Page 219**

Fig. 9. **Baculites comanchensis** ADKINS, × 2. **Pawpaw:** Fort Worth .... **Page 207**

Figs. 10–11. **Submantelliceras worthense** (ADKINS), × 2. **Pawpaw:** Fort Worth. Fig. 10, widely umbilicate form; fig. 11, narrowly umbilicate form .... **Page 239**

Fig. 12. **Arca washitaensis** ADKINS, holotype, × 1.5. **Pawpaw:** Fort Worth .... **Page 89**

Fig. 13. **Probysteroceras wenoense** (ADKINS), × 2. **Pawpaw:** Fort Worth .... **Page 229**

Fig. 14. **Hamites tenawa** ADKINS AND WINTON, × 2. **Pawpaw:** Fort Worth .... **Page 210**

Fig. 15. **Stoliczkaia adkinsi** BÖSE, × 1. **Pawpaw:** Fort Worth .... **Page 236**

Figs. 16–17. **Metopaster (?) hortensae** ADKINS AND WINTON. Fig. 16, × 2.5. Fig. 17, × 1. **Pawpaw:** Fort Worth .... **Page 266**

Fig. 18. **Comptonia wintoni** ADKINS, holotype, × 2. **Pawpaw:** Fort Worth .... **Page 266**

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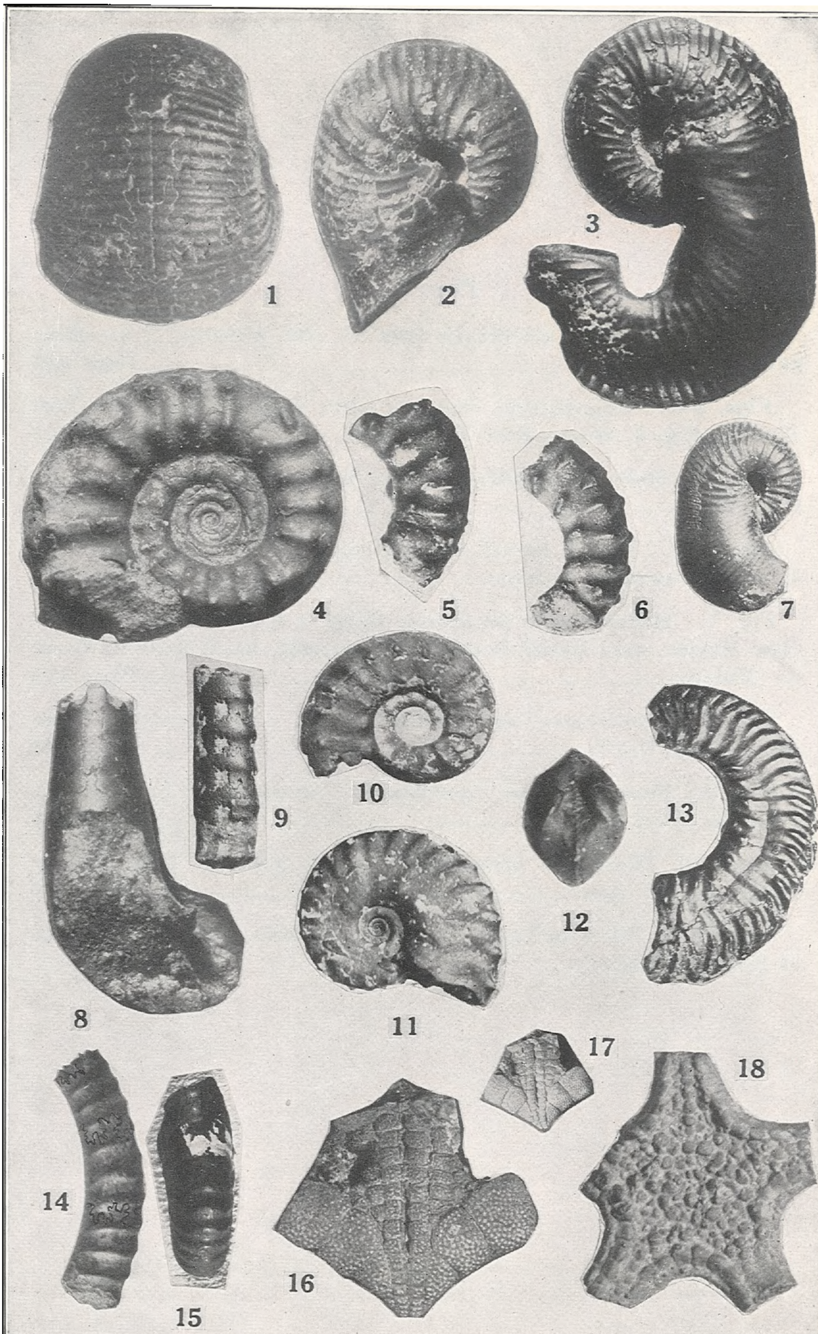

Plate XXI

Fig. 1. **Turrilites worthensis** ADKINS AND WINTON, × 3. **Pawpaw:** Fort Worth........ Page 215

Figs. 2–3. **Engonoceras** spp., × 1.9. Fig. 2, **Pawpaw:** Fort Worth. Fig. 3, **Weno:** Fort Worth........ Page 261

Fig. 4. **Stoliczkaia adkinsi** BÖSE, **holotype,** × 1.5. **Pawpaw:** Fort Worth........ Page 236

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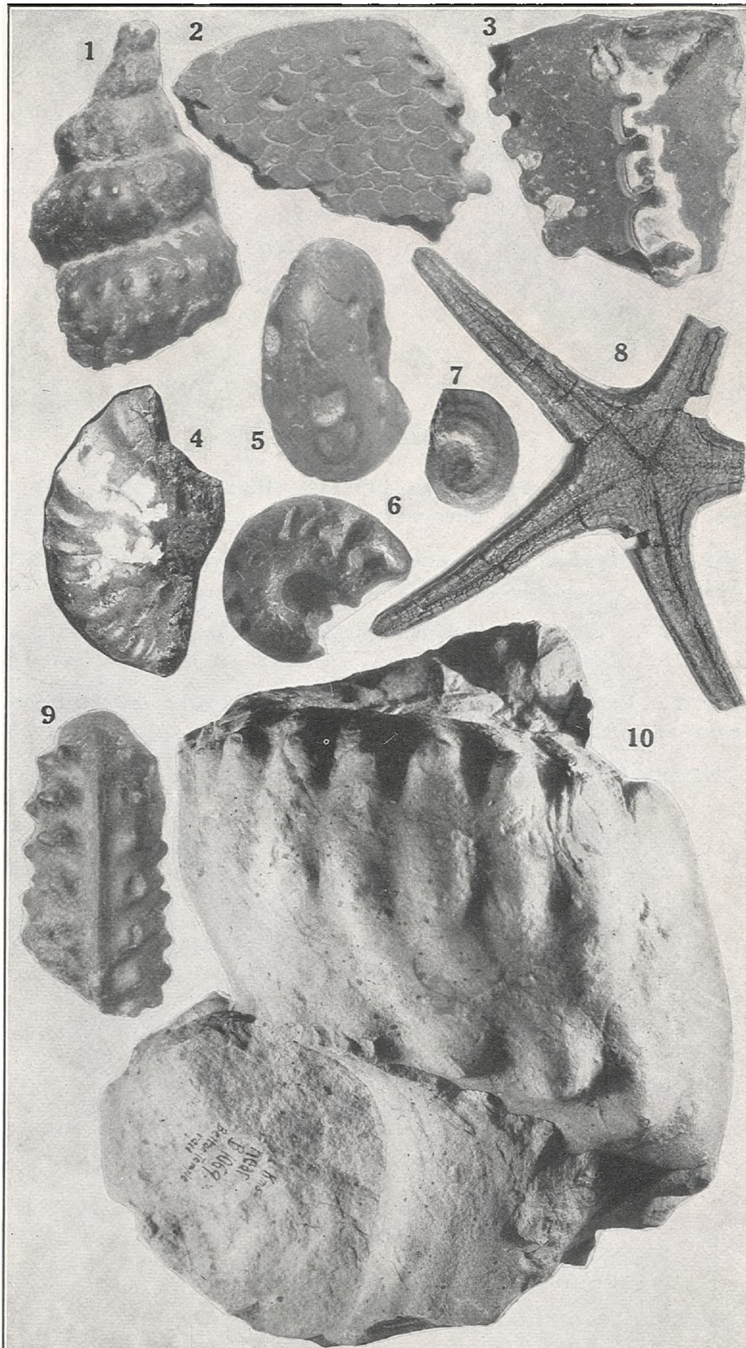
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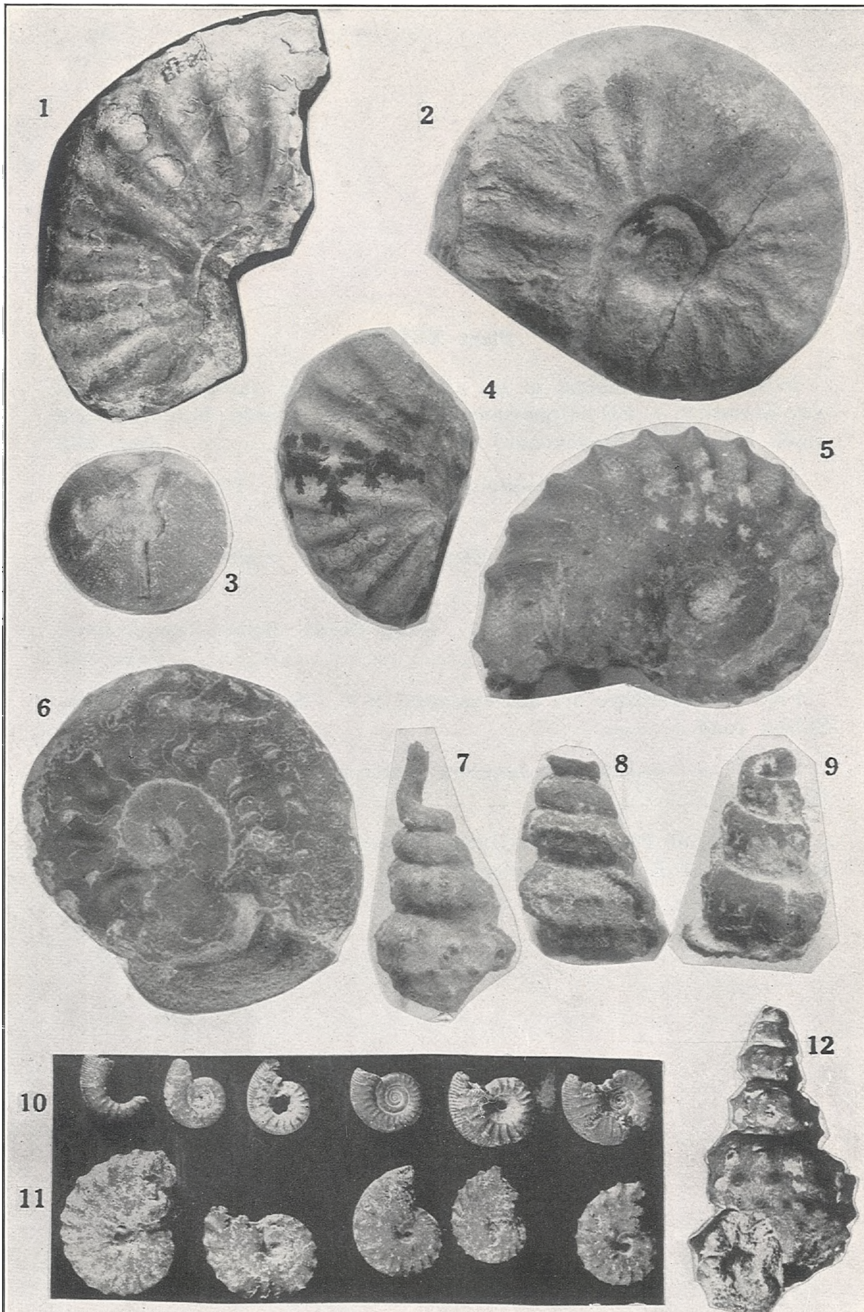
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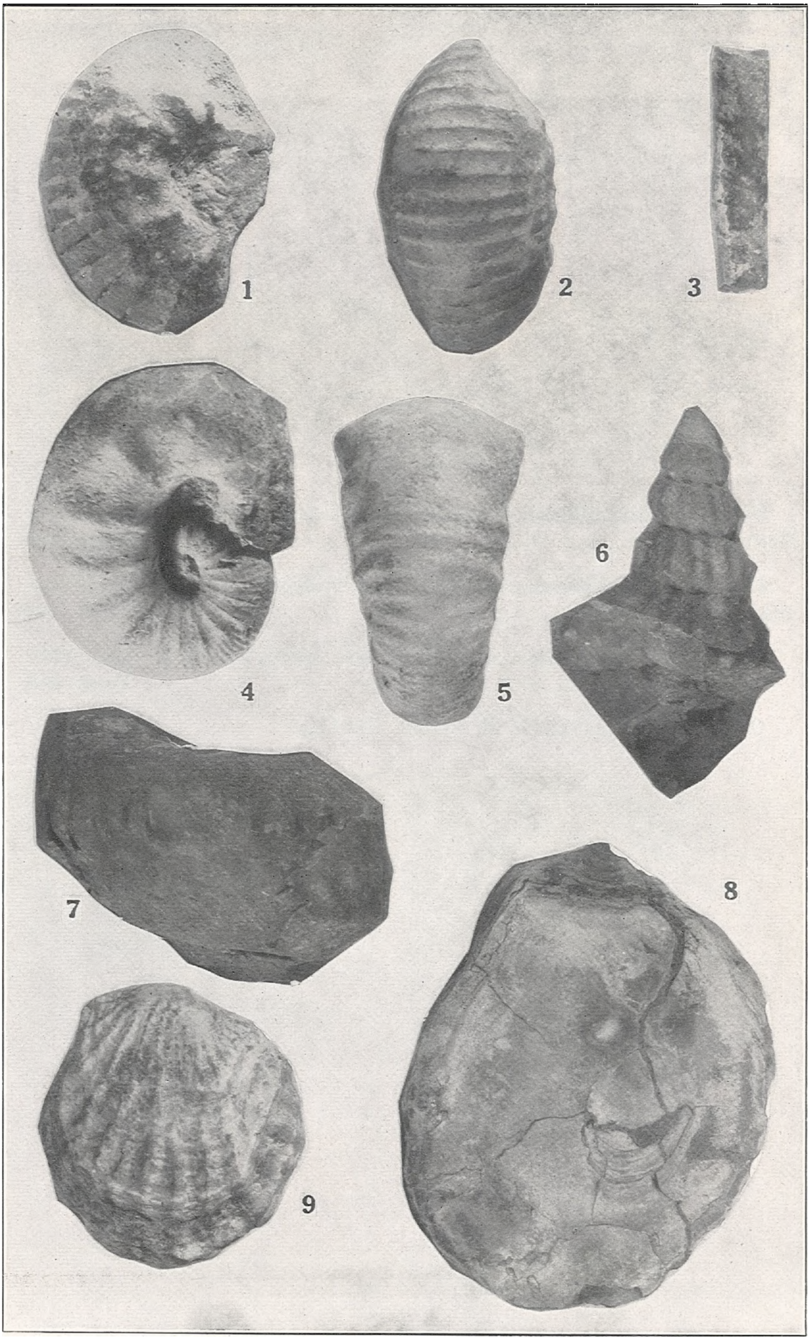
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Fig. 1. **Mantelliceras sellardsi** n. sp., holotype, × 1. **Eagle Ford:** Round Rock..**Page 239**

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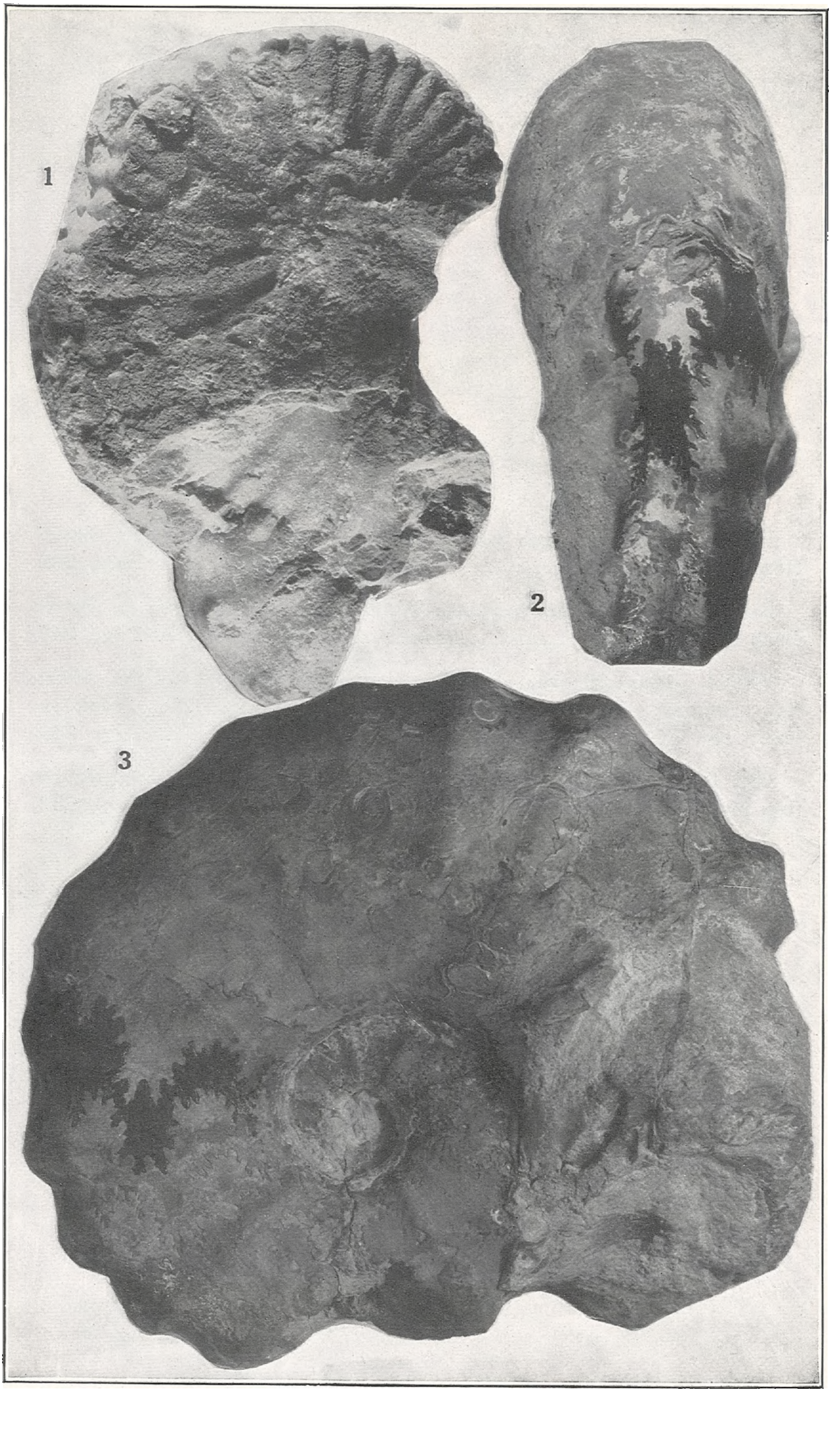

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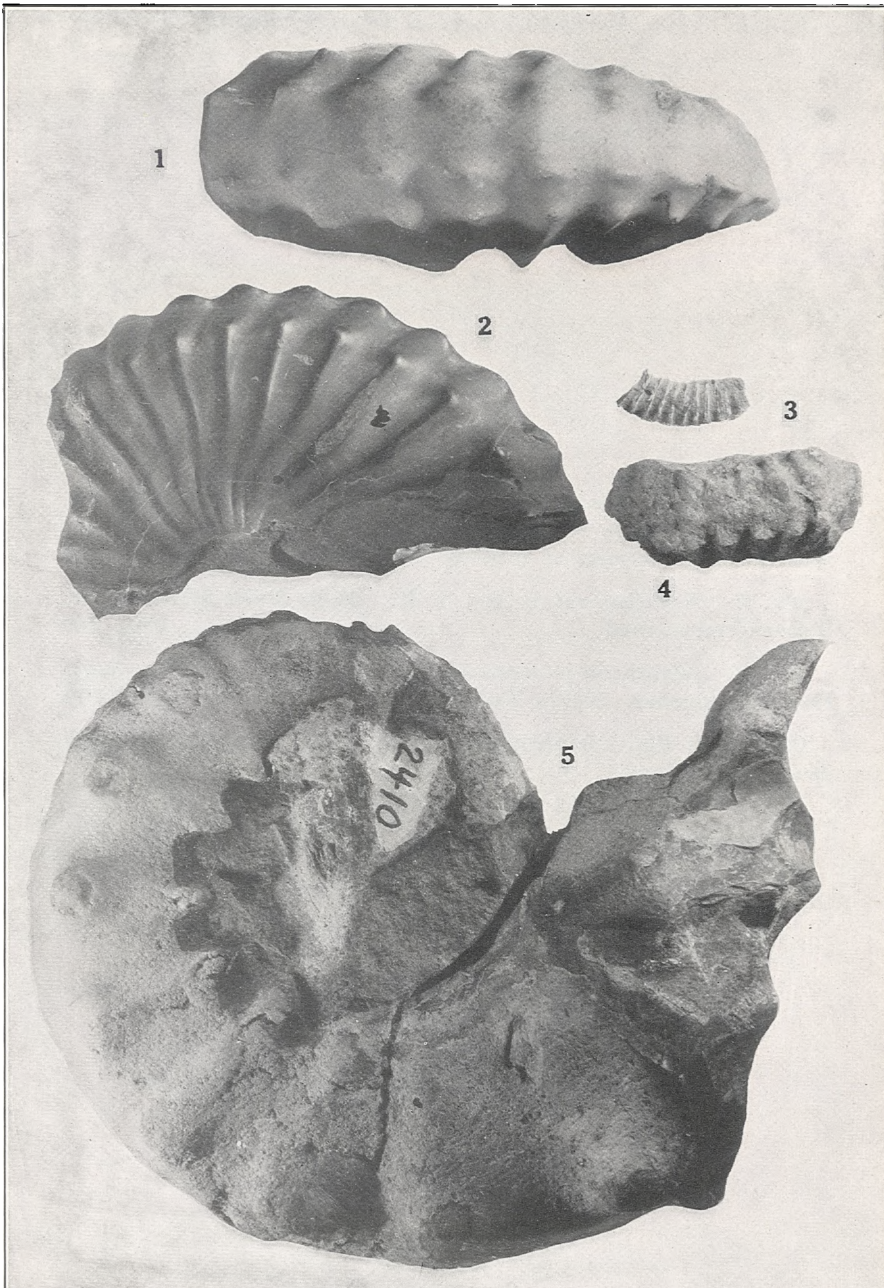
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Fig. 1. **Metacalycoceras** sp. aff. **"mantelli"** LASSWITZ, × 0.75. **Eagle Ford:** Eagle Mountains, "El Paso Creek." Photograph of specimen in University of Breslau............**Page 242**

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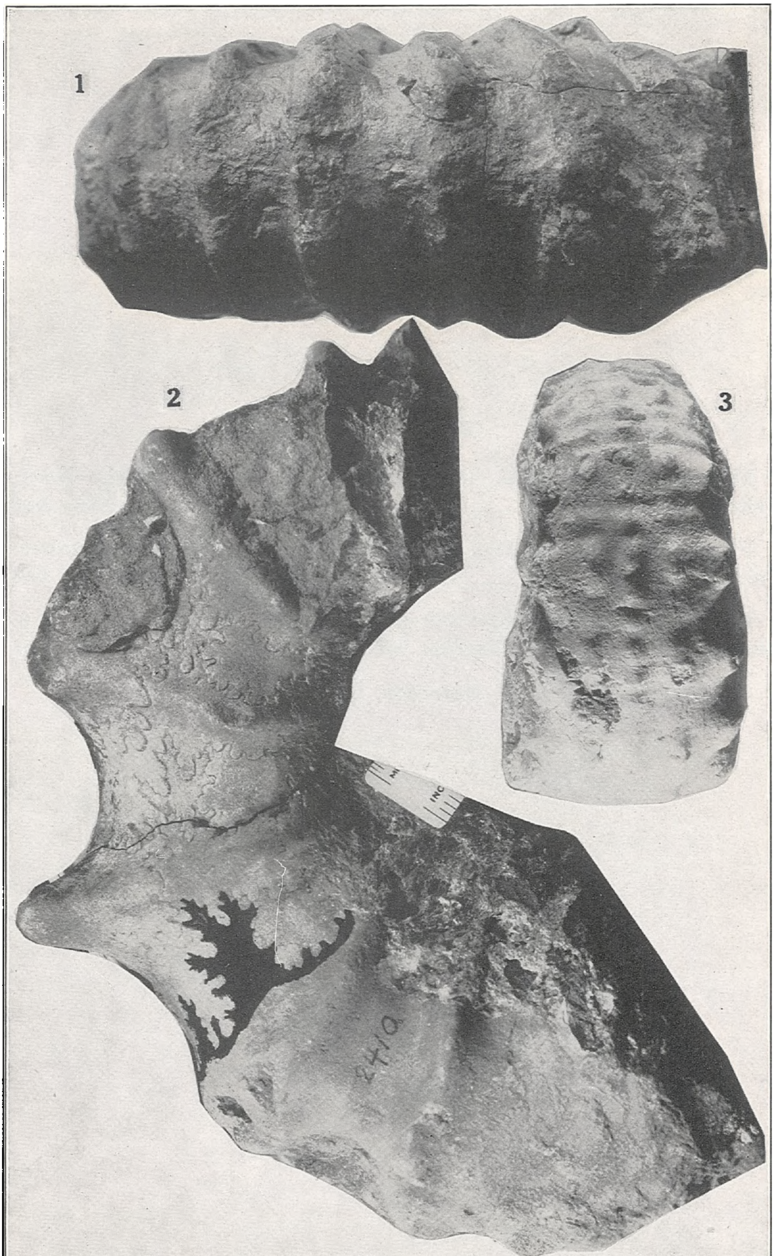
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Originals in Bureau of Economic Geology.


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Holotype.
M. tarrantense
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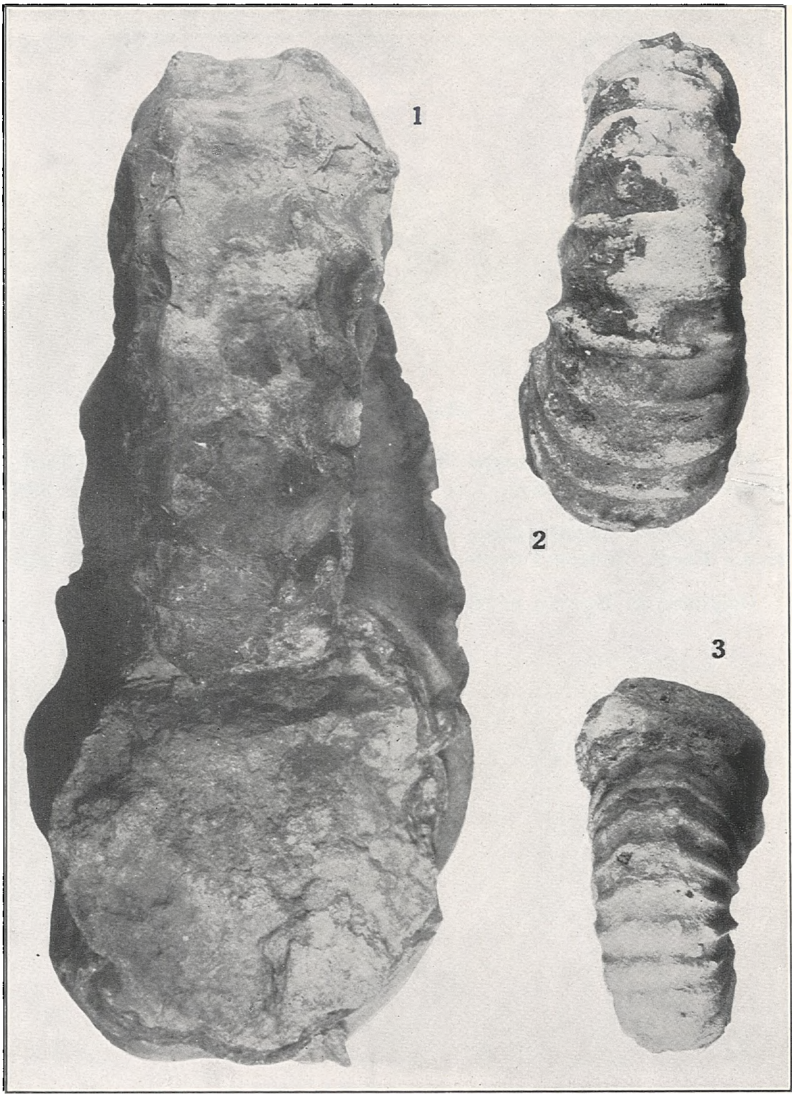
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Figs. 3–4. **Acanthoceras** sp. aff. **turneri** C. A. WHITE, × 0.8. **Eagle Ford:** Belton-Temple highway .... **Page 246**

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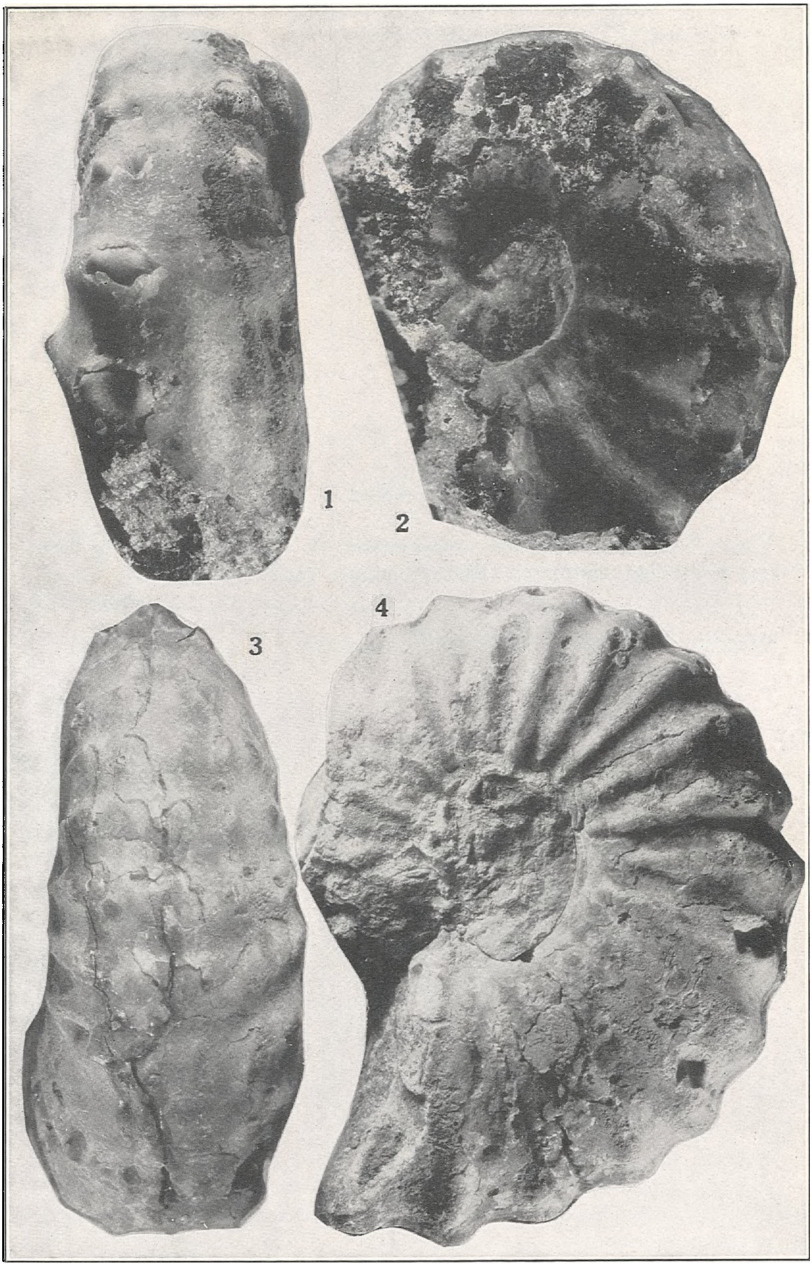
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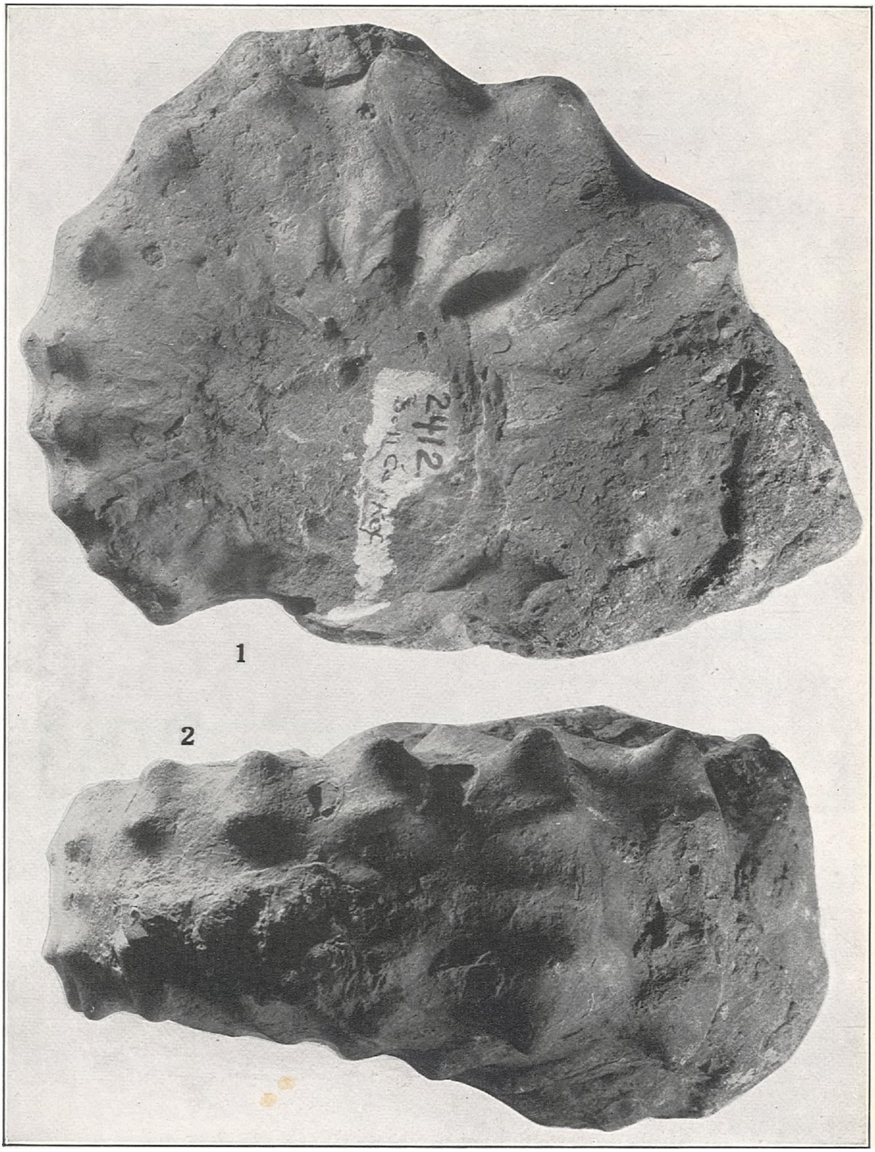
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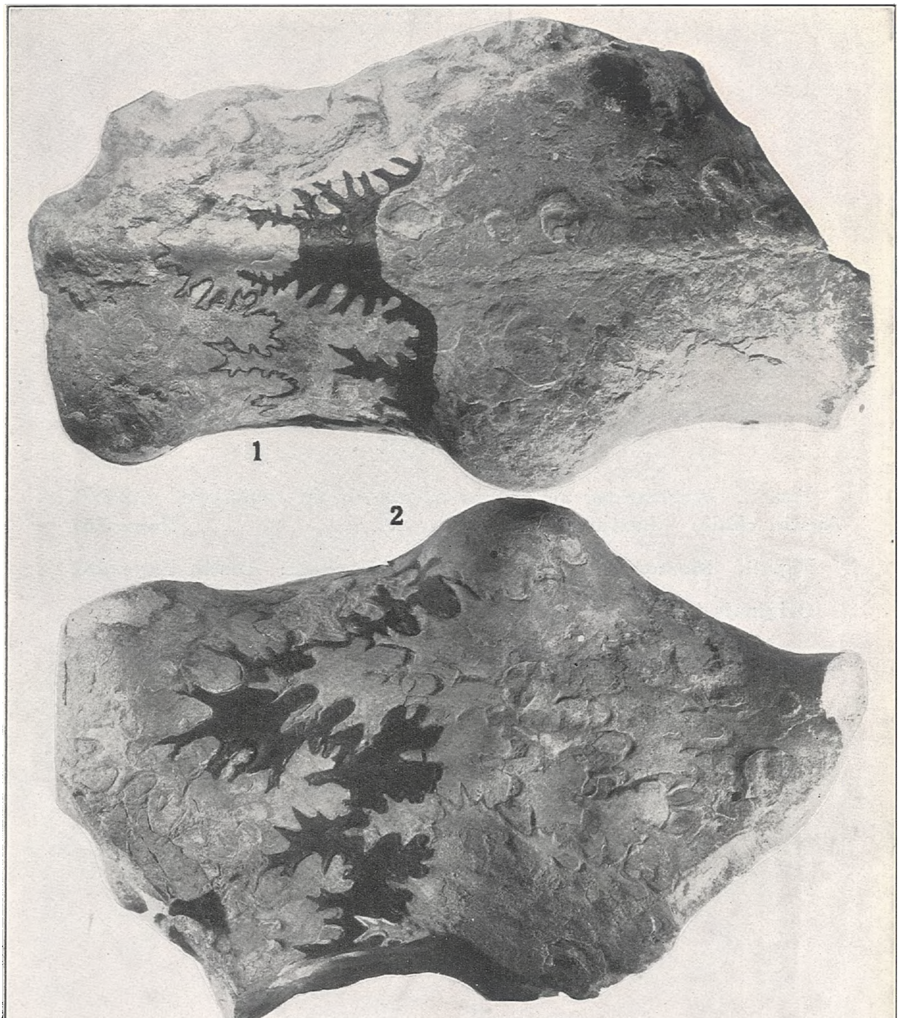
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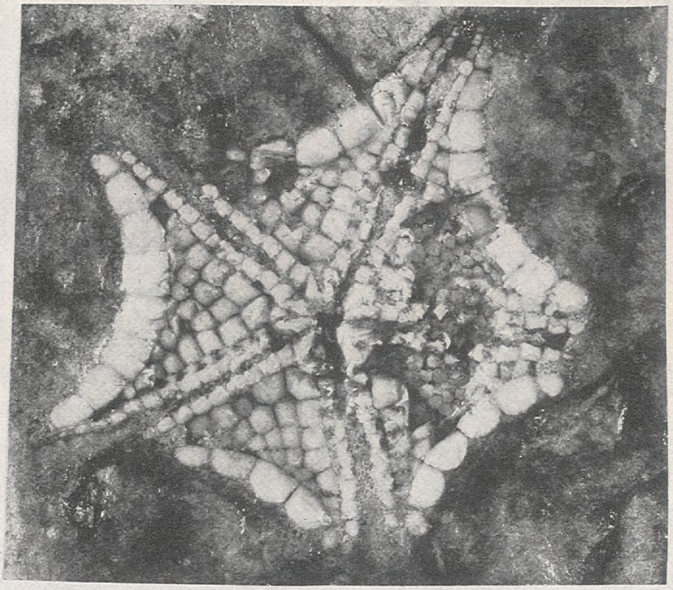

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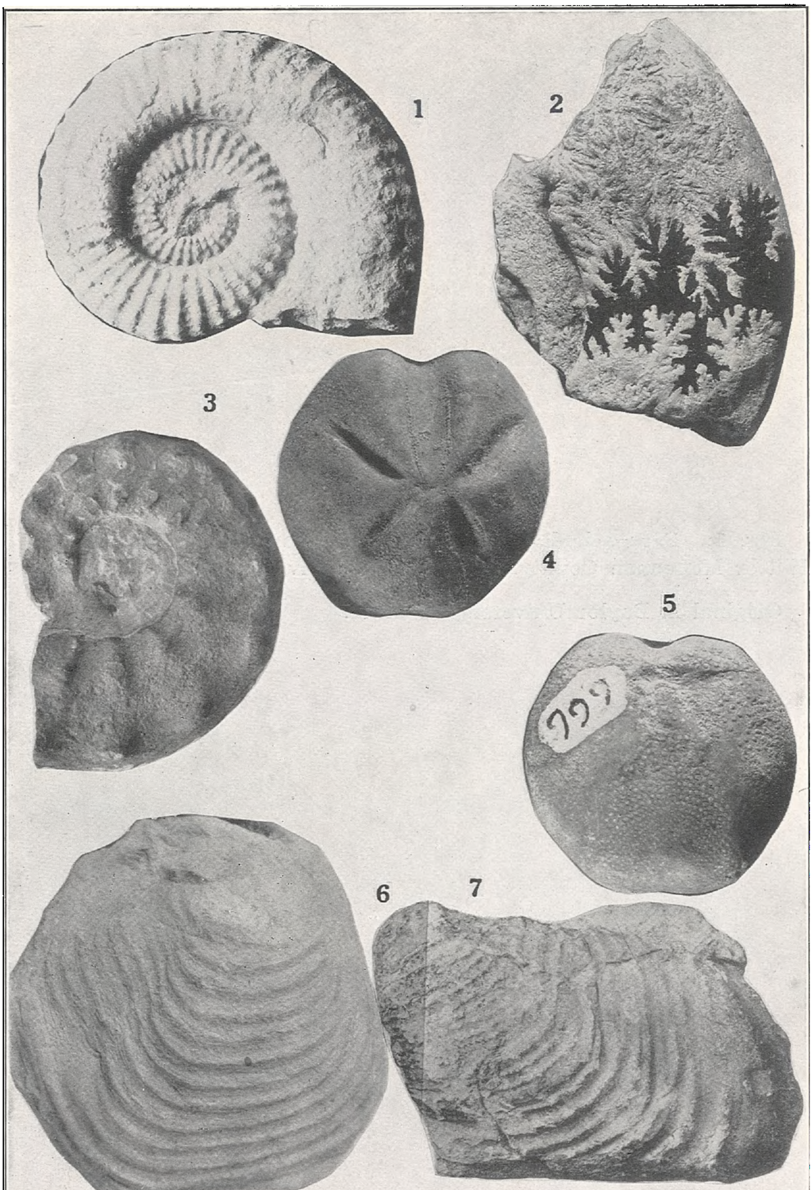
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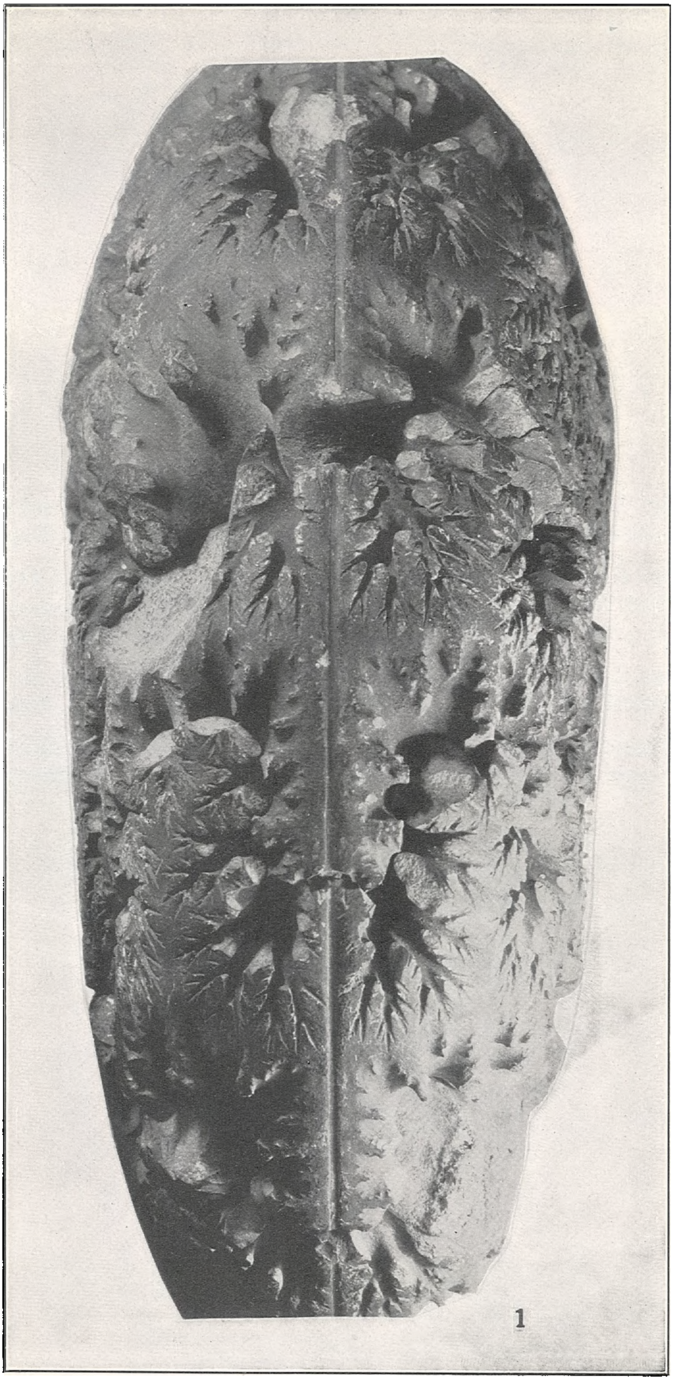

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Fig. 1. **Exogyra ponderosa** ROEMER, × ⅔. Roemer collection, University of Bonn. **Taylor:** Locality unknown .... **Page 111**

Fig. 2. **Parapachydiscus streckeri** n. sp., holotype, × ⅔. Anacacho rudistid reef (**Taylor** age): Texas Asphalt Company's quarry at Cline .... **Page 221**

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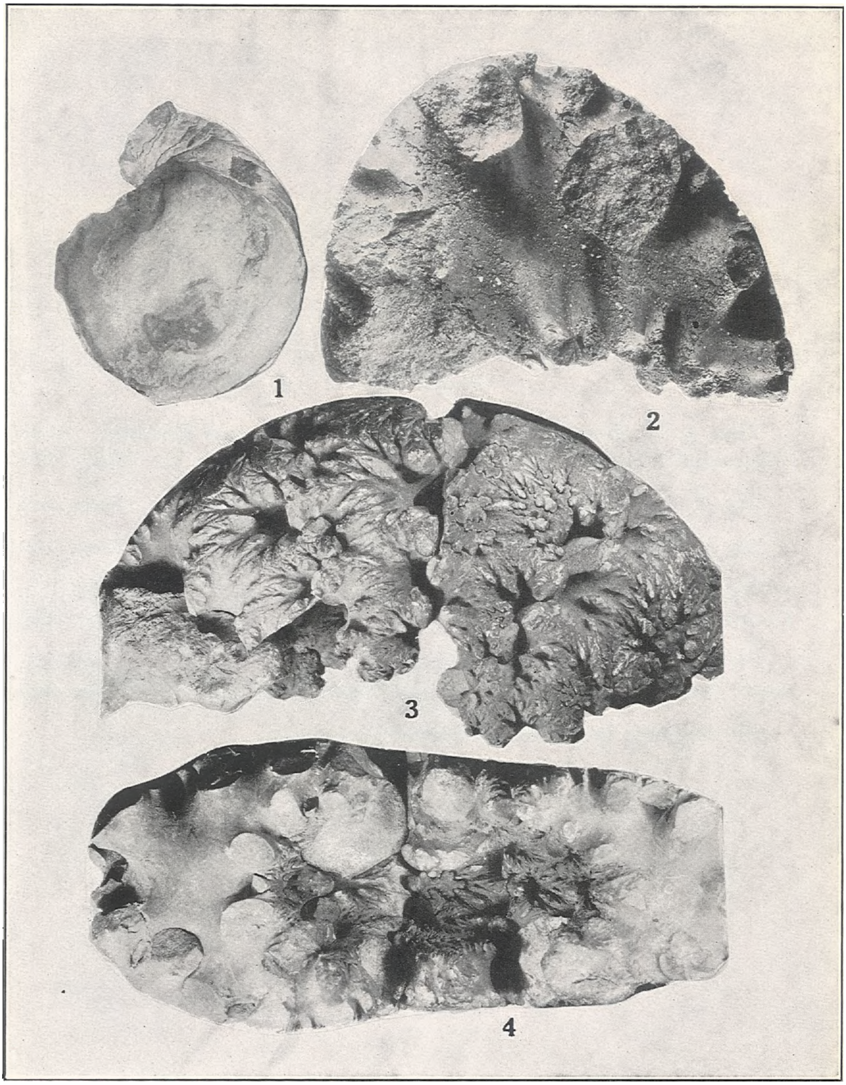
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Figs. 1, 3. **Bostrychoceras** n. sp. aff. **polyplocum** ROEMER, × 0.5. **Anacacho:** Medina County........ Page 214

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