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STUDIES OF SOME COMANCHE PELECYPODS AND GASTROPODS

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STUDIES OF SOME COMANCHE PELECYPODS AND GASTROPODS

By T. W. STANTON

ABSTRACT

This report is a partial product of many years of study of Comanche faunas and of 10 field seasons in areas of Comanche outcrops. It includes the description of 190 species and varieties of mollusks, of which 131 are gastropods and 59 are pelecypods. The pelecypods include 6 new species and 3 new varieties, and the gastropods include 73 new species and 7 new varieties, a total of 89 new species and varieties. The part on gastropods constitutes the major contribution, whereas the part on pelecypods covers only a few of the Comanche species. During the preparation of the report the writer had access to most of the Comanche fossil types, some of which were in private collections. As many of these have since been lost and others were inadequately described, their re-description and re-illustration should clarify problems of nomenclature. Descriptions of a number of sections in the Edwards Plateau and in trans-Pecos Texas are included to show the stratigraphic occurrence of some of the fossils and to emphasize the Washita age of the Devils River limestone of southwestern Texas.

INTRODUCTION

This study of the Comanche faunas was begun more than 50 years ago when the preparation of a comprehensive monograph on the mollusks of the Comanche series was contemplated. Early in the present century a manuscript of considerable size had been prepared, but subsequently the press of more urgent duties made additions exceedingly difficult, and publications by various authors on the Comanche fossils, particularly cephalopods, made parts of the original manuscript obsolete. It is now considered advisable to publish only the part on the gastropods and pelecypods. The part on gastropods is believed to be fairly comprehensive and to constitute the major contribution, whereas the part on pelecypods covers only a fraction of the Comanche species. During the preparation of this report 10 field seasons were spent in areas of Comanche outcrops, large collections of Lower Cretaceous fossils were studied, and the Comanche fossil types of F. W. Cragin, T. A. Conrad, R. T. Hill, G. B. Shattuck, T. W. Vaughan, C. A. White, and F. B. Meek were examined. The re-description and re-illustration of some of their types should help to settle some of the confusion which has arisen in paleontologic writings.

This report is based on 322 lots of fossils collected mainly by R. T. Hill, T. W. Vaughan, and T. W. Stanton in Kansas, Oklahoma, Arkansas, Texas, New Mexico, and Arizona, and in the Rio Grande region of Chihuahua in Mexico. Most of these lots were obtained prior to 1902, and with few exceptions the fossils from lots obtained later have not been considered unless they furnished information particularly pertinent to the understanding of certain species. The names of collectors, and the time and place of collection of the fossil lots are as follows:

Burns, Frank, 1895, in north central Texas.
Cragin, F. W., about 1885 to 1897, in Texas and Kansas.
Cummins, W. F., about 1885 to 1895, in central and west Texas.
Emory, W. H., 1853, 1854, in southwestern Texas.
Gould, C. N., 1898, in Kansas.
Hill, R. T., 1886, 1894, 1895, 1897, in Texas; 1888, in Arkansas.
Hyatt, Alpheus, 1889, in northeastern New Mexico.
Imlay, R. W., 1940, in trans-Pecos Texas.
Lasky, S. G., 1934, in southwestern New Mexico.
Mearns, E. A., 1892, in southeastern New Mexico; 1892, 1893, in southern Arizona.
Mesler, R. D., 1912, in Arkansas.
Miser, H. D., 1912, in Arkansas.
Prather, J. K., 1900, 1901, in central Texas.
Richardson, G. B., 1906, in southeastern New Mexico.
Shattuck, G. B., 1894, in central Texas.
Stanton, T. W., 1889, in Chihuahua; 1898, in Kansas; 1925, in Arkansas; 1889, 1895, 1897, 1898, 1906, 1923, 1925, 1926, 1928, 1929, in Texas.
Taff, J. A., 1900, in Arkansas.
Vaughan, T. W., 1894, 1895, 1896 in Texas; 1896 in Oklahoma and Kansas.
White, C. A., 1888, 1889, in Texas.

Concerning the present disposition of the Comanche fossil types of F. W. Cragin, the Texas State collections contain most of those described in the 4th Annual Report of the Texas Geological Survey, and the U. S. National Museum collections contain a number of the types described in miscellaneous publications. In 1897 the types from Cragin's personal collection in Colorado College at Colorado Springs were borrowed, used as the basis of descriptions and illustrations presented here, and then returned. Subsequently, Cragin left Colorado College, lost interest in fossils, and his types were largely dissipated through careless handling. Eventually, the few remaining types were recognized by the late Prof. I. A. Keyte and sent to the U. S. National Museum.

BIOLOGICAL ANALYSIS

In the accompanying distribution chart are listed the 190 species and varieties described in this report; 59 are pelecypods, and 131 are gastropods. The pelecypods include 6 new species and 3 new varieties, and the gastropods include 73 new species and 7 new varieties; a total of 89 new species and varieties.

Only a few families of pelecypods are considered. The Ostreidae include 12 species and varieties of *Ostrea,* 9 species and varieties of *Gryphaea,* and 13 species and varieties of *Exogyra.* The Pectinidae include 13 species and varieties under the subgenera *Syncyclonema, Chlamys,* and *Neithea* of the genus *Pecten,* but several of the subgeneric assignments are provisional. The Limidae include 6 species of *Lima,* of which 3 are assigned to *Mantellum* and 2 to *Plagiostoma.* It probably also includes *Ctenostreon? cumminsi* Stanton, n. sp. Two species of *Chondrodonta* are not definitely assigned to any family; it seems more likely that they belong in the Pectinacea rather than in the Pinnidae or Mytilidae. *Pachymya austinensis* Shumard was assigned to the Pachymyidae by Shattuck (1903, p. 26),[1] but its internal resemblances to *Panope* suggest that it may belong to the Saxicavidae. Many features of its shell, particularly the carina, are like those in *Arcomya.*

The gastropods are represented by at least 26 families and 42 genera and subgenera. The generic names are those in common use, but many of them apply only in a broad sense and will undoubtedly be replaced when more detailed taxonomic studies are made. The distribution of families, genera, and subgenera and the number of species and varieties in each genus is as follows:

Family, genus, and subgenus	*Number of species*
Pleurotomariidae:	
Pleurotomaria	1
(Leptomaria)	2
Fissurellidae:	
Rimula	1
Turbinidae:	
Turbo?	8
Amberleyidae:	
Amberleya	1
Trochidae:	
Tectus	1
Monodonta	1
(Osilinus?)	1
Margarites	3
Solariella	1
Calliostoma	1
(Eutrochus)	1
Skeneidae:	
Teinostoma?	1
Neritidae:	
Nerita?	3
Neritina?	1
Pileolus	1
Pseudomelaniidae:	
Pseudomelania?	1
Epitoniidae:	
Epitonium?	1
Architectonicidae:	
"Solarium"	1
Naticidae:	
Natica?	1
Lunatia?	3
Gyrodes	1
Tylostoma	5
Viviparidae:	
Viviparus?	1
Rissoidae:	
Rissoa?	1
Turritellidae:	
Turritella	10
Thiaridae:	
Cassiope	4
Trichotropidae:	
Trichotropis	1
Nerineidae:	
Nerinea	22
(Nerinella)	2
(Ptygmatis)	1
(Aptyxiella)	2
Pseudonerinea	6
Cerithiidae:	
Cerithium	13
Triforidae:	
Triforis?	1
Aporrhaidae:	
Anchura	1
(Drepanocheilus)	3
Aporrhais	8
Vanikoroidae:	
Vanikoro?	1
Strombidae:	
Rostellaria	1
Fusidae:	
Falsifusus?	2
Cancellariidae:	
Cancellaria?	1
Actaeonidae:	
Actaeonella	2
Trochactaeon	2
Ringiculidae:	
Avellana	4

[1] See "Works to which reference is made," pp. 114–116.

STRATIGRAPHIC OBSERVATIONS

The regional relationships of the Comanche series in the United States have been discussed in several papers in recent years (Twenhofel, 1924; Stanton, 1928; Adkins, 1933). In general, the rather comprehensive treatment of the Texas Comanche by Adkins will be found very useful, but the writer doubts whether the stratigraphic terms used for north-central Texas should be extended to trans-Pecos Texas and whether the Del Rio and Grayson formations are exact time equivalents, even though

they appear to be of the same age at their bases. A tentative correlation of the Comanchean series, modified mainly after Adkins, is shown on the correlation chart. Differences in interpretation between various workers may be settled by additional field and laboratory studies. Much field work remains to be done in trans-Pecos Texas and in the Edwards plateau before the correct ages of the beds involved can be determined. Some of the sections measured in those regions are given below, partly as contributions to local stratigraphy and partly to show the stratigraphic occurrence of some of the fossils described in this report. The sections in the vicinity of the mouths of the Pecos River and the Devils River are given particularly to emphasize the Washita age of the Devils River limestone.

Generalized section in vicinity of mouth of Devils River, Val Verde County, Tex.

	Feet
3. Buda limestone: Hard, gray, brittle, weathering into nodular forms	25–75
2. Del Rio clay: Greenish, weathering red and brown; contains *Exogyra arietina* Roemer; 10 feet of gray, nodular weathering, argillaceous limestone at base contains *Turrilites brazoensis* Roemer (loc. 11872)	20–50
1. Devils River limestone: About 6 miles west of Del Rio the upper 10 feet of limestone contains *Turrilites brazoensis* Roemer, *Pecten texanus* Roemer, *Cymatoceras texanum* (Shumard), *Kingena wacoensis* (Roemer) (loc. 11870). At bottom of Devils River a soft layer yielded *Pecten texanus* and *Pervinquieria leonensis* (Conrad) (loc. 11871)	180
	225–300±

Section in vicinity of Big Bend of Devils River below Big Satan Creek, Val Verde County, Tex.

3. Buda limestone	30–40
2. Del Rio clay	40?
1. Devils River limestone: About 150 feet below top occur *"Caprina," Toucasia, Chondrodonta,* and gastropods (loc. 11876); at base of cliff, about 5 feet above water level occur *Kingena, Pecten texanus* Roemer, echinoids (loc. 11875), and imprints of *Pervinquieria?*	425
	500±

Section in vicinity of Pecos River, about 1 mile above its mouth, Val Verde County, Tex.

3. Buda limestone	15–30
2. Del Rio clay	10–15
1. Devils River limestone: Upper 10 feet contains *Toucasia, Caprina,* and *gastropods* (loc. 11880); 30 feet below top *Nerinea* is abundant (loc. 11881); 40 feet below top many *Toucasia* occur, and immediately beneath is a bed with *Chondrodonta* (loc. 11882); next 50 feet contains *Nerinea riograndensis* Stanton, n. sp., *N. schotti* Conrad, *N. ponsaltensis* Stanton, n. sp., *Caprinula? occidentalis* Conrad, and *Trochactaeon cumminsi* Stanton (loc. 11883); from 165 to 190 feet below top, or about 90 feet above the bridge, a few specimens of *Kingena* and oysters were obtained (loc. 11884); lower 150 feet of exposures in canyon appear to be unfossiliferous. The limestone of the middle part of the canyon walls is softer than the limestone above and below and tends to form steep slopes or large caves	340
	375±

Section in vicinity of Pecos River—Continued

1. Devils River limestone—Continued

Section of Quitman formation about 1 mile southeast of Quitman Canyon, Hudspeth County, Tex.

23. Limestone and shale, many fossils (loc. 1851), including *Ctenostreon? cumminsi* Stanton; contact with Glen Rose limestone containing abundant *Orbitolina*	30
22. Shale and sandstone	20
21. Limestone, blue	6
20. Shale	8
19. Limestone, compact, blue	10
18. Shale, some beds of sandstone and limestone	25
17. Sandstone and siliceous limestone	10
16. Limestone, argillaceous; and shale	25
15. Limestone, compact, siliceous, blue; contains abundant *Ostrea, Exogyra, Pecten*	10
14. Sandstone, yellowish brown	4
13. Limestone, yellowish; and shale; *Ostrea*	30
12. Shale	15
11. Limestone; contains *Ostrea*	3
10. Sandstone and clay, gray, calcareous; contains some *Ostrea* and *Trigonia*	36
9. Shale, calcareous to noncalcareous, yellowish, some hard layers; contains many fossils including ammonites (loc. 1860)	30
8. Sandstone, calcareous; contains large oysters	3
7. Shale, some calcareous layers	15
6. Sandstone and shale, calcareous; some *Ostrea*	10
5. Shale, calcareous; many fossils	15
4. Limestone, siliceous, yellowish brown	2
3. Clay, sandy; and sandstone, calcareous; some *Ostrea*	50
2. Sandstone, calcareous, brown, in layers 1 to 2 feet thick, separated by thicker shale beds; many fossils	20
1. Limestone, siliceous, alternating with sandstone and shale; contains abundant *Ostrea, Pecten occidentalis* Conrad, *Lima wacoensis* Roemer, *Exogyra,* and *Trigonia* (loc. 1853)	75
	452

Section on northeastern slope of Quitman Mountain, 1 to 2 miles southeast of Quitman Canyon, Hudspeth County, Tex.

Edwards (or Finlay) limestone:

13. Limestone, massive, interstratified with more or less argillaceous nodular beds; *"Caprina" occidentalis* Conrad abundant in some of the harder layers	75
12. Limestone, argillaceous; clays; and some arenaceous beds; *Exogyra texana* Roemer in some beds	300
11. Sandstone, calcareous, brown; contains *Actaeonella dolium* Roemer and *Nerinea*	15
10. Covered	15
9. Sandstone, calcareous, brown; oyster bed at top	8

Section on northeastern slope of Quitman Mountain—Con.

Edwards (or Finlay) limestone—Continued

	Feet
8. Limestone, thick-bedded, alternating with covered spaces	200
7. Sandstone and clay, some argillaceous and arenaceous limestone, alternating in thin beds; *Exogyra texana* Roemer near middle.	200
Glen Rose limestone:	
6. Limestone, more or less argillaceous, mostly thin-bedded; *Orbitolina* abundant	212
5. Limestone, thick-bedded, siliceous; contains *Lunatia? praegrandis* (Roemer), *Ostrea*, *"Radiolites,"* *Orbitolina*, small gastropods..	50
Quitman formation:	
4. Clays, sandstone, and argillaceous to arenaceous limestone in alternating beds; contains *Exogyra quitmanensis* Cragin, *Ctenostreon? cumminsi* Stanton, and *Trigonia* (locs. 1833, 1832)	300
3. Limestone, arenaceous	25
2. Limestone, argillaceous; clay; contains *Ostrea*, *Exogyra quitmanensis* Cragin, and *Trigonia*	20
1. Limestone, massive, compact, blue; contains *Ostrea*, *Gryphaea*, *Neritina* (loc. 1835)	50
	1,470

In this section, units 13–7 correspond to units 7–1 of a previously published section (Stanton, 1905, p. 30). The presence of a fault between units 6 and 5 has been substantiated by C. L. Baker (1927, p. 44) who states that "An overthrust runs just to the northeast of the summit ridge of the northwestern two-thirds of the southern Quitman Mountains."

Section in Cajoncito Canyon on the Rio Grande about 2 miles below the A. L. Ranch in southern Hudspeth County, Tex.

Edwards (or Finlay) limestone:

14. Limestone, thick-bedded; contains *Turritella*, echinoids, and *Gryphaea* (loc. 1899)	90
13. Limestone, argillaceous; contains *Exogyra texana* Roemer, *Protocardia*, *Ostrea crenulimargo* Roemer, *Neritina elpasensis* Stanton, *Aporrhais tarrantensis* Stanton, n. sp., *Cyprimeria*, ammonites, and other fossils (loc. 1891)	25
12. Limestone, thick-bedded mainly, blue; contains a few *Exogyra texana* Roemer	60
11. Limestone, argillaceous; contains *Gryphaea* and *Exogyra texana* Roemer	20
10. Limestone, thick-bedded; *"Radiolites"* abundant in some layers	80
9. Limestone, argillaceous to thin-bedded; contains *Gryphaea mucronata* Gabb and *Exogyra texana* Roemer. Fossils from Nos. 9-7 grouped under loc. 1896	50
8. Clays, some thin beds of brown sandstone	20
7. Limestone, thin-bedded; layers of *Gryphaea* and some *Exogyra texana* Roemer	40
6. Limestone, thick-bedded; contains many *Toucasia*, forms top of cliff (loc. 1908)	80
5. Limestone, thick-bedded; *"Radiolites"* in some layers	40

Section in Cajoncito Canyon on the Rio Grande—Continued

Edwards (or Finlay) limestone—Continued

	Feet
4. Limestone, shale, and brown sandstone in alternating beds; contains *Exogyra texana* Roemer	50
3. Limestone, arenaceous, blue; contains *Orbitolina*, *Gryphaea*, *Ostrea*, and *Exogyra texana* Roemer	10
2. Limestone, shale, and brown sandstone in alternating beds	50
1. Limestone, some beds argillaceous; layers of sandstone becoming more common toward top; *contains Exogyra texana* Roemer (rare) *Gryphaea*, *Orbitolina*, and a few gastropods	100
	715

The Lower Cretaceous rocks in the vicinity of the abandoned A. L. Ranch include both the Fredericksburg and Trinity groups. The following measured section belongs entirely in the Trinity group and was begun several hundred feet lower stratigraphically than unit 1 of the section in Canyon Cajoncito.

Section on the A. L. Ranch on the Rio Grande in southern Hudspeth County, Tex.

Glen Rose limestone:

24. Limestone, argillaceous, buff and light gray, some sandstone and clay layers; contains *Exogyra texana* Roemer (loc. 1913)	50
23. Limestone, gray; *Orbitolina* abundant	20
22. Covered	50
21. Limestone, thin-bedded, argillaceous; harder layers contain many *Orbitolina*	5
20. Limestone, thick-bedded, compact; contains *Gryphaea*, *Orbitolina* and *Monopleura* (near top)	100
19. Limestone, thin-bedded, blue; *Orbitolina* abundant (loc. 1925)	50
18. Limestone, massive; *"Radiolites"* abundant	10
17. Limestone, thick-bedded; *Toucasia* abundant in lower part	20
16. Limestone, shaly to arenaceous; brown, soft	10
15. Limestone, massive, blue; contains *Orbitolina* and corals	15
14. Limestone; *Toucasia* abundant in some layers	20
13. Limestone, argillaceous; contains *Lunatia? praegrandis* (Roemer), *L.? pedernalis* (Roemer), *Orbitolina* (loc. 1923)	10
12. Limestone, massive, compact	15
11. Covered	10
10. Limestone, massive, compact	15
9. Limestone	10
8. Limestone, argillaceous; contains *Lunatia? praegrandis* (Roemer) at top, and *Orbitolina* throughout in the harder layers (loc. 1904)	100
Quitman formation:	
7. Covered	30
6. Clay, brown	15
5. Limestone, arenaceous	2
4. Clay, brown	10
3. Clay, calcareous and arenaceous; contains *Exogyra quitmanensis* Cragin (loc. 1831)	250

Section on the A. L. Ranch on the Rio Grande—Continued

Quitman formation—Continued

	Feet
2. Limestone, compact; *Toucasia* abundant	20
1. Sandstone, brown, alternating with clays and limestone; contains *Exogyra quitmanensis* Cragin and *Trigonia taffi* Cragin (loc. 1859)	250
	1,087

Section on Flat Mesa 1 mile north of town of Sierra Blanca, Hudspeth County, Tex.

[Thickness estimated]

Sandstone, gray, exposed on flat at top of mesa	2

Finlay limestone:

8. Limestone, gray; contains *Requienia*, *Nerinea*, and *Turritella* (loc. 1811)	10
7. Limestone, siliceous, compact, brownish gray, containing flints; *Eoradiolites davidsoni* (Hill)? locally abundant	50
6. Limestone, nodular, blue; *Exogyra texana* Roemer uncommon	20–30

Cox sandstone:

5. Sandstone, brown, and conglomeratic layers	125
4. Limestone, nodular, blue; contains *Exogyra texana* Roemer, *Turritella seriatim-granulata* Roemer (loc. 1810)	10–15
3. Sandstone, not well exposed	25
2. Limestone, arenaceous; upper part contains *Exogyra texana* Roemer, lower part contains *Actaeonella dolium* Roemer, some Turritellas and bivalves (loc. 1809)	6
1. Sandstone, brown	100
	350±

Adkins (1933, p. 352) has shown that this section is overlain on Flat Mesa by about 95 feet of sandy shale and sandstone containing *Gryphaea navia* Hall, *Oxytropidoceras belknapi* (Marcou), and other fossils of Kiamichi age, and that this is overlain at the west end of Flat Mesa by 40 feet of massive brown sandstone that contains fossils suggesting a Duck Creek age. My studies have shown that beds of Washita, probably Fort Worth, age are present in the gap between the main peaks of Sierra Blanca and at the western base of the mountain.

Section at southeast end of Finlay Mountains, Hudspeth County, Tex.

Finlay formation:

32. Limestone, massive, blue; contains *Radiolites* and *Requienia* in abundance (loc. 1897)	75
31. Limestone, argillaceous, nodular, some clay layers; contains *Exogyra texana* Roemer	20
30. Limestone, arenaceous, weathering brown; "*Nodosaria texana*" abundant	4

Section at southeast end of Finlay Mountains—Continued

Finlay formation—Continued

	Feet
29. Limestone, argillaceous, nodular; some clay layers; contains *Exogyra texana* Roemer, *Cerithium bosquense* Shumard, *Tylostoma tumidum* Shumard, and echinoids (loc. 1905)	10
28. Clay, some thin layers of brown sandstone	6
27. Limestone, argillaceous, nodular; contains *Exogyra texana* Roemer	10
26. Clay, some arenaceous and calcareous layers; contains *Exogyra texana* Roemer, *Neritina elpasensis* Stanton, n. sp., and *Ostrea crenulimargo* Roemer (loc. 1900)	20
25. Limestone, arenaceous; small Nerineas abundant (loc. 1916)	2

Cox formation:

24. Sandstone and clay in alternating thin beds	30
23. Sandstone, massive, brown	40
22. Limestone, arenaceous; *Exogyra texana* Roemer, *Actaeonella dolium* Roemer abundant (loc. 1909)	2
21. Covered	50
20. Limestone, arenaceous, brown; many Nerineas (loc. 1894)	3
19. Covered	50
18. Limestone, argillaceous, blue; *Exogyra texana* Roemer uncommon (loc. 1922)	30
17. Limestone, arenaceous, compact; *Actaeonella dolium* Roemer abundant (loc. 1922)	2
16. Limestone, argillaceous, blue	30
15. Sandstone, fine-grained, yellowish brown	3
14. Covered, probably clay	10
13. Sandstone, fine-grained, yellowish brown	2
12. Covered	50
11. Sandstone	10
10. Sandstone, and clay, mostly covered	100
9. Clay and cross-bedded sandstone	30
8. Limestone, argillaceous, gray; contains small bivalves	6
7. Sandstone, coarse-grained	8
6. Clay and sandstone layers, brown	60
5. Sandstone, brown	10
4. Clay and thin layers of sandstone, brown	100

Campagrande limestone:

3. Limestone, blue, compact; contains *Nerinea*	30
2. Limestone and shale, argillaceous and arenaceous	200
1. Limestone, blue, compact; contains *Nerinea* and *Caprina?* (loc. 1907)	100
	1,103

GEOGRAPHIC DISTRIBUTION

The occurrence by State and locality of the 190 species and varieties described in this report is indicated in the table of distribution (in pocket), and the general position of each locality is shown on figure 1. Detailed descriptions of the individual localities are given in the following list.

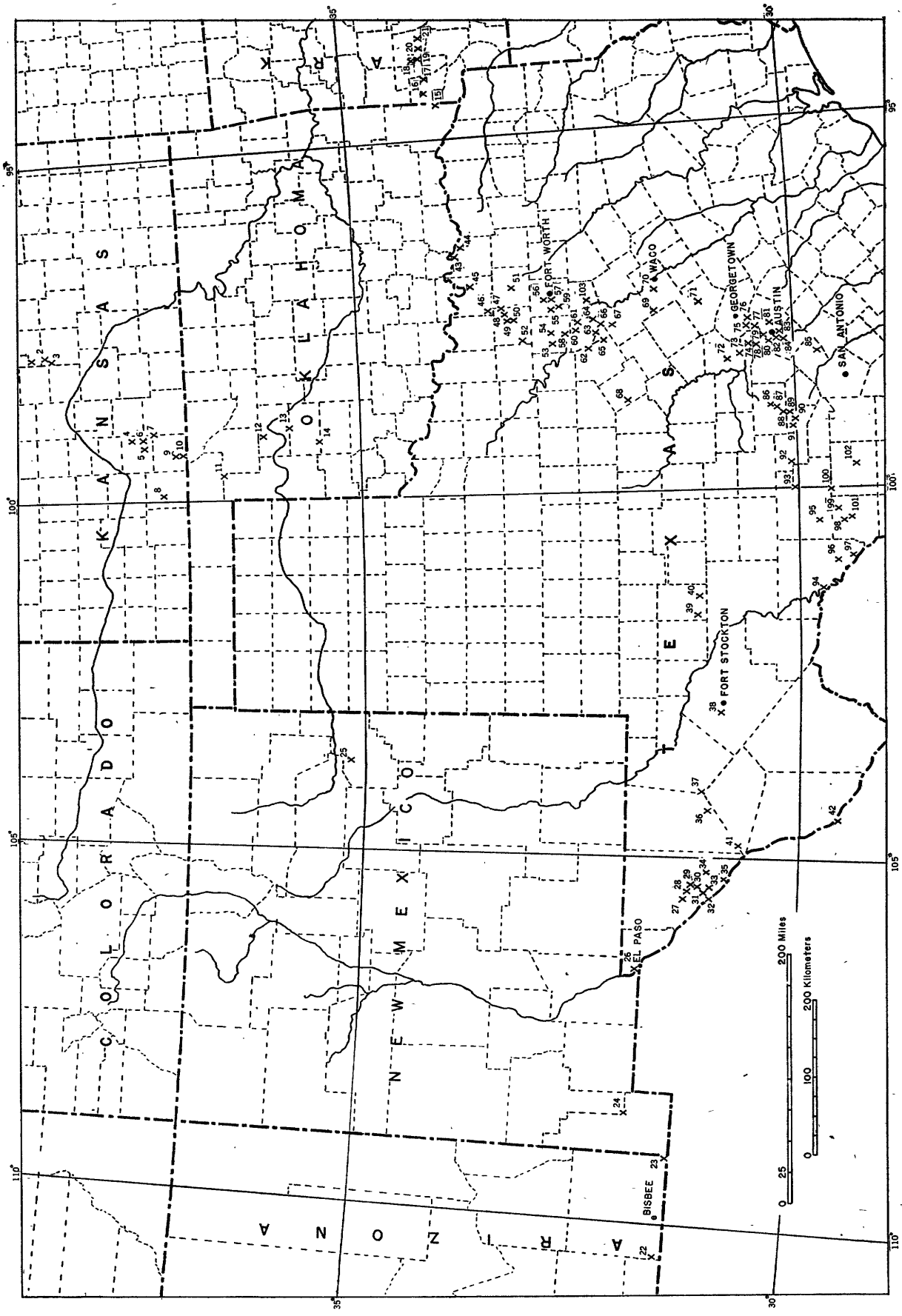

FIGURE 1.—Index map showing localities of collections from the Comanche series. Numbers on this map refer to those given in the locality list (pp. 7–17) and in the distribution table (in pocket).

Localities at which gastropods and pelecypods were collected from the Comanche series

No. on fig. 1	Geological Survey Mesozoic locality	Collector, year of collection, description of locality, and stratigraphic assignment
1	1971	T. W. Stanton, L. F. Ward, and C. N. Gould, 1898. Three miles south of Bavaria, Saline County, Kans. Belvidere formation.
1	1972	T. W. Stanton and C. N. Gould, 1898. Southwest corner of Brookville, Saline County, Kans. Belvidere formation.
2	1978	C. N. Gould, 1898. A quarter of a mile west of Osborne house, near Marquette, McPherson County, Kans. Belvidere formation.
2	1979	C. N. Gould and Mark White, 1898. Hill 4½ miles southwest of Marquette, McPherson County, Kans. Belvidere formation.
2	1980	Mark White and C. N. Gould, 1898. A quarter of a mile west of Osborne house, sec. 4, T. 18 S., R. 5 W., 4½ miles southwest of Marquette, McPherson County, Kans. Belvidere formation.
3	1977	C. N. Gould, 1898. One mile west of Osborne house, near Natural Corral, McPherson County, Kans. Belvidere formation.
4	1950	T. W. Stanton and C. N. Gould, 1898. One mile above Greenleaf's Ranch, near head of Medicine Lodge River, 12 miles above Belvidere, Kiowa County, Kans. Kiowa shale.
5	1948	T. W. Stanton and C. N. Gould, 1898. Near top of hill south of forks of Medicine Lodge River, about 7 miles west of Belvidere, Kiowa County, Kans. Spring Creek member of Belvidere formation.
6	1428	R. T. Hill, 1894. Blue Cut Mound, Comanche County, Kans. No. 3 of Hill's section.
6	1429	R. T. Hill, 1894. Blue Cut Mound, Comanche County, Kans. Kiowa shale, No. 4 of Hill's section.
6	1439	R. T. Hill, 1894. Blue Cut Mound, Comanche County, Kans. Kiowa shale, No. 15 of Hill's section.
6	1961	T. W. Stanton and C. N. Gould, 1898. Walker Creek, south of Belvidere, Kiowa County, Kans. Champion shell bed at base of Kiowa shale.
6	1963	T. W. Stanton, 1898. One mile south of Belvidere, Kiowa County, Kans. Kiowa shale, 20 to 40 feet above base.
6	1964	T. W. Stanton, 1898. Half a mile to 2 miles south of Belvidere, Kiowa County, Kans. Champion shell bed at base of Kiowa shale.
6	1967	T. W. Stanton, 1898. One mile south of Belvidere, Kiowa County, Kans. Kiowa shale, 40 or 50 feet above base.
6	1968	T. W. Stanton and C. N. Gould, 1898. Head of valley 3 miles west of Belvidere, Kiowa County, Kans. Champion shell bed at base of Kiowa shale.
6	18452	R. T. Hill, 1894. Black Hill, 5 miles southeast of Belvidere, Kiowa County, Kans. Kiowa shale, No. 11 of Hill's section.
6	18488	R. T. Hill, 1894. Two miles north of Belvidere, Kiowa County, Kans. Belvidere formation.
6	18497	R. T. Hill, 1894. Near summit of big cut, Belvidere, Kiowa County, Kans.
7	1440	R. T. Hill, 1894. Hill 4 miles west of Sun City, Comanche County, Kans. Kiowa shale.
8	1951	T. W. Stanton, 1898. West Bear Creek, about 11 miles southwest of Ashland, Clark County, Kans. Kiowa shale, No. 9 of Stanton's section.
8	1952	T. W. Stanton and C. N. Gould, 1898. Branch of Bluff Creek, 3 miles above Messing's Ranch, Clark County, Kans. Kiowa shale, upper 30 feet of section.
8	1954	T. W. Stanton, 1898. West branch Bear Creek, about 11 miles northwest of Ashland, Clark County, Kans. Kiowa shale, on slope below No. 7, but evidently from No. 9 of Stanton's section.
8	1956	T. W. Stanton and C. N. Gould, 1898. Bluff Creek, about 4 miles above Messing's Ranch, and 10 or 12 miles north of Ashland, Clark County, Kans. Kiowa shale.
8	1957	T. W. Stanton, 1898. Chatman Creek, about 12 miles northwest of Ashland, Clark County, Kans. Spring Creek clays, 20 feet below base of Greenleaf sandstone in Belvidere formation.
8	1958	T. W. Stanton, 1898. West fork of Bear Creek, about 10 miles northwest of Ashland, Clark County, Kans. Kiowa shale.
9	1790	T. W. Vaughan, 1896. Two and a half miles north of Avilla, Comanche County, Kans. Kiowa shale.
9	3308	C. S. Prosser. Northern side of Avilla Hill, Comanche County, Kans. Kiowa shale, No. 4 of Prosser's section.
10	1447	R. T. Hill, 1894. Black Hill, Comanche County, Kans. Kiowa shale, No. 15 of Hill's Section.
10	1448	R. T. Hill, 1894. Black Hill, Comanche County, Kans. Kiowa shale, No. 11 of Hill's section.

Localities at which gastropods and pelecypods were collected from the Comanche series—Continued

No. on fig. 1	Geological Survey Mesozoic locality	Collector, year of collection, description of locality, and stratigraphic assignment
10	1788	T. W. Vaughan, 1896. Black Hill, 6 miles south of Avilla, Comanche County, Kans. Kiowa shale.
10	1789	T. W. Vaughan, 1896. Six miles south of Avilla, Camp Supply Road, Comanche County, Kans. Kiowa shale.
10	1791	T. W. Vaughan, 1896. Black Hill, 6 miles south of Avilla, Comanche County, Kans. Kiowa shale.
10	1960	T. W. Stanton and C. N. Gould, 1898. Black Hill, 5 miles southeast of Belvidere, Kiowa County, Kans. Kiowa shale.
11	1781	T. W. Vaughan, 1896. About 3 miles west of Camp Supply, and 18 miles northwest of Woodward, Ellis County, Okla. Kiamichi formation.
11	1782	T. W. Vaughan, 1896. Top of butte about 3 miles west of Camp Supply, and 18 miles northwest of Woodward, Ellis County, Okla. Kiamichi formation.
11	1785	T. W. Vaughan, 1896. Butte about 3 miles west of Camp Supply, and 18 miles northwest of Woodward, Ellis County, Okla. Kiamichi formation.
12	1783	T. W. Vaughan, 1896. NW¼ sec. 9, T. 19 N., R. 17 W., 7 miles west of Taloga, Dewey County, Okla. Washita group.
13	1784	T. W. Vaughan, 1896. Eighteen miles north of Arapaho on Taloga Road, about 2 miles south of sec. 35, T. 16 N., R. 17 W., Dewey County, Okla.
14	1786	T. W. Vaughan, 1896. Sec. 11, T. 12 N., R. 18 W., about 10 miles southwest of Arapaho, Custer County, Okla. Kiamichi formation.
15	886	R. T. Hill, 1888. In Oklahoma west of Cerro Gordo, Ark. Washita group.
16	8287	R. D. Mesler, 1912. Half a mile east of DeQueen, Sevier County, Ark. DeQueen limestone.
17	8286	H. D. Miser and R. D. Mesler, 1912. Two miles north of Provo, Sevier County, Ark. Trinity group, DeQueen limestone member of Trinity formation, near base.
18	883	R. T. Hill, 1888? Muddy Fork Post Office, Howard County, Ark. Trinity formation.
19	8288	R. D. Mesler, 1912. Three miles west-southwest of Nathan, in the northeast corner of sec. 3, T. 8 S., R. 27 W., Howard County, Ark. DeQueen limestone member of Trinity formation.
19	8290	R. D. Mesler, 1812. East of DeQueen, 1½ miles southwest of Steel Ford on Cossatot River, Sevier County, Ark. DeQueen limestone member of Trinity formation.
20	884	R. T. Hill, 1888? Murfreesboro, Pike County, Ark. Trinity formation.
20	888	R. T. Hill, 1888? Junction of Clear Fork and Muddy Fork of Little Missouri River, near Murfreesboro, Pike County, Ark. Trinity formation.
20	972	R. T. Hill, 1888? Half a mile northeast of Murfreesboro, Pike County, Ark. Trinity formation.
20	2214	J. A. Taff, 1900. Junction of Muddy Fork and Clear Fork of Little Missouri River, 3 miles west of Murfreesboro, Pike County, Ark. Trinity formation.
20	8291	H. D. Miser and R. D. Mesler, 1912. Along wagon road about 2 miles northeast of Murfreesboro, in northeast corner of sec. 9, T. 8 S., R. 25 W., Pike County, Ark. Dierks limestone member of Trinity formation.
20	8292	H. D. Miser, 1912. About 3 miles west-southwest of Murfreesboro, in sec. 14, T. 8 S., R. 26 W., Pike County, Ark. Dierks limestone member of Trinity formation.
21	887	R. T. Hill, 1888? Wolf Creek Post Office, Pike County, Ark. Trinity formation.
22	1697	E. A. Mearns, 1893. From summit of the second to the highest peak of the Huachuca Mountains, Cochise County, Ariz. Washita group.
23	1691	E. A. Mearns, 1892. Guadalupe Canyon, near Sycamore Creek, 5 miles north of Hall's Ranch, southeastern Arizona. Trinity group.
23	1695	E. A. Mearns, 1892. Four miles northwest of monument No. 73, in the southeastern corner of Arizona. Trinity group.
24	16955	S. G. Lasky, 1934. NW¼ sec. 36, T. 27 S., R. 16 W., Little Hatchet Mountains, N. Mex. Trinity group.
24	16964	S. G. Lasky, 1934. Saddle of low hill, half a mile southeast of tank at southwest corner of Big Hatchet Mountains, N. Mex. Trinity group.
24	17440	S. G. Lasky, 1937. Center of east edge of sec. 12, T. 28 S., R. 16 W., Little Hatchet Mountains, N. Mex. *Exogyra* bed 75 to 100 feet above No. 7 of section. Trinity group.
24	17442	S. G. Lasky, 1937. Sec. 13, T. 28 S., R. 16 W., Little Hatchet Mountains, N. Mex. Stone Cabin formation, higher *Exogyra* zone. Trinity group.
25	18511	Alpheus Hyatt, 1889? Mesa Tucumcari, N. Mex. Purgatoire formation.
25	18512	Alpheus Hyatt, 1889? West side of mesa on point east of Arroyo de la Laguna, N. Mex. Purgatoire formation.
25	18513	Alpheus Hyatt, 1889? Monte Revuelto, on southern side of point at head of Canyon Bonito, N. Mex. Purgatoire formation.

Localities at which gastropods and pelecypods were collected from the Comanche series—Continued

No. on fig. 1	Geological Survey Mesozoic locality	Collector, year of collection, description of locality, and stratigraphic assignment
25	18514	Alpheus Hyatt, 1889? Face of bluff of Llano Estacado, northeast of entrance to Apache Canyon, N. Mex. Purgatoire formation.
25	18515	Alpheus Hyatt, 1889? Mesa northwest of Fort Bascom, N. Mex. Purgatoire formation.
25	18516	Alpheus Hyatt, 1889? Canyon Jonda, Mesa Rica, N. Mex. Purgatoire formation.
26	706	Anson Mills, 1889. Near El Paso, in New Mexico. Fredericksburg group?
26	1462	T. W. Vaughan and T. W. Stanton, 1895. Southern Pacific Railway on bank of Rio Grande, just west of bridge about 4 miles above El Paso, in New Mexico. Limestone of Fredericksburg age, lowest bed exposed.
26	1463	T. W. Vaughan and T. W. Stanton, 1895. West side of Rio Grande, about 4 miles northwest of El Paso, in New Mexico. Beds of Fredericksburg age, No. 2 of published section.
26	1464	T. W. Vaughan and T. W. Stanton, 1895. West side of Rio Grande, 4 miles northwest of El Paso, in New Mexico. Fort Worth-Duck Creek limestone, No. 5 of published section.
26	1465	T. W. Vaughan and T. W. Stanton, 1895. West side of Rio Grande, about 4 miles northwest of El Paso, in New Mexico. Weno (?) formation, No. 6 of published section.
26	1466	T. W. Vaughan and T. W. Stanton, 1895. Four miles northwest of El Paso near international boundary, in New Mexico. Grayson (Del Rio) formation, No. 9 of measured section.
26	1689	E. A. Mearns, 1892. South side of the Rio Grande between railroad bridge across river and the initial monument of the U. S. and Mexican Boundary Survey, about 4 miles west of El Paso, in New Mexico. Washita group, upper part.
26	1690	E. A. Mearns, 1892. Near initial monument of the U. S. and Mexican Boundary Survey, 4 miles west of El Paso, in New Mexico. Uppermost fossiliferous bed of the Grayson (Del Rio) formation.
26	1792	S. W. Loper, 1897. Three miles west of El Paso, in New Mexico, across the Rio Grande opposite railroad bridge. Washita group, upper part.
26	1793	S. W. Loper, 1897. Low ridge between Stone House Mesa and the Upper Silurian ridge, near El Paso, in New Mexico.
26	1943	T. W. Stanton, 1898. Rio Grande above El Paso, near initial monument of the U. S. and Mexican Boundary Survey, in New Mexico. Grayson (Del Rio) formation.
26	1944	T. W. Stanton, 1898. Near initial monument of U. S. and Mexican Boundary Survey, 4 miles above El Paso, in New Mexico. Buda limestone.
26	3771	G. B. Richardson, 1906. Four miles northwest of El Paso, in New Mexico. Limestone of Fredericksburg age.
26	18503	T. W. Stanton and T. W. Vaughan, 1895. Near initial monument of U. S. and Mexican Boundary Survey, about 4 miles west of El Paso, in New Mexico. Fredericksburg group, No. 2 of published section.
27	1900	T. W. Stanton, 1898. Southeast end of Finlay Mountains, Hudspeth County, Tex. Limestone of Fredericksburg age.
27	1905	T. W. Stanton, 1898. Southeast end of Finlay Mountains, Hudspeth County, Tex. Limestone of Fredericksburg age.
27	1909	T. W. Stanton, 1898. Finlay Mountains, Hudspeth County, Tex. Fredericksburg group, Nos. 21 and 22 of section.
27	1916	T. W. Stanton, 1898. Southeast end of Finlay Mountains, Hudspeth County, Tex. Fredericksburg group.
27	1922	T. W. Stanton, 1898. Finlay Mountains. Fredericksburg group, Nos. 17 and 18 of section.
28	1813	T. W. Stanton, 1897. Gap between north and south peaks of the Sierra Blanca, Hudspeth County, Tex. Limestone of Washita age.
28	1914	T. W. Stanton, 1898. Gap between the main peaks of the Sierra Blanca, Hudspeth County, Tex. Washita group.
29	1809	T. W. Stanton, 1897. No. 2 of section on Flat Mesa, 4 miles north of town of Sierra Blanca, Hudspeth County, Tex. Finlay formation(?).
29	1810	T. W. Stanton, 1897. Four miles north of town of Sierra Blanca, Hudspeth County, Tex. Finlay limestone, No. 4 of Stanton's Flat Mesa section.
30	1806	T. W. Stanton, 1897. Bluff Mesa, 2 miles southwest of town of Sierra Blanca, Hudspeth County, Tex. Trinity group.
31	1828	T. W. Stanton, 1898. Just south of head of Quitman Canyon, Hudspeth County, Texas. Quitman formation of Taff.
31	1832	T. W. Stanton, 1898. North slope of mountain, 2 miles south of Quitman Canyon, Hudspeth County, Tex. Fredericksburg group, No. 4 of Stanton's section.

Localities at which gastropods and pelecypods were collected from the Comanche series—Continued

No. on fig. 1	Geological Survey Mesozoic locality	Collector, year of collection, description of locality, and stratigraphic assignment
31	1833	T. W. Stanton, 1898. Upper slope of mountain 2 miles south of Quitman Canyon, Hudspeth County, Tex. Quitman formation of Taff, No. 4 of Stanton's section.
31	1851	T. W. Stanton, 1898. One mile south of Quitman Canyon, Hudspeth County, Tex. Quitman formation of Taff, near base.
31	1853	T. W. Stanton, 1898. One mile south of Quitman Canyon, Hudspeth County, Tex. Quitman formation of Taff, upper part.
31	1854	T. W. Stanton, 1898. One mile south of Quitman Canyon, Hudspeth County, Tex. Quitman formation of Taff, upper part.
31	1860	T. W. Stanton, 1898. One mile south of Quitman Canyon, Hudspeth County, Tex. Quitman formation of Taff, No. 9 of Stanton's section.
31	1910	T. W. Stanton, 1898. Two miles east of head of Quitman Canyon, Hudspeth County, Tex. Fredericksburg group, upper 50 feet of exposure.
31	1912	T. W. Stanton, 1898. One mile southeast of head of Quitman Pass, Hudspeth County, Tex. Fredericksburg group.
32	1831	T. W. Stanton, 1898. A. L. Ranch on Rio Grande west of Quitman Mountains, Hudspeth County, Tex. Quitman formation of Taff, No. 3 of Stanton's section.
32	1859	T. W. Stanton, 1898. A. L. Ranch on the Rio Grande west of Quitman Mountains. Quitman formation of Taff, No. 1 of Stanton's measured section.
32	1891	T. W. Stanton, 1898. Cajoncito on the Rio Grande 2 miles below A. L. Ranch, Hudspeth County, Tex. Fredericksburg group, No. 13 of Stanton's section.
32	1896	T. W. Stanton, 1898. Cajoncito on the Rio Grande, 2 miles below the A. L. Ranch, Hudspeth County, Tex. Nos. 9-7 of section.
32	1902	T. W. Stanton, 1898. Coal ridge east of Quitman Mountains near Rio Grande, Hudspeth County, Tex.
32	1908	T. W. Stanton, 1898. At Cajoncito on the Rio Grande, 2 miles below the A. L. Ranch, Hudspeth County, Tex. Fredericksburg group, No. 6 of Stanton's section.
32	1913	T. W. Stanton, 1898. A. L. Ranch on Rio Grande west of Quitman Mountains. Fredericksburg group, No. 24 of section.
32	1923	T. W. Stanton, 1898. A. L. Ranch on Rio Grande west of Quitman Mountains, Hudspeth County, Tex. No. 13 of Stanton's section.
33	1895	T. W. Stanton, 1898. About 6 miles south of Quitman Canyon, in eastern foothills of Quitman Mountains, Hudspeth County, Tex. Limestone of Fredericksburg age.
33	1920	T. W. Stanton, 1898. East base of Quitman Mountains, at mouth of large canyon about 6 miles south of Quitman Canyon, Hudspeth County, Tex. Washita group.
34	1849	T. W. Stanton, 1898. A little south of old stage road at end of ridge trending northwest from Eagle Mountain, about 13 miles southeast of town of Sierra Blanca, Hudspeth County, Tex. Trinity group, probably low.
35	1808	T. W. Stanton, 1897. Ridge east of Mule Canyon, 25 miles south of town of Sierra Blanca, Hudspeth County, Tex. Limestone of Washita age.
35	1829	T. W. Stanton, 1898. Head of Red Bull Canyon, about 3¼ miles from Hot Spring on trail from Quitman Arroyo, Hudspeth County, Tex. Quitman formation of Taff.
35	1843	T. W. Stanton, 1898. West of Mule Canyon, near Rio Grande, Hudspeth County, Tex. Washita Group.
35	1845	T. W. Stanton, 1898. West of Mule Canyon near Rio Grande, Hudspeth County, Tex. Lower part of No. 8 of published section.
35	1848	T. W. Stanton, 1898. Three miles northeast of Hot Spring, on the Rio Grande, at first Indian Mound on trail to Quitman Arroyo, Hudspeth County, Tex. Quitman formation of Taff.
35	1862	T. W. Stanton, 1898. Head of Red Bull Canyon, on trail from Quitman Arroyo to Hot Spring hill. Quitman formation of Taff.
35	1898	T. W. Stanton, 1898. Base of most eastern ridge near south end of Quitman Mountains. Fredericksburg group.
35	1903	T. W. Stanton, 1898. A quarter of a mile east of southern end of Quitman Mountains. Fredericksburg group.
35	18359	J. B. Reeside, Jr., and R. W. Imlay, 1940. Near mouth of Mayfield Canyon, about 3 miles east of Indian Hot Spring, Hudspeth County, Tex. Quitman formation of Taff, beds with *Douvilleiceras*.
36	1926	T. W. Stanton, 1898. Four and a half miles southwest of Kent, Culberson County, Tex. Buda limestone.
36	1927	T. W. Stanton, 1898. About 5 miles southwest of Kent, Culberson County, Tex. Washita group.
36	1928	T. W. Stanton, 1898. Six miles west of Kent, Culberson County, Tex. Buda limestone.
36	1929	T. W. Stanton, 1898. Two miles west of Kent, Culberson County, Tex. Washita group.

Localities at which gastropods and pelecypods were collected from the Comanche series—Continued

No. on fig. 1	Geological Survey Mesozoic locality	Collector, year of collection, description of locality, and stratigraphic assignment
36	1930	T. W. Stanton, 1898. Near water tanks, 8 miles west of Kent, Culberson County, Tex. Washita group, top of local section.
36	1931	T. W. Stanton, 1898. Hill 1 mile south-southeast of Kent, Culberson County, Tex. No. 1 of Stanton's section.
36	1932	T. W. Stanton, 1898. About a quarter of a mile southwest of Kent, Culberson County, Tex. Washita group, from base of hill to foot of escarpment.
36	1933	T. W. Stanton, 1898. Hill 1 mile south-southeast of Kent, Culberson County, Tex. Nos. 2 and 3 of Stanton's section.
36	1935	T. W. Stanton, 1898. Hill 5 miles west of Kent, Culberson County, Tex. Washita group, near middle of section on hill.
36	1936	T. W. Stanton, 1898. Upper part of hill 5 miles west of Kent, Culberson County, Tex. Washita group, upper part.
36	1937	T. W. Stanton, 1898. Five miles west of Kent, Culberson County, Tex. Base of Washita group.
36	1938	T. W. Stanton, 1898. Five miles west of Kent, Culberson County, Tex. Washita group, 30 feet above base of section.
36	1939	T. W. Stanton, 1898. Near water tank 8 miles west of Kent, Culberson County, Tex. Washita group, lower part.
37	1863	T. W. Stanton, 1898. Near San Martine water tank on the Texas and Pacific Railway, 8 miles east of Kent, Reeves County, Tex. Buda limestone.
38	13196	T. W. Stanton and W. B. Lang, 1925. Top of low mesa 1½ miles north of west end of Leon Springs Reservoir, about 9 miles west of Fort Stockton, Pecos County, Tex. Limestone of Washita age (= middle Cap Rock of W. S. Adkins, who correlates it with the Denton formation).
39	11853	T. W. Stanton and J. A. Udden, 1923. Top of mesa about 1½ miles south of Texas Oil Company's Santa Rita well, 14 miles west of Big Lake, Reagan County, Tex. Washita group.
40	11854	T. W. Stanton, 1923. Cut and adjacent ravine on Kansas City and Orient Railway, 2½ miles southeast of Big Lake, Reagan County, Tex. Limestone of upper Washita age.
41	1476	T. W. Vaughan and T. W. Stanton, 1895. Ridge west of railroad, about 7 miles southwest of Chispa, Jeff Davis County, Tex. Limestone of Washita age.
41	1478	T. W. Vaughan and T. W. Stanton, 1895. Hill west of Rio Grande Railroad, 7 miles southwest of Chispa, Jeff Davis County, Tex. Limestone of Washita age.
41	1479	T. W. Vaughan and T. W. Stanton, 1895. About 6½ miles southwest of Chispa on Rio Grande Railroad, Jeff Davis County, Tex. Limestone of Washita age immediately beneath Upper Cretaceous shales.
42	620	C. A. White and T. W. Stanton, 1889. Across Rio Grande from Presidio, Tex., in Mexico. Probably high in the Washita group.
43	1490	R. T. Hill and T. W. Stanton, 1895. Two miles north of Pottsboro, Grayson County, Tex. Grayson marl member of Denison formation.
43	1492	R. T. Hill and T. W. Stanton, 1895. Little Mineral Creek, 4 miles southwest of Marshall's farm and about 15 miles from Denison, Grayson County, Tex. Goodland limestone.
43	1493	T. W. Stanton, 1895. Between Marshall's farm and Preston, Grayson County, Tex. Kiamichi formation.
43	1494	R. T. Hill and T. W. Stanton, 1895. Bluffs overlying Red River Valley east of Preston, Grayson County, Tex. Goodland limestone (?).
43	1500	R. T. Hill and T. W. Stanton, 1895. Thompsons Ferry on the Red River near Preston, Grayson County, Tex. Duck Creek limestone.
43	1501	R. T. Hill and T. W. Stanton, 1895. Near Marshall's farm, 10 to 12 miles northwest of Denison on road to Preston, Grayson County, Tex. Goodland limestone.
44	439	R. T. Hill, 1886? Two miles east of Denison, Grayson County, Tex. Washita group.
44	439b	R. T. Hill, 1886? Three miles north of Denison, Grayson County, Tex. Pawpaw sandy member of Denison formation.
44	439c	R. T. Hill, 1886? Two miles north of Denison, Grayson County, Tex. Washita Group.
44	1451	R. T. Hill, 1894. Two miles west of Denison, Grayson County, Tex. Denton clay member of Denison formation.
44	1452	R. T. Hill, 1894. Three miles west of Denison, Grayson County, Tex. Denton clay member of Denison formation.
44	1453	R. T. Hill, 1894. Two and a half miles west of Denison, Grayson County, Tex. Denton clay member of Denison formation.
44	1454	R. T. Hill, 1894. Duck Creek, 4 miles north of Denison, Grayson County, Tex. Kiamichi shale.

Localities at which gastropods and pelecypods were collected from the Comanche series—Continued

No. on fig. 1	Geological Survey Mesozoic locality	Collector, year of collection, description of locality, and stratigraphic assignment
44	1456	R. T. Hill, 1894. One mile west of Denison, Grayson County, Tex. Pawpaw sandy member of Denison formation.
44	1458	R. T. Hill, 1894. East Denison, Grayson County, Tex. Pawpaw sandy member of Denison formation.
44	1459	R. T. Hill, 1894. Denison, Grayson County, Tex. Main Street limestone member of Denison formation.
44	1548	Frank Burns, 1895. Three-quarters of a mile northeast of the depot at Denison, on a hillside beyond some old quarries above Pawpaw Creek, Grayson County, Tex. Pawpaw sandy member of Denison formation.
44	1549	R. T. Hill and T. W. Stanton, 1895. Two and a half miles north of Denison, Grayson County, Tex. Forth Worth limestone and Denton clay member of Denison formation.
44	1549a	R. T. Hill and T. W. Stanton, 1895. North of Denison, Grayson County, Tex. Fort Worth limestone, top.
44	1550	R. T. Hill and T. W. Stanton, 1895. Duck Creek, 4 miles north of Denison, Grayson County, Tex. Kiamichi and Duck Creek formations.
44	1551	R. T. Hill, F. Burns, and T. W. Stanton, 1895. Bonham Railway cut on the southeast edge of Denison, Grayson County, Texas. Grayson marl member of Denison formation.
44	1566	Frank Burns, 1895. Duck Creek, 3 miles north of Denison, Grayson County, Tex. Duck Creek formation, lower part.
44	1583	Frank Burns, 1895. Railroad cut north of Oil Mill, northwest Denison, Grayson County, Tex. Forth Worth limestone.
44	1589	Frank Burns, 1895. Pawpaw Creek half a mile southeast of depot at Denison, Grayson County, Tex. Pawpaw formation.
44	1590	Frank Burns, 1895. Three miles north of Denison, Grayson County, Tex. Kiamichi formation, limestone just above shale.
44	1591	Frank Burns, 1895. Near first mile post of the railroad north of Denison, Grayson County, Tex. Pawpaw sandy member of Denison formation.
44	1592	Frank Burns, 1895. Duck Creek, half a mile north of depot at Denison, Grayson County, Tex. Pawpaw sandy member of Denison formation in creek.
44	1593	Frank Burns, 1895. Near first milepost of the railroad north of Denison, Grayson County, Tex. Main Street limestone member of Denison formation.
44	1640	G. B. Shattuck and R. T. Hill, 1894. Two and a half miles north of Denison, Grayson County, Tex. Forth Worth limestone.
44	18479	R. T. Hill, 1894. Duck Creek, near Denison, Grayson County, Tex. Kiamichi shale.
44	18490	R. T. Hill, 1894. Two miles north of Denison, Grayson County, Tex. Denton clay member of Denison formation.
44	18492	R. T. Hill, 1894. Two and a half miles north of Denison, Grayson County, Tex. Denton clay member of Denison formation.
44	18493	R. T. Hill, 1894. Three miles north of Denison, Grayson County, Tex. Duck Creek formation.
44	18494	R. T. Hill, 1894. Denison, Grayson County, Tex. Main Street limestone member of Denison formation.
44	18498	T. W. Vaughan, 1894. One and a quarter miles north of Denison, on east side of railroad, Grayson County, Tex. Washita group.
45	1489	R. T. Hill and T. W. Stanton, 1895. Four and a half miles northeast of Gainesville, Cooke County, Tex. Pawpaw sandy member of Denison formation.
46	1502	R. T. Hill and T. W. Stanton, 1895. About 20 miles southwest of Gainesville, Cooke County, Tex. Goodland limestone.
46	1503	R. T. Hill and T. W. Stanton, 1895. Between Blocker and Wheat Creeks, about 20 miles southwest of Gainesville, Cooke County, Tex. Goodland limestone.
46	1504	R. T. Hill and T. W. Stanton, 1895. Between Blocker and Wheat Creeks, about 18 miles southwest of Gainesville, Cooke County, Tex. Kiamichi formation.
46	1507	R. T. Hill and T. W. Stanton, 1895. Fifteen and a half miles southwest of Gainesville on road to Decatur, Cooke County, Tex. Goodland limestone.
46	1508	R. T. Hill and T. W. Stanton, 1895. About 16½ miles southwest of Gainesville on road to Decatur, Cooke County, Tex. Goodland limestone.
46	1510	R. T. Hill and T. W. Stanton, 1895. Twenty miles southwest of Gainesville on road to Decatur, Cooke County, Tex. Walnut clay.
46	1511	R. T. Hill and T. W. Stanton, 1895. Near Blocker Creek, 21 miles southwest of Gainesville, Cooke County, Tex. Goodland limestone.
46	1512	T. W. Stanton, 1895. Twenty miles southwest of Gainesville, Cooke County, Tex. Comanche Peak limestone(?).

Localities at which gastropods and pelecypods were collected from the Comanche series—Continued

No. on fig. 1	Geological Survey Mesozoic locality	Collector, year of collection, description of locality, and stratigraphic assignment
47	1505	T. W. Stanton, 1895. Half a mile east of Greenwood on Horse Creek, 12 miles northeast of Decatur, Wise County, Tex. Walnut clay.
48	1506	T. W. Stanton, 1895. West bluff of Black Creek, 7 miles northeast of Decatur, Wise County, Tex. Walnut clay.
49	445	R. T. Hill, 1886? Two miles north of Decatur, Wise County, Tex. Fredericksburg group.
50	445a	R. T. Hill, 1886. Two miles south of Decatur, Wise County, Tex. Fredericksburg group.
51	519	R. T. Hill, 1886. Denton, Tex.
52	446	R. T. Hill, 1886? Eighteen miles southwest of Decatur, Wise County, Tex. Glen Rose limestone.
53	440e	R. T. Hill, 1886? Eight miles west of Weatherford, Parker County, Tex. Glen Rose limestone.
54	440	R. T. Hill, 1886. Weatherford, Parker County, Tex. Fredericksburg group (?).
54	440a	R. T. Hill, 1886? Four miles south of Weatherford, Parker County, Tex. Comanche Peak limestone.
54	1568	R. T. Hill and T. W. Stanton, 1895. About 7 miles south of Weatherford, Parker County, Tex. Glen Rose limestone.
54	1576	R. T. Hill and T. W. Stanton, 1895. Crossing of Sanches Creek on Stephenville road, about 8 miles south of Weatherford, Parker County, Tex. Glen Rose limestone.
55	443	R. T. Hill, 1886? Ten miles west of Fort Worth on Texas Pacific Railway, Tarrant County, Tex. Comanche Peak limestone.
55	458a	R. T. Hill, 1886? Six miles west of Fort Worth, Tarrant County, Tex. Goodland limestone.
56	458d	R. T. Hill, 1886? Six miles north of Fort Worth, Tarrant County, Tex. Washita group.
56	458g	R. T. Hill, 1886? Eight miles north of Forth Worth near Big Fossil Creek, Tarrant County, Tex. Weno formation.
57	458b	R. T. Hill, 1886? About 1 mile west of Fort Worth, Tarrant County, Tex. Washita group.
57	458f	R. T. Hill, 1886? One to two miles south of Fort Worth, Tarrant County, Tex. Washita group.
57	458h	R. T. Hill, 1886? One to three miles north of Fort Worth, Tarrant County, Tex.
57	1570	R. T. Hill and T. W. Stanton, 1895. Near railroad tracks at foot of 7th Street, Fort Worth, Tex. Fort Worth limestone, lower part.
57	1575	T. W. Stanton, 1895. Railroad cut a quarter of a mile south of Union Depot. Fort Worth, Tarrant County, Tex. Denton formation.
57	1578	Frank Burns, 1895. Around depot, Fort Worth, Tarrant County, Tex. Fort Worth limestone.
57	1587	Frank Burns, 1895. Near railroad bridge, northern part of Fort Worth, Tarrant County, Tex. Fort Worth limestone.
58	440d	R. T. Hill, 1886? Twelve miles south of Weatherford, Parker County, Tex. Fredericksburg group (?). Collected from a boulder.
59	1577	Frank Burns, 1895. Benbrook, 8 miles west of Fort Worth, Tarrant County, Tex. Goodland limestone.
60	2069	R. T. Hill, 1897? East bluff of Brazos River, at the railroad bridge about 2 miles east of Granbury, Hood County, Tex. Glen Rose limestone.
61	441	R. T. Hill, 1886? Between Granbury and Comanche Peak, Hood County, Tex. Comanche Peak limestone.
61	1571	R. T. Hill and T. W. Stanton, 1895. Lower slopes of Comanche Peak, Hood County, Tex. Walnut clay.
61	1574	R. T. Hill and T. W. Stanton, 1895. Comanche Peak in Hood County, Tex. Comanche Peak limestone.
62	1546	Frank Burns, 1895. Bluffdale, Erath County, Tex. Glen Rose limestone, upper bed.
63	1544	Frank Burns, 1895. Right bank of Paluxy River, 2½ miles above Glen Rose, Somervell County, Tex. Glen Rose limestone.
63	1547	Frank Burns, 1895. Right bank of the Paluxy River, 5 miles above Glen Rose, Somervell County, Tex. Glen Rose limestone.
63	1555	Frank Burns, 1895. Bed of the Paluxy River at Glen Rose, Somervell County, Tex. Glen Rose limestone.
64	1584	Frank Burns, 1895. Georges Creek, 10 miles east of Glen Rose, Somervell County, Tex. Comanche Peak limestone.
65	1545	Frank Burns, 1895. Chalk Mountain, 12 miles southwest of Glen Rose in Erath County, Texas. Comanche Peak limestone.

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Localities at which gastropods and pelecypods were collected from the Comanche series—Continued

No. on fig. 1	Geological Survey Mesozoic locality	Collector, year of collection, description of locality, and stratigraphic assignment
66	1554	Frank Burns, 1895. Seven Knobs, 5 miles southeast of Glen Rose, Somervell County, Tex. Comanche Peak limestone.
67	2296	J. K. Prather, 1901. From highest part of 100-foot bluff near mouth of Steel Creek, near Fowler, Bosque County, Tex. Comanche Peak limestone.
67	2297	J. K. Prather, 1901. Bluff below camp at Fowler, Bosque County, Tex. Comanche Peak limestone.
68	448	R. T. Hill, 1886? Round Mountain, Comanche County, Tex. Fredericksburg group.
69	2253	J. K. Prather, 1900. Bluff Creek, 25 miles west of Waco, and 5 miles from Crawford in McLennan County, Tex. Edwards limestone.
69	2300	J. K. Prather, 1901. Bluff Creek, 5 miles from Crawford, McLennan County, Tex. Edwards limestone.
69	4096	T. W. Stanton, 1906. Bluff Creek, 4 miles northwest of Crawford, McLennan County, Tex. Edwards limestone, 8 feet above base of exposure.
70	2054	J. K. Prather. On Bosque River near Waco, McLennan County, Tex. Washita group.
70	2059	J. K. Prather. Hog Creek, 8 miles west of Waco, McLennan County, Tex. Washita group.
70	2061	J. K. Prather. Banks of South Bosque Creek, behind town of South Bosque, McLennan County, Tex. Washita group.
70	2062	J. K. Prather. Near Waco, McLennan County, Tex. Washita group.
71	2068	R. T. Hill, 1897. Nolans River, half a mile east of public square, old fair grounds road, Belton, Bell County, Tex. Edwards limestone.
71	2070	R. T. Hill, 1897. Near Belton, Bell County, Tex. Edwards limestone.
72	1798	T. W. Stanton, 1897. Post Mountain, 1 mile west of Burnet, Tex. Comanche Peak limestone.
72	1800	T. W. Stanton, 1897. On road 2 miles northeast of Burnet, Burnet County, Tex. Comanche Peak limestone.
73	1556	R. T. Hill, T. W. Vaughan, and T. W. Stanton, 1895. Spanish Creek, about 39 miles northwest of Austin, Burnet County, Tex. Glen Rose limestone, lower part.
74	1599	T. W. Vaughan, T. W. Stanton, 1895. Cow Creek, below Travis Peak Post Office, about 35 miles northwest of Austin, Travis County, Tex. Travis Peak formation.
74	1631	T. W. Vaughan and T. W. Stanton, 1895. Bluff on east side of Colorado River below mouth of Cow Creek, Travis County, Tex. Glen Rose limestone, 150 feet above river.
74	1801	T. W. Stanton, 1897. Bed or Cow Creek, 1 mile below Travis Peak Post Office, Travis County, Tex. Travis Peak formation.
74	1802	T. W. Stanton, 1897. Bed of Cow Creek, 2 miles below Travis Peak Post Office, Travis County, Tex. Travis Peak formation.
74	1803	T. W. Stanton, 1897. On ridge about 2 miles northwest of Travis Peak Post Office, Travis County, Tex. Glen Rose formation.
75	789	A. R. Roessler. Seven miles west of Round Rock, on divide between Lake Brushy and Running Brushy Creek, Williamson County, Tex. Washita group.
76	452	R. T. Hill, 1886? Two miles south of Round Rock, Williamson County, Tex. Washita group.
77	1625	R. T. Hill and T. W. Stanton, 1895. About 12 miles northwest of Austin, Travis County, Tex. Comanche Peak limestone.
77	18495	R. T. Hill and T. W. Vaughan, 1894. Near summit of Jollyville Divide, near head of Cypress Creek, 18 miles from Austin, Travis County, Tex. Fredericksburg group?.
78	18453	R. T. Hill and T. W. Vaughan, 1894. Between Bee Creek and Pedernales River on road from Bee Caves to Corwin, Travis County, Tex. Glen Rose limestone.
78	18496	R. T. Hill and T. W. Vaughan, 1894. Pedernales River bluff, crossing of road from Bee Caves to Corwin, Travis County, Tex. Glen Rose limestone.
79	18455	R. T. Hill and T. W. Vaughan, 1894. Near Corwin road to Pedernales River and Bee Caves, Travis County, Tex. Glen Rose limestone.
80	18469	R. T. Hill and T. W. Vaughan, 1894. Boundary Mountain, 21 miles west of Austin, Blanco quadrangle, Tex. Fredericksburg group.
80	18478	T. W. Vaughan, 1894. Hill about 1 mile south of Round Mountain, Travis County, Tex. Walnut clay.
81	436a	R. T. Hill, 1886. Shoal Creek, Austin, Travis County, Tex. Buda limestone.
81	438	R. T. Hill, 1886. Mount Bonnell, Travis County, Tex. Georgetown limestone, 100 feet above Colorado River.
81	1603	R. T. Hill and T. W. Stanton, 1895. Mount Barker, west of Austin, Travis County, Tex. Comanche Peak limestone.
81	1608	T. W. Stanton, 1895. Railroad cut near West Pecan Street, Austin, Travis County, Tex. Georgetown limestone.

Localities at which gastropods and pelecypods were collected from the Comanche series—Continued

No. on fig. 1	Geological Survey Mesozoic locality	Collector, year of collection, description of locality, and stratigraphic assignment
81	1794	T. W. Stanton, 1897. Stone bridge across Bartons Creek, about 2 miles southwest of Austin, Travis County, Tex. Edwards limestone.
81	1795	T. W. Stanton, 1897. Bartons Creek, 3 to 4 miles above its mouth, near Austin, Travis County, Tex. Edwards limestone.
81	18454	T. W. Vaughan, 1894. Anderson Bend, Colorado River, about 20 miles west of Austin, Tex. Glen Rose limestone.
81	18456	T. W. Vaughan and G. B. Shattuck, 1894. Top of High Bluff, south side of Bartons Creek, half a mile above Bartons Springs, Travis County, Tex. Georgetown limestone.
81	18457	T. W. Vaughan, 1894. Hill on roadside, about 2 miles from Austin near Bartons Creek, Travis County, Tex. Washita group.
81	18458	R. T. Hill, 1894. Near Bartons Creek on Oatmanville road, Travis County, Tex. Georgetown limestone.
81	18459	G. B. Shattuck, 1894. Near 7-mile post west of Austin, Travis County, Tex. Fredericksburg group.
81	18463	T. W. Vaughan, 1894. Northwest corner of C. Thiel's pasture, near Austin, Travis County, Tex. Fredericksburg group.
81	81464	R. T. Hill and T. W. Vaughan, 1894. Near south side of Taylors Creek, Travis County, Tex. Georgetown limestone.
81	18465	R. T. Hill, 1894. Mount Bonnell, old river road, near Austin, Travis County, Tex. Georgetown limestone.
81	18466	R. T. Hill, 1894. Shoal Creek, Austin, Travis County, Tex. Del Rio clay.
81	18467	Val Giles, 1894. Opposite Bartons Springs, from bed of creek emptying into Bartons Creek at dam near Austin, Travis County, Tex. Georgetown limestone.
81	81468	R. T. Hill, 1894. Seven and a half miles west of Austin, Travis County, Tex. Comanche Peak limestone.
81	18471	G. B. Shattuck, 1894. Bartons Springs mill, near Austin, Travis County, Tex. Georgetown limestone.
81	18473	R. T. Hill, 1894. Fault line near Spicewood Springs, Travis County, Tex. Comanche Peak limestone.
81	18474	R. T. Hill and T. W. Vaughan, 1894. International-Great Northern Railroad cut, between Austin and dam, Travis County, Tex. Georgetown limestone.
81	18475	R. T. Hill and T. W. Vaughan, 1894. Elbow on south side of Bartons Creek between Oatmanville and Bee Caves, Travis County, Tex. Glen Rose limestone.
81	18476	R. T. Hill and T. W. Vaughan, 1894. Hill between Oatmanville and Bartons Creek, Travis County, Tex.
81	18477	R. T. Hill and T. W. Vaughan, 1894. Hill south of Bartons Creek, Travis County, Tex.
81	18480	T. W. Vaughan, 1894. Hillside south of Round Mountain, Travis County, Tex. Glen Rose limestone.
81	18481	R. T. Hill and T. W. Vaughan, 1894. Near Austin, Tex. Georgetown limestone.
81	18482	R. T. Hill, 1894. Near Austin, Tex. Edwards limestone (?).
81	18483	T. W. Vaughan and G. B. Shattuck, 1894. High bluff above ford, on west side of Colorado River above mouth of Bartons Creek, near Austin, Travis County, Tex. Edwards limestone.
81	18484	G. B. Shattuck, 1894. Fish Pond Point, near Bartons Springs, Austin, Travis County, Tex.
81	18485	R. T. Hill or T. W. Vaughan, 1894. Travis County, Tex. Glen Rose limestone.
81	18486	T. W. Vaughan, 1894. Nine miles from Austin on the Bee Caves road, Travis County, Tex. Fredericksburg group.
81	18487	R. T. Hill, 1894. Fault near Sieders Spring, Travis County, Tex. Georgetown limestone(?).
81	18489	R. T. Hill, 1894. Nine miles from Austin on the Bee Caves road, Travis County, Tex. Fredericksburg group.
81	18491	G. B. Beck, 1894? Travis County, Tex. Glen Rose formation.
81	18500	R. T. Hill, 1894. White Nose Peak, west of Oatmanville, Travis County, Tex. Fredericksburg group(?).
81	18501	R. T. Hill or T. W. Vaughan, 1895. Taylors Bluff, Bartons Springs, near Austin, Travis County, Tex.
81	18502	R. T. Hill, 1894. International Railroad cut west of Austin, Travis County, Tex. Georgetown limestone.
81	18505	T. W. Vaughan, 1894. Opposite Bartons Springs, from bed of creek emptying into Bartons Creek at dam near Austin, Travis County, Tex. Georgetown limestone.
82	18461	C. H. Stuver, 1894. Johnsons Branch of Bear Creek, Hays County, Tex. Glen Rose limestone.

Localities at which gastropods and pelecypods were collected from the Comanche series—Continued

No. on fig. 1	Geological Survey Mesozoic locality	Collector, year of collection, description of locality, and stratigraphic assignment
83	18472	R. T. Hill and T. W. Vaughan, 1894. Bear Creek near Hays-Travis County line, Tex. Comanche Peak limestone.
83	18504	R. T. Hill and T. W. Vaughan, 1894. South side of Bear Creek, on Manchaca and Cedar Valley road, near Hays-Travis County line. Edwards limestone.
84	18460	T. W. Vaughan, 1894. Hill near Driftwood Post Office, south of Onion Creek, Hays County, Tex. Glen Rose formation.
84	18462	T. W. Vaughan, 1894. Buda and Driftwood road, north side of Onion Creek, half a mile from crossing, Hays County, Tex. Glen Rose limestone.
84	18470	T. W. Vaughan, 1894. Hill south of Camp No. 6, Hays County, Tex. Glen Rose limestone.
84	18499	R. T. Hill and T. W. Vaughan, 1894. North of Onion Creek, near Driftwood Post Office, Hays County, Tex. Glen Rose limestone.
85	593	C. A. White, 1888. Three miles northwest of New Braunfels, Comal County, Tex. Washita group.
86	1560	T. W. Vaughan and T. W. Stanton, 1895. Hill 1½ miles north of Fredericksburg, Gillespie County, Tex. Walnut and Comanche Peak formations.
86	1563	T. W. Vaughan and T. W. Stanton, 1895. Hill about 3 miles northeast of Fredericksburg, Gillespie County, Tex. Comanche Peak limestone.
87	1627	R. T. Hill and T. W. Stanton, 1895. About 3 miles southwest of Fredericksburg on road to Kerrville, Gillespie County, Tex. Walnut clay and Comanche Peak limestone.
88	1633	T. R. Hill, T. W. Vaughan, and T. W. Stanton, 1895. Eleven or 12 miles southwest of Fredericksburg on road to Kerrville, Gillespie County, Tex. Glen Rose limestone, upper part.
89	1558	R. T. Hill, T. W. Vaughan, and T. W. Stanton, 1895. Wolf Creek, about 9 miles northeast of Kerrville, Kerr County, Tex. Comanche Peak limestone.
89	1564	T. W. Stanton, 1895. Ten miles northeast of Kerrville, Kerr County, Tex. Glen Rose limestone, upper part.
89	1632	R. T. Hill, T. W. Vaughan, and T. W. Stanton, 1895. About 6 miles northeast of Kerrville on road to Fredericksburg, Kerr County, Tex. Edwards limestone.
90	1595	T. W. Stanton, 1895. Quarry 1 mile east of Kerrville, Kerr County, Tex. Glen Rose limestone.
91	1622	T. W. Vaughan, T. W. Stanton, 1895. Guadalupe River, 3½ miles west of Kerrville, Kerr County, Tex. Glen Rose limestone.
92	1557	T. W. Vaughan, and T. W. Stanton, 1895. One to two miles east of Merrill's Ranch, about 40 miles west of Kerrville, Kerr County, Tex. Edwards limestone.
92	1628	T. W. Stanton, 1895. One mile east of Merrill's Ranch, Kerr County, Tex. Edwards limestone.
92	1629	T. W. Stanton, 1895. One mile south of Merrill's Ranch, about 40 miles west of Kerrville, Edwards County, Tex. Edwards limestone.
93	1616	R. T. Hill and T. W. Vaughan, 1895. Near 38th milestone from Rock Springs on road to Leakey, Edwards County?, Tex. Washita group, upper part.
94	1941	T. W. Stanton, 1898. High bridge across the Pecos River on the Galveston, Harrisburg & San Antonio Railroad, 3 miles east of Shumla, Val Verde County, Tex. Devils River limestone, upper part.
94	1945	T. W. Stanton, 1898. Top of bluffs on old stage road east of Pecos River near mouth, Val Verde County, Tex. Del Rio clay.
94	1946	T. W. Stanton, 1898. Painted Caves, on the Rio Grande, 1 mile below mouth of Pecos River, Val Verde County, Tex. Devils River limestone, upper part.
94	11883	T. W. Stanton, 1923. On highway grade on east side of Pecos River bridge, Val Verde County, Tex. Devils River limestone, about 90 feet below top.
95	1594	T. W. Vaughan and T. W. Stanton, 1895. Bed of west fork of Nueces River, opposite mouth of Bluff Creek, 1 mile below Kickapoo Springs, Edwards County, Tex. Comanche Peak limestone.
95	1597	T. W. Stanton, 1895. Bed of west fork of Nueces River, near Kickapoo Springs, Edwards County, Tex. Comanche Peak limestone.
95	1598	T. W. Vaughan and T. W. Stanton, 1895. Bed of creek at upper spring, Kickapoo Springs, Edwards County, Tex. Edwards limestone.
95	1601	T. W. Vaughan and T. W. Stanton, 1895. North bluff of Bluff Creek, half a mile above mouth, near Kickapoo Springs, Edwards County, Tex. Edwards limestone, 150 feet above base.
96	4090	T. W. Stanton, 1906. Devils River near mouth of Rough Canyon, on Belcher Ranch, about 20 miles northwest of Del Rio, Val Verde County, Tex. Devils River limestone, top of bluff 260 feet high.

Localities at which gastropods and pelecypods were collected from the Comanche series—Continued

No. on fig. 1	Geological Survey Mesozoic locality	Collector, year of collection, description of locality, and stratigraphic assignment
97	1515	T. W. Vaughan and T. W. Stanton, 1895. Near San Felipe Springs, Del Rio, Val Verde County, Tex. Devils River limestone, upper 20 feet.
98	1487	R. T. Hill, T. W. Vaughan, and T. W. Stanton, 1895. About 12 miles north of Brackettville on road to Kickapoo Springs, Kinney County, Tex. Devils River limestone.
99	1615	R. T. Hill, T. W. Vaughan, and T. W. Stanton, 1895. West fork of Nueces River, at northern edge of Brackettville limestone sheet, Kinney County, Tex.
100	1609	T. W. Vaughan, T. W. Stanton, 1895. Butte near Arnold's Ranch on East Nueces River above Montell, Uvalde County, Tex. Comanche Peak limestone.
101	1604	T. W. Vaughan, 1895. Scarp southeast of Pinto Creek, half a mile east of road north from Brackettville, Kinney County, Tex. Del Rio clay and Buda limestone.
102	1882	T. W. Vaughan, 1898. Silver mine (Blocker), old shaft, about 12 miles northeast of Uvalde, Uvalde County, Tex. Del Rio clay.
103	1585	Frank Burns, 1895. Cleburne, Tex. Grayson marl.

SYSTEMATIC DESCRIPTIONS

PELECYPODA

Genus OSTREA Linnaeus, 1758

Ostrea (Lopha) alternans Cragin

Plate 10, figures 1, 2, 7

1893. *Ostrea alternans* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 198.

1928. *Alectryonia alternans* Cragin. Adkins Texas Univ. Bull. 2838, p. 103.

Original description:

Commonly agglomerate, between a half and a third of the dimensions of *O. subovata* Shum., and relatively shorter than that species in the direction of its height, ovate to rhomboidal, inequivalve, 8–12 radiate-plicate, the folds bold and acute, posterior border usually having an ear, or wing-like angle, a little below the beaks and which is often separated from them by an emargination, a small wing or lobe being also sometimes developed on or about the middle of the posterior border; adductor scar situated beyond the middle of the valve; upper valve nearly flat, rather thin, rugose-wrinkled, distinctly radiate-plicate near the margin only, anterior and posterior edges not milled; lower valve thicker, deeply excavated, plicate over the entire valve, anterior and posterior borders without pronounced intra-marginal sulci; ligamental area triangular, less ample than in *O. subovata*, erect and pointed or posteriorly recurved, according as the beaks vary from pyramidal to exogyrate.

Measurements: Height 61, length 47, breadth 26 mm.

Occurrence: Taken from the alternating Glen Rose beds of Sandy Creek, Travis County, about 100 feet below the main bed of *Exogyra texana*, and 12 miles northwest of Burnet, by Messrs. Taff and Drake. Also at Double Mountain by Messrs. Dumble and Cummins; in the latter locality associated at one station with *Ostrea crenulimargo stonewallensis*.

Occasional examples of this species bear superficial resemblance to a certain large phase of *O. crenulimargo stonewallensis*, but may be readily distinguished from it by the absence of the narrow marginal sulcus seen in the lower valve and of the milled edge seen in the upper valve of *stonewallensis*, as also usually by the presence of a distinct posterior wing, etc.

The exogyrate phase of *O. alternans* is not likely to be confused with any other ostreid; but it may not always prove easy to distinguish specimens with triangular and only slightly deflected beaks from young, adnate shells of *Ostrea subovata*. Usually, however, if not always, the beaks of *O. alternans*, when not exogyrate, are more pointed and the hinge area is more acutely triangular than in the nearly half-grown or correspondingly sized specimens of *subovata*, while the attached valve is more deeply excavated than in the latter; and the posterior wing, while sometimes present in *subovata* also usually has a different position from that in *alternans*.

The specimens figured are part of the original type lot in the Texas State collection at Austin.

Ostrea (Arctostrea) carinata Lamarck

Plate 7, figures 8–13

Foreign synonymy follows:

1869. *Ostrea carinata* Lamarck. Coquand, Monographie du genre Ostrea, terrain crétacé, p. 129, pl. 49, figs. 3–9, Marseilles.

1910. *Alectryonia (Arctostrea) carinata* (Lamarck). Pervinquière, Palaeontologia Universalis, fasc. 2, sér. 3, fiches 197a, 197b (types).

1913. *Ostrea diluviana* Linnaeus (part). Woods, Cretaceous Lamellibranchia of England, vol. 2, pt. 9, p. 342, Palaeontographical Soc. Mon. (Woods has apparently placed together several similar species).

North American synonymy follows:

1849. *Ostrea carinata* Lamarck. Roemer, F., Texas, p. 394, Bonn.

1852. *Ostrea carinata* Lamarck. Roemer, F., Die Kreidebildungen von Texas, p. 75, pl. 9, fig. 5, Bonn.

1857. *Ostrea carinata* Lamarck. Conrad, U. S. and Mex. Boundary Survey Rept., vol. 1, pt. 2, p. 156, pl. 10, fig 6.

1884. *Ostrea carinata* Lamarck. White, U. S. Geol. Survey 4th Ann. Rept., p. 293, pl. 43, figs. 1–4.

1901. *Ostrea (Alectryonia) carinata* Lamarck. Hill, U. S. Geol. Survey 21st Ann. Rept., pt. 7, pl. 36, fig. 2.

1910. *Ostrea (Alectryonia) carinata* Lamarck. Böse, Inst. geol. México Bol. 25, p. 104, pl. 16, figs. 13, 14.

1911. *Alectryonia carinata* Lamarck. Whitney, Texas Univ. Bull. 184, p. 12, pl. 1, figs. 1, 2.

1920. *Ostrea (Alectryonia) carinata* (?) Lamarck. Adkins and Winton, Texas Univ. Bull. 1945, p. 59, pl. 16, figs. 2–5.

1920. *Ostrea carinata?* Lamarck. Adkins, Texas Univ. Bull. 1856, p. 122.

1925. *Ostrea carinata* Lamarck. Winton, Texas Univ. Bull. 2544, p. 57, pl. 8, fig. 3.

1927. *Ostrea carinata* Lamarck. Bybee and Bullard, Texas Univ. Bull. 2710, p. 50, pl. 7, fig. 7; pl. 9, fig. 1.

1928. *Alectryonia (Arctostrea)* sp. aff. *A. carinata* (Lamarck). Adkins, Texas Univ. Bull. 2838, p. 105, pl. 16, fig. 3.

Shell of moderate size, nearly or quite equivalve, very slender, more or less strongly curved, especially near the extremities, with variable, in some specimens nearly obsolete, ear-like expansions near the beaks; valves deep and capacious, becoming very thick in old age, flattened in a rather broad band down the middle and also on the sides, resulting in an almost rectangular cross section for the two valves united, except that the side on the outer curvature of the shell is slightly convex; surface very strongly plicate with 25 to 40 or more ribs which radiate from an irregular median line, are at first rounded, sinuous, directed obliquely backward, and dichotomously branched one or more times on the median flattened area, and then become much more prominent and angular and pass straight across the side to the margin where they form deep serrations that interlock with those on the other valve; ribs commonly bearing tubercles, or even small spines, which are arranged in several irregular rows on the outer convex side of the shell, are commonly absent on the inner side, and are most prominent on the left valve near the attached beak.

The largest specimen figured measures 87 mm. in length (or 102 mm. if measured around the curvature), 20 mm. in breadth, and 24 mm. in thickness. The example from Texas figured by Roemer was

about 150 mm. in length measured around the curvature, or 104 mm. directly across. According to Stoliczka 120 to 150 mm. in length is large for the European specimens, and he cites one from India 150 mm. long and 80 mm. thick. The thickest Texas specimen seen, a left valve, measures 23 mm., which would give the shell a total thickness of about 45 mm. The test itself in this specimen is 17 mm. thick, showing that the increased thickness of the whole shell adds little to the size of the cavity.

The Texas specimens of this species, of which about 75 have been examined, vary considerably in the amount of curvature of the shell, the number of ribs, and the extent to which tubercles and spines are developed. A few examples from the vicinity of Austin, in Travis County, and from Bell County, show variation in the sculpture of the middle flat area of the shell along which for considerable distances the ribs branch from two pallial, longitudinal ribs separated by a narrow channel. All agree in the possession of a median flattened band which, except in the specimens just cited, cannot be called chambered or excavated.

In most specimens the interior of the shell is undulated in correspondence to the external sculpture, but in old, thickened individuals the interior is almost smooth. The muscular impressions are large, prominent, and situated very near the beak and the side of the shell. The attachment of the ligament in the left valve is marked by a deep oblique or curved groove bordered on each side by a ridge, and in the right valve it is marked by a broad, slightly elevated surface.

Roemer (1852, p. 75, pl. 9, fig. 5) gives an excellent brief description of this form, but his figure of an unusually large specimen is apparently somewhat inaccurate, as it differs in several respects from any of the specimens in the collections now studied. This figure was copied by Conrad, and by Coquand, who was doubtless misled by it when he referred the form to *Ostrea pectinata* Lamarck, from which the Texan shell really differs much more than from European examples of *O. carinata*. Roemer's figure was also copied by White, but he added three accurate figures drawn from another specimen. It has been reproduced with two of White's figures by Hill and Vaughan (1898a, pl. 56, fig. 1a).

Comparison of these Texan shells with examples of *Ostrea carinata* from the Cenomanian of Germany and France shows no essential differences and justifies Roemer's identification. However, Adkins (1928, p. 105) considers that they comprise at least two species distinct from *O. carinata* Lamarck of Europe.

No described American species is closely related to this one, but some imperfect examples of a form that is probably distinct have been collected in the Quitman formation near the south end of the Quitman Mountains, Hudspeth County, Tex. It appears to be a somewhat broader, more robust form, but the material is too fragmentary to characterize.

Plesiotypes: U.S.N.M. 103185a-e.

The species is widespread throughout the area of outcrops of the Washita group and has been recorded from the Fredericksburg group.

Ostrea crenulimargo Roemer

Plate 1, figures 1–15

1852. *Ostrea crenulimargo* Roemer, Die Kreidebildungen von Texas, p 76, pl. 9, figs. 6a–b, Bonn.

1869. *Ostrea crenulimargo* Roemer. Coquand, Monographie du genre Ostrea, terrain crétacé, p. 55, pl. 25, figs. 7, 8, Marseilles.

1884. *Ostrea crenulimargo* Roemer. White, U. S. Geol. Survey 4th Ann. Rept., p. 294, pl. 33, figs. 8, 9.

1893. *Ostrea crenulimargo* Roemer. Cragin, Texas Geol. Survey 4th Ann. Rept., p. 201, pl. 45, fig. 6.

1893. *Ostrea crenulimargo* Roemer. var. *stonewallensis* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 202, pl. 45, figs. 1–5.

1928. *Ostrea crenulimargo* Roemer. Adkins, Texas Univ. Bull. 2838, p. 100.

Translation of original description:

Shell triangular, not very convex; upper free valve triangular, with the outline angularly emarginate; surface covered with irregular, finely crenulated growth-lines that follow the angulations of the outline; inner surface smooth, little excavated, showing a deep semicircular muscular impression and beautifully crenulated on the margin.

The above description is drawn especially from the specimen represented by figures 6a, 6b. Other examples present which also show the characteristic crenulation of the margin differ considerably in form and convexity of the shell among themselves as well as from the figured specimen, and indeed this variation seems here to be especially dependent on the form and size of the body to which the lower valve is attached.

Occurrence: Not common near Fredericksburg.

Explanation of the figures: Figure 6a, exterior of the best preserved specimen of the upper valve; figure 6c interior of the same specimen.

It is evident that the author did not have specimens of the lower valve sufficiently well-preserved to characterize it fully, though he recognized the great variability of the species. When it is remembered that the lower valve of oysters and other attached forms is always much more variable than the free valve it will be seen that this species may well include the variety *stonewallensis* which was separated as a distinct variety, with some doubt, by Cragin. The variety itself, as he described and illustrated it, includes many forms; and some specimens, like that represented by figure 2 on plate 1, from the same locality, are almost exact duplicates of Roemer's original figure.

The variety *stonewallensis* was based on speci-

mens from Double Mountain, Stonewall County, Tex.; other specimens, from Forestburg, Montague County, were referred to the typical form of the species by Cragin, who attempted to point out features by which they may be distinguished, although he recognized the difficulties in separating them, as is shown by the following statement:

> The Double Mountain Ostrea was adjudged by the late author of *O. crenulimargo*, to whom specimens were submitted only a short time before his death, to be distinct from any known species; but while the central and prevailing aspects of this *Ostrea* and of that from Forestburg are sufficiently distinct, certain extremes, as above shown, closely approach each other, and it is not improbable that the two forms belong to a single species.

After studying the collections of the Texas Geological Survey and a large suite of specimens from the region southwest of Gainesville, near Forestburg, I am convinced that Cragin was right in suggesting that "the two forms belong to a single species," and it seems to me that they should not be separated even as varieties.

It is difficult to draw up a description of such a variable species that will define it and yet include all the forms that properly belong to it, though Cragin's description of the variety *stonewallensis* is fairly successful if applied to the species as a whole. The species is invariably of small to medium size, seldom exceeding 50 mm. in its greatest dimension and averaging probably not more than 35 or 40 mm. The most common form is rather stout triangular in outline. The left valve is moderately convex and is marked by 4 to 8 strong radiating plications, some of which extend beyond the margin in more or less well-marked digitations, especially on the anterior side. The surface also bears irregular lines and ridges of growth. The upper valve is flat or slightly convex; some show a few well-marked plications, but most are marked only by lines of growth which may be finely crenulate like the interior margins of the valve. The outline of the upper valve is ordinarily entire, but in some specimens it is broken by projections and digitations corresponding to those on the lower valve, but less prominent. The interior of the valve is commonly finely crenulated or "milled" on the margin, in some valves, around the whole free border—as in Roemer's type, but commonly only on the anterior and posterior, not the ventral borders. This crenulation forms vertical striae across the edges of the valve as it grows thicker with age. It is never very distinctly marked, and on most lower valves is obsolete.

The outline of the shell is normally triangular; but by increase of the lateral deflection of the beaks the outline becomes more exogyrate, or if this is accompanied by an excessive promulgation of the posterior angle it assumes a falcate form. The radiating sculpture varies in depth in all these forms, but in the very slender falcate forms it is mostly confined to the anterior portion of the shell, and in some triangular forms almost disappears. The specimens figured indicate the limits of variation.

Some of the falcate and exogyrate specimens resemble extreme variations of the forms described by Cragin (1893, p. 186, pl. 45, figs. 7–10) as *Exogyra hilli* and *E. weatherfordensis*, and suggest relationships in that direction, but the great majority of specimens of *Ostrea crenulimargo* are very different. Several of the forms from the Trinity group of Arkansas, figured by Hill (1888, pl. 5, figs. 1–10; pl. 7, fig. 30) as the young of *O. franklini*, but referred by Cragin (1893, p. 186) to *E. hilli*, are very similar in form to such specimens of *O. crenulimargo* as those represented on plate 1, figures 5, 6, 11, and 12. It seems to me probable that all the species and varieties named are very closely related, but the series is not sufficiently complete for demonstration of their exact relationships.

Another species supposed to be very closely related to, if not identical with, *O. crenulimargo* is *O. quadriplicata* Shumard (1860, p. 608), which does somewhat resemble certain forms of it in outline; but *O. quadriplicata* is a less variable species with a more nearly constant number of strong plications and digitations on the left valve, which also bears numerous fiber radiating lines such as are never seen on *O. crenulimargo*.

Plesiotypes: U.S.N.M. 21767a-e, 103176a-c, 103177a-b.

Locality and position: Roemer's types came from the vicinity of Fredericksburg, Tex., in an undetermined bed which must, however, have been in the upper part of the Trinity group or the lower part of the Fredericksburg group. The specimens described by Cragin were collected at Forestburg in Montague County, and at Double Mountain in Stonewall County, in both places from beds referred to the Glen Rose limestone or Paluxy sand. A large collection obtained by Hill and me on Clear and Blocker Creeks, 20 to 23 miles southwest of Gainesville and not far from the Forestburg locality, came from beds that are referred to the Walnut clay. Specimens have been collected also in beds of Fredericksburg age in the Finlay Mountains, and on the Rio Grande west of the Quitman Mountains in Hudspeth County. The species seems to be confined to the lower part of the Fredericksburg group and the upper part of the Trinity group in Texas.

Ostrea franklini Coquand

Plate 2, figures 1–11

1852. *Ostrea* sp. ind. Roemer, Die Kreidebildungen von Texas, p. 76, Bonn.

1860. *Ostrea cretacea* Morton. Owen, Second report geol. reconnaissance of Arkansas, pl. 7, figs. 3a, 3b, 7, Philadelphia.
1869. *Ostrea franklini* Coquand, Monographie due genre Ostrea, terrain crétacé, p. 53, pl. 23, figs. 8–10, Marseilles.
1884. *Ostrea franklini* Coquand. White, U. S. Geol. Survey 4th Ann. Rept., p. 296, pl. 39, figs. 1–3.
1888. *Ostrea franklini* Coquand. Hill, Arkansas Geol. Survey Ann. Rept. for 1888, vol. 2, p. 131, pl. 5, figs. 10–18; pl. 6, figs. 19–25; pl. 7, figs. 28, 30. (The other figures on plates 5 and 7 probably do not belong to this species.)
1893. *Ostrea franklini* Coquand. Hill, Biol. Soc. Washington Proc., vol. 8, p. 23.
1893. *Ostrea franklini* Coquand. Cragin, Texas Geol. Survey 4th Ann. Rept., p. 203.
1895. *Ostrea franklini* Coquand. Cragin, Am. Geologist, vol. 16, p. 373.
1906. *Ostrea franklini* Coquand. Veatch, U. S. Geol. Survey Prof. Paper 46, pl. 4, figs. 1, 1a–1d.
1928. *Ostrea franklini* Coquand. Vanderpool, Jour. Paleontology, vol. 2, No. 2, p. 99, 3 figs. on pl. 12.
1928. *Ostrea franklini* Coquand. Adkins, Texas Univ. Bull. 2838, p. 101.
1929. *Ostrea franklini* Coquand. Dane, Arkansas Geol. Survey Bull. 1, p. 14, pl. 4, figs. 1–5.

Translation of Coquand's description:

Shell ostreiform, oval, pointed, elongate, slightly oblique, inequivalve; lower valve convex, rounded at the base, very pointed at the beak, ornamented by very closely arranged concentric striae; upper valve shorter than the other, flat, pointed at the beak, ornamented by concentric striae.

This species, though showing some relations with *O. cretacea*, is separated from it by its much more pointed form, by its non-lamelliform striae, and especially by the absence of longitudinal ribs.

It is Campanian and comes from Arkansas.

This description was based entirely on Owen's published figures of some oysters from Arkansas which he considered identical with Morton's Upper Cretaceous *Ostrea cretacea* from Alabama. Owen's work on his Arkansas report was terminated by his death before the paleontological part was completed, and the three plates that had been prepared to illustrate the invertebrate fossils were published with only the names of species, unaccompanied by descriptions. Three specimens, though not those figured, from his collection now in the National Museum leave no doubt as to the identity of the species and its distinctness from *Ostrea cretacea* Morton. They are labeled "Hempstead County, Arkansas," which adjoins Pike County, where Hill made the large collections of this species described by him in 1888. An average-sized specimen from this region measures about 46 mm. in length, 28 mm. in greatest breadth, and 16 mm. in convexity of the two valves united.

Naturally Coquand could not recognize the great amount of variation shown by this species, and one of the features on which he relied for its separation—the absence of longitudinal or radiating ribs—does not hold good, because a few specimens were found in which plications are shown more or less distinctly.

The typical form, as figured by Owen and copied by Coquand and White, is very common in western Arkansas. Its most prominent characteristics are its small size, slender, more or less arcuate form, very narrow pointed beaks—that of the lower valve extending far beyond the upper valve—the moderate convexity of the valves, and the comparatively smooth surface. The variations from this form are toward a greater size, stouter and more irregular form, greater or less lateral curvature, greater convexity, and the development of rather faint radial plications. Rarely the form is very long and slender, one specimen measuring 72 mm. in length, 17 mm. in greatest breadth, and 8 mm. in convexity.

Though this considerable variability is conceded, it does not seem to me great enough to allow all the forms figured by Hill under the name *Ostrea franklini* to be considered mere individual variations. Some of the small, rather strongly plicate specimens with distinctly exogyrate beaks, that he figured as the young of this species, seem really to belong to a distinct species of *Exogyra*, though it is true that occasional undoubted examples of *O. franklini* do show more or less marked exogyrate features in their early stages. The largest specimen figured also seems to deserve recognition as at least a separate variety, and it has been assigned by Cragin (1893, p. 199) to a distinct species under the name *O. camelina*. The existence of abundant intermediate forms in the Trinity group in Texas has led me to treat it as only a variety, for which Cragin's name is retained.

In reviewing Hill's Arkansas report, Marcou (1889, pp. 357–367) compared his figures of *Ostrea franklini* with a number of European Jurassic species, and in several cases made identifications with them. It is hardly necessary to say that these identifications are not justified and must be credited to Marcou's over-zealous search for evidence of the Jurassic age of the Comanche series.

Types: 3 specimens from Owen's type lot, U.S.N.M. 20253a-c; plesiotypes, 22548a-f, 22597a-b, 22651.

Locality and position: Part of Owen's original collection is labeled "Hempstead County," southwestern Arkansas. The species was collected in abundance by Hill at a number of localities in the neighborhood of Murfreesboro, Ark., from beds now known to be equivalent to the Glen Rose limestone of Texas. The Glen Rose has yielded the species at many localities, though the typical form there is not generally so abundant as some of the varieties.

Cragin reports numerous specimens from the Glen Rose limestone in Bosque County, Tex. It is also abundant in the upper part of the Glen Rose limestone, associated with the variety *Ostrea camelina*, at a locality 12 miles south of Weatherford, Parker County, Tex., and small specimens apparently referable to it occur in the same formation 11 miles southwest of Fredericksburg, Gillespie County, Tex., on the road to Kerrville. Doubtless it may be found in the same formation at many other localities. *Ostrea kiowana* Twenhofel, from the Kiowa shale of southern Kansas, is difficult to separate from *O. franklini;* the beaks of *O. kiowana* are generally not so narrow and pointed, and some specimens have the margins near the beaks crenulated on the interior, a feature that has not been noticed in *O. franklini* from Arkansas and Texas.

Ostrea franklini ragsdalei Hill

1893. *Ostrea franklini ragsdalei* Hill, Biol. Soc. Washington Proc., vol. 8, p. 23, pl. 1, fig. 6.
1901. *Ostrea ragsdalei* Hill, U. S. Geol. Survey 21st Ann. Rept., pt. 7, pl. 21, fig. 1.
1928. *Ostrea franklini* var. *ragsdalei* Hill. Adkins, Texas Univ. Bull. 2838, p. 101.

Original description:

Shell acuminate, oblong, marked by numerous, regular longitudinal costae; beak of large valve prolonged, costate, subcylindrical.

Several incomplete specimens of the larger valve of this species were procured from the fauna at the plant bed near Glen Rose. The outline is somewhat similar to that of *O. franklini* Coquand, but the larger valve is much more round, the point more prolonged and characterized by the strong costae which do not appear upon the adult specimens of the *O. franklini* elsewhere found.

The variety is named for Mr. G. H. Ragsdale, the naturalist, of Gainesville, Texas.

Thus far this variety has only been found [in the Glen Rose limestone] at Glen Rose.

Ostrea franklini camelina Cragin

Plate 3, figures 1–3; plate 4, figures 1–4

1888. *Ostrea franklini* Hill (part), Arkansas Geol. Survey Ann. Rept. for 1888, pl. 7, figs. 29, 29a.
1893. *Ostrea camelina* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 199.
1928. *Ostrea camelina* Cragin. Adkins, Texas Univ. Bull. 2838, p. 100.

This variety is ordinarily considerably larger than the typical form of the species, stouter and more robust in its proportions and relatively much more capacious. The left valve is very convex and on account of irregularities of growth generally shows more or less of a protuberance or hump near the middle, a feature that seems to have suggested the name. Some left valves also have a more or less distinct posterior lobe such as is common in species of *Gryphaea*. Some right valves are flat, and others are irregularly convex, but all are less convex than the left valve. The surface has the same variations as in the typical variety, some individuals showing obscure radial plications and thus approaching the variety *ragsdalei*.

One of the type specimens in the Texas State collection (pl. 4, fig. 1), a left valve, measures 91 mm. in length, 65 mm. in greatest breadth, and 40 mm. in convexity of the single valve.

Types: Cotypes in Texas State collection at Austin; plesiotypes, U.S.N.M. 103178a-d.

Locality and position: Cragin reports the variety from the Trinity group of Burnet, Travis, Hood, and Erath Counties, Texas, and of Pike County, Ark. The Geological Survey collections contain specimens from the Glen Rose limestone 12 miles south of Weatherford in Parker County, from Glen Rose in Somervell County, from the Travis Peak formation on Cow Creek near Travis Peak Post Office in Travis County, from Spanish Creek, Burnet County, Tex.; also 2 miles north of Provo, Sevier County, Arkansas.

Ostrea kansasensis Logan

Plate 6, figures 1, 2, 11, 12

1899. *Ostrea kansasensis* Logan, Kansas Univ. quart., ser. A, vol. 8, p. 88, pl. 20, figs. 9–11.
1899. *Ostrea ellsworthensis* Logan, idem, pl. 21, figs. 1, 2.
1899. *Ostrea willistoni* Logan, idem, p. 89, pl. 21, figs. 5, 6.
1899. *Ostrea canonensis* Logan, idem, p. 90, pl. 21, figs. 3, 4.

Shell small, broadly crescentic to irregularly ovate in outline; beaks somewhat pointed, more or less deflected laterally; lower valve moderately convex; posterior end narrowly rounded; postero-dorsal border concave; antero-ventral border broadly rounded and, in the adult, ordinarily with 4 or 5 more or less prominent digitations or angulations; surface in the early stages, and less commonly in the adult, marked only by irregular lines of growth, but in digitate specimens there are more or less definite, short radiating ribs on the outer portion ending in the marginal digitations.

The shell is relatively thick, the crescentic muscular impressions are deeply excavated, and the margins of the interior of the shell are slightly crenulated.

An average specimen measures 35 mm. in length and 25 mm. in greatest breadth. The corresponding dimensions of a larger digitate specimen are 40 mm. and 32 mm.

The forms of *Ostrea* described under these four names were obtained from the Mentor formation at two localities in Ellsworth County, Kansas, the first and third "near Kanapolis" and the other two at "Coal Canon." They differ considerably among themselves, but after studying two of the types that show the widest divergence (*O. kansasensis* and

O. williston) I am convinced that they all belong to one variable species, and that it is closely related to *O. quadriplicata*. Less perfect specimens from the same region had previously been referred to *O. quadriplicata*, and I suspect that most of the examples of that species cited from the Mentor beds by Professor Cragin and me really belong to *O. kansasensis*. The latter is distinguished chiefly by its somewhat broader form, its less prominent development of digitations and ribs in most specimens, and the absence of radiating lines on the umbonal region. In some respects it combines the characteristics of *O. quadriplicata* and *O. crenulimargo*.

The four names regarded as synonyms all having been published in the same paper, the one that is first on the page is retained for the species.

Locality and position: The types came from the Mentor formation near Kanapolis and at Coal Canon, Kans. There are a few imperfect specimens in the Geological Survey collections from the same formation and general region 4½ miles southwest of Marquette and 3 miles south of Bavaria, Kans.

Ostrea perversa Cragin

Plate 6, figures 5, 8–10

1893. *Ostrea perversa* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 205, pl. 28, figs. 1–6.
1928. *Ostrea perversa* Cragin. Adkins, Texas Univ. Bull. 2838, p. 101.

Original description:

Shell rather thin, equivalve or subequivalve, ovate to oblong, front profile often presenting a single or a double flexure; valves with shallow interior excavation, the exteriors equally or subequally convex, at least on the proximal part, the distal part being somewhat compressed, and at one or two places strongly so, as if pinched between a thumb and a finger; beaks subequal, usually pointed, and, in the young, more or less recurved, becoming at length tortuous or undergoing an apparent change of orientation, as if the growing shell had shifted the side of principal accession from the ventral to the anterior or antero-ventral quarter, the major axis of the shell revolving 45° to 90° from its position in the young; outer surface of valves concentrically striate, with several subdued imbrications, the scar of attachment usually absent or inconspicuous.

The largest cotype measures 93 mm. in length, 61 mm. in breadth, and 26 mm. in convexity.

The original published figures accurately illustrate the types. The lateral twisting of the beaks, somewhat as in *Exogyra*, is a peculiar feature of this otherwise simple species, though as Cragin remarked, it is not certain that this is a constant feature. A very similar change in the direction of growth is seen in many specimens of *Ostrea franklini*, which this form resembles in other respects.

Types: Cotypes supposedly in the Texas State collections at Austin; plesiotypes, U.S.N.M. 103457a-b.

Locality and position: The types are from the Del Rio clay on Shoal Creek, near Austin; from the upper part of the Fort Worth limestone on Buffalo Branch of Nolands River, 3 miles below Cleburne, Johnson County; on the east side of Denton Creek valley opposite Justin, Denton County; and on the south side of Cedar Mills, Grayson County, Tex. The specimens here figured are from the Grayson marl, a quarter of a mile north of Denton Creek and 5 miles northeast of Roanoke, Denton County, Tex.

Ostrea (Lopha) quadriplicata Shumard

Plate 7, figures 1, 2, 5–7

1860. *Ostrea quadriplicata* Shumard, Acad. Sci. St. Louis Trans., vol. 1, p. 608.
1879. *Ostrea quadriplicata* Shumard. White, U. S. Geol. and Geog. Survey Terr. 11th Ann. Rept., p. 275, pl. 5, fig. 6a; pl. 8, figs. 3a, 3b.
1884. *Ostrea quadriplicata* Shumard. White, U. S. Geol. Survey 4th Ann. Rept., p. 299, pl. 43, figs. 5–7.
1895. *Ostrea quadriplicata* Shumard. Cragin, Am. Geologist, vol. 16, p. 374.
1901. *Ostrea quadriplicata* Shumard. Hill, U. S. Geol. Survey 21st Ann. Rept., pt. 7, pl. 37, fig. 4.
1906. *Ostrea quadriplicata* Shumard. Veatch, U. S. Geol. Survey Prof. Paper 46, pl. 7, figs. 4, 4a, 4b.
1910. *Ostrea quadriplicata* Shumard. Böse, Inst. geol. México Bol. 25, p. 101, pl. 16, figs. 1–12.
1920. *Ostrea quadriplicata* Shumard. Adkins and Winton, Texas Univ. Bull. 1945, p. 60, pl. 16, figs. 6–10.
1920. *Ostrea (Alectryonia) quadriplicata* Shumard. Adkins, Texas Univ. Bull. 1856, p. 123.
1924. *Ostrea quadriplicata* Shumard. Twenhofel, Kansas Geol. Survey Bull. 9, p. 78, pl. 16, fig. 4.
1925. *Ostrea quadriplicata* Shumard. Winton, Texas Univ. Bull. 2544, p. 58, pl. 8, fig. 1.
1927. *Ostrea quadriplicata* Shumard. Bybee and Bullard, Texas Univ. Bull. 2710, p. 51, pl. 7, figs. 8, 9.
1928. *Alectryonia quadriplicata* (Shumard). Adkins, Texas Univ. Bull. 2838, p. 104, pl. 16, fig. 1.

Shell small, rather slender, more or less strongly arcuate or falcate in outline, with several digitations on the antero-ventral border commonly well-developed in the adult; beaks generally acutely pointed, or in the upper valve slightly subtruncate, and somewhat deflected laterally.

Lower valve moderately convex, with the postero-dorsal slope very abrupt so as to form an angle with the rest of the surface; sculpture in the early stages of growth consisting of rather coarse, irregular, branching radiating lines crossed by distant imbricated lines of growth; when the shell is about half grown 3 to 5 of the radiating lines develop into strong angular ribs that are prolonged beyond the general outline as digitations of considerable length. Upper valve flat or very slightly convex, with the outline much more simple than that of the lower valve but ordinarily more or less

angulated at the points where it meets the digitations of the lower valve; surface commonly marked only by rather prominent lines of growth, but the early stages of some valves bear a few radiating lines corresponding to those on the other valve. Interior of both valves with the margins finely crenulated, the crenulations being more prominent on the upper valve, on the thickened edges of which they form transverse striations; muscular impressions small, subovate, near the margin; ligamental grooves rather narrow, oblique, bordered by narrow ridges.

A specimen somewhat larger than the average measures 40 mm. in length, 22 mm. in breadth, and 15 mm. in convexity of both valves. Many specimens are somewhat stouter, and a few are more slender.

This species has sometimes been confused with *Ostrea crenulimargo*, from which it may be distinguished by its more constant slender, falcate form, its more regularly developed and differently arranged plications and digitations, and especially by the coarse radiating lines that cover most of the surface of the lower valve. It is possible that these two species belong to the same genetic series, but the beds in which they occur are separated by a considerable thickness of strata that have not yielded any similar forms, and the intermediate varieties, if they existed, have not been found.

Plesiotypes: U.S.N.M. 8077, 103180, 103181a-b, 103182.

Locality and position: The types of the species, as originally described by Shumard, came from the "Washita limestone forming the upper part of the bluffs of Red River, Lamar County, and ten miles above the mouth of Kiamesha Creek." The species is abundant in the neighborhood of Denison in Grayson County, where it ranges from the upper layers of the Denton clay through the Pawpaw sandy member and into the Main Street limestone member; it is also common in the same units near Fort Worth in Tarrant County; and it reappears in considerable abundance in the Washita group near Kent in Culberson County, in the gap between the principal peaks at Sierra Blanca in Hudspeth County, where Adkins records it in the Kiamichi formation of the area, and on the Rio Grande 4 miles above El Paso, Tex. It occurs sparingly and not very well preserved in the Purgatoire formation near Mesa Tucumcari, N. Mex,; also in the Kiowa shale near Belvidere, and the Mentor formation at Brookville, Kans. The specimens from Denison and Fort Worth generally have the radiating lines of the lower valve better developed than those from the other regions mentioned.

Ostrea riograndensis Stanton, n. sp.

Plate 5, figures 1, 2

Shell rather large, subovate, the umbonal and ventral margins broadly rounded and the sides nearly parallel; test rather thick; upper valve slightly and irregularly convex with nearly smooth surface; interior of shell with simple margins; ligamental grooves very broad and shallow, with a crescentic elevation in the middle; adductor muscular impressions large, oval, deeply impressed.

One of the types measures 108 mm. in length, and 77 mm. in breadth near the base and 53 mm. near the beak.

This simple *Ostrea* closely resembles some varieties of the Upper Cretaceous *O. glabra* Meek and Hayden (1876, p. 509, pl. 40, figs. 2a-d) and it does not differ greatly from certain forms of the living *O. virginica*, the somewhat heavier shell and broader umbonal region being the most obvious differences.

The types are two upper valves from western Texas, where the lower valves were not found; but a number of specimens from a locality 18 miles southwest of Decatur, Tex., that are provisionally referred to the same species, include several lower valves that are not very much more convex than the upper valve and have beaks more narrow and prolonged. These show considerable variation and irregularity in growth, and some of the valves also differ somewhat from the regular form of the types, but the general aspect and habit of the shells is very similar.

Cotypes: U.S.N.M. 103183a-b.

Locality and position: The types are from the Quitman formation of Taff on the trail from Quitman Arroyo to Hot Springs, south of the Quitman Mountains in southern Hudspeth County, Tex., where they are associated with *Exogyra quitmanensis* Cragin. The other specimens mentioned are from the Glen Rose limestone 18 miles southwest of Decatur in Wise County, Tex.

Ostrea (Lopha) subovata Shumard

Plate 8, figure 1; plate 9, figures 1, 2

1854. *Ostrea subovata* Shumard, in Marcy, R. B., Exploration of the Red River of Louisiana in the year 1852, U. S. 33d Cong., 1st sess., H. Doc., p. 179, pl. 5, fig. 2.

1857. *Ostrea vellicata* Conrad, U. S. and Mex. Boundary Survey, vol. 1, pt. 2, p. 156, pl. 11, figs. 2a, 2b.

1858. *Ostrea marshii* Marcou (not Sowerby), Geology of North America, p. 43, pl. 4, fig. 4.

1869. *Ostrea subovata* Shumard. Coquand, Monographie du genre Ostrea, terrain crétacé, p. 48, pl. 17, fig. 4, Marseilles.

1884. *Ostrea subovata* Shumard. White, U. S. Geol. Survey 4th Ann. Rept., p. 301.

1893. *Ostrea subovata* Shumard. Cragin, Texas Geol. Survey 4th Ann. Rept., p. 207.
1895. *Ostrea subovata* Shumard. Cragin, Am. Geologist, vol. 16, p. 374.
1910. *Ostrea (Alectryonia) marcoui* Böse, Inst. geol. México Bol. 25, p. 105, pl. 16, fig. 15; pl. 17, fig. 1.
1928. *Alectryonia marcoui* Böse. Adkins, Texas Univ. Bull. 2838, p. 103.
1928. *Alectryonia? subovata* Shumard. Adkins, Texas Univ. Bull. 2838, p. 103.

Shumard's original description:

Subovate, trigonal, elongate, massive; inferior valve irregularly convex, inflated, thick, umbo obtusely angulated, somewhat prominent; ribs four or five, longitudinal, irregular, rounded, nodulose; surface marked with concentric imbricating lamellae; superior valve rather thin, ovate, nearly plain, slightly convex near the beak, surface with four or five well-marked longitudinal sulci.

It occurs at Fort Washita, Indian Territory, with *Gryphaea pitcheri* and *Ammonites vespertinus*. It appears to be quite rare, the specimen figured being the only one furnished by the expedition.

The unsatisfactory drawing of the imperfect type specimen gives a very inadequate idea of the size and sculpture of this species and of course cannot suggest its variability. Marcou published a much better figure, under the name of *O. marshii* Sowerby, of a specimen from Pyramid Mount, N. Mex., where it occurs in beds of the Washita group, which he supposed to be Jurassic.

The species attains a large size, with the two valves similar and subequal, not very convex. The radiating ribs or plications vary considerably from very broad and rounded to rather narrow and more or less angular. They also vary in number from the 4 or 5 shown by Shumard's type to 8 or 9, or in some specimens as many as 11, but this variation is partly due to differences in the size and maturity of the shells, as on large examples the number of ribs is increased toward the margin by branching and by the interpolation of new ribs. The concentric lamellae, which on some specimens are very prominent, are irregularly arranged, being distant over most of the surface and crowded near the margin. There is also much variation in the thickness of the valves.

One of the figured specimens from the neighborhood of Austin, considered a typical example of rather large size, measures 179 mm. in length, 138 mm. in greatest breadth, and about 50 mm. in greatest convexity of the two valves. The corresponding dimensions of the other figured specimen from near Denison are 134 mm. and 32 mm. respectively.

Oysters of this general type, with broad form and coarse plications, were common during the Jurassic and Cretaceous periods. Among these may be mentioned *O. marshii* Sowerby (1814, p. 103, pl. 48), of the European Jurassic, with which Marcou identified this species, and *O. engelmanni* Meek and Hayden (1865, p. 73, figs. a and b), from the American Jurassic, from both of which *O. subovata* may be distinguished by differences in outline and sculpture. *Ostrea travisana* Stephenson (1936, p. 4, pl. 2, fig. 5; pl. 3, figs. 1–5) is more convex, has a greater number of more regular plications, and occurs in a much higher formation. *Ostrea dilleri* White (1889, p. 14, pls. 1, 2), from the Chico beds of California, has similar differences.

Plesiotypes: U.S.N.M. 19108, 103184.

Locality and position: The holotype came from Fort Washita, Bryan County, Okla., probably from a horizon near the base of the Washita group. At Denison, Grayson County, Tex., the species is common in the Denton formation. It occurs near Austin and near Waco, Tex., in the Georgetown limestone. At Belvidere, Kans., it locally forms a thick mass in the lower part of the Kiowa shale. Marcou's specimens from Pyramid Mount, N. Mex., came from nearly equivalent beds. Imperfect specimens apparently belonging to the species have been found in the Goodland limestone, about 10 miles from Denison on the road to Preston, Grayson County, and about 20 miles southwest of Gainesville, Cooke County, Tex. At Benbrook, west of Fort Worth, and at Seven Knobs near Glen Rose, Tex., the species is associated with Comanche Peak fossils. It has been found in similar association near El Paso, where a variety with very thick valves and comparatively few plications also occurs in the Grayson (Del Rio) formation. It is possible that the specimen from this place described by Conrad (1857, p. 156, pl. 11, figs. 2a-b) under the name *Ostrea vellicata* is an immature and deformed example of *O. subovata*. Cragin cites several other localities in Texas, Kansas, and New Mexico. Some imperfect specimens that may belong to *O. subovata* were collected in Guadalupe Canyon, near Sycamore Creek, southeastern Arizona.

Ostrea (Lopha) welleri Logan

Plate 7, figures 3, 4

1899. *Ostrea welleri* Logan, Kansas Univ. Quart., ser. A, vol. 8, p. 89, pl. 20, figs. 7, 8.

Shell (upper valve) of moderate size, rather slender, slightly arcuate, with sinuous margin, flat or somewhat concave; beak laterally curved; surface marked by a few irregular, rather coarse plications radiating from the median line, and partly visible on the interior; muscular impression and adjacent parts of the interior finely granular; margin with fine, rather obscure crenulations; ligamental groove broad and shallow.

Length 60 mm, greatest width (below the middle) 29 mm.

This description is drawn from a single upper valve borrowed from W. N. Logan for examination, and apparently one of his types from which his figure 7 was drawn. The two figures now published are from photographs of this specimen. It is evident that in the original description and figure the exterior of the shell was mistaken for the interior.

The species is evidently related to *Ostrea subovata* Shumard, and it is possible that it may prove to be based on the young of that species.

Locality and position: From the Mentor formation near Kanapolis, Ellsworth County, Kans.

Genus GRYPHAEA Lamarck, 1801

Gryphaea corrugata Say

Plate 10, figures 3–6; plate 11, figures 1, 3, 4

For a fairly complete synonomy to 1898 see Hill and Vaughan, U. S. Geol. Survey Bull. 151, p. 53.

1853. *Gryphaea pitcheri* Morton. Shumard, in Marcy, R. B., Exploration of the Red River of Louisiana in the year 1852, U. S. 32d Cong., 2d sess., S. Doc. 54, p. 205.
1884. *Gryphaea pitcheri* White (part, not Morton), U. S. Geol. Survey 4th Ann. Rept., p. 302, pl. 49, fig. 3.
1898. *Gryphaea corrugata* Say. Hill and Vaughan, U. S. Geol. Survey Bull. 151, p. 53, pl. 5, fig. 8; pls. 6, 7; pl. 8, figs. 1–7, 10, 12, 15–17; pls. 9–12; pl. 15; pl. 17, fig. 4; pl. 18, figs. 1–3; pl. 19, figs. 1, 2.
1924. *Gryphaea corrugata* Say. Twenhofel, Kansas Geol. Survey Bull. 9, p. 70, pl. 23, figs. 1, 2.
1928. *Gryphaea corrugata* Say. Adkins, Texas Univ. Bull. 2838, p. 107.

I consider that *Gryphaea hilli* Cragin is a distinct species from *G. corrugata* Say, and probably not in the direct line of descent from *G. mucronata* to *G. corrugata*, but rather that both are independent branches from the *G. mucronata* stock to which the former is more closely related than the latter.

Plesiotypes: U.S.N.M. 28769–71, 28773.

Gryphaea corrugata belviderensis Hill and Vaughan

Plate 13, figures 1, 2

1898. *Gryphaea corrugata* var. *belviderensis* Hill and Vaughan, U. S. Geol. Survey Bull. 151, pp. 56, 57, pls. 9, 10.
1924. *Gryphaea corrugata belviderensis* Hill and Vaughan. Twenhofel, Kansas Geol. Survey Bull. 9, p. 70, pl. 23, fig. 5.
1928. *Gryphaea corrugata* var. *belviderensis* Hill and Vaughan. Adkins, Texas Univ. Bull. 2838, p. 107.

Mature forms of this variety are distinguished from the typical variety of *Gryphaea corrugata* by their larger size, more triangular outline, and flatter form. They are distinguished from *G. corrugata* var. *tucumcarii* by their more pointed apical region, less incurved beak, and less developed radial sinus.

Cotypes: U.S.N.M. 28774.

Localities and position: Kiowa shale of southern Kansas.

Gryphea corrugata tucumcarii Marcou

Plate 14, figure 4; plate 15, figures 13, 14

1851. *Gryphaea tucumcarii* Marcou, in Whipple, U. S. Pacific R. R. Expl. Rept., U. S. 33d Cong., 1st sess., H. Doc. 129, vol. 18, pt. 2, pp. 44–48.
1855. *Gryphaea dilatata* var. *tucumcarii* Marcou, Soc. géol. France Bull., 2e sér., t. 12, p. 880, pl. 21, figs. 1–3.
1858. *Gryphaea dilatata* var. *tucumcarii* Marcou, Geology of North America, pp. 43, 44, pl. 4, figs. 1–3
1895. *Gryphaea tucumcarii* Marcou. Cragin, Am. Geologist, vol. 16, p. 374.
1895. *Gryphaea tucumcarii* Marcou. Stanton, Am. Jour. Sci., 3d ser., vol. 50, p. 216.
1898. *Gryphaea corrugata* var. *tucumcarii* Marcou. Hill and Vaughan, U. S. Geol. Survey Bull. 151, p. 56, pl. 13, figs. 4, 5; pl. 14, figs. 1, 2; pl. 16, figs. 1–3; pl. 17, fig. 5.
1910. *Gryphaea pitcheri* var. *tucumcarii* Marcou. Böse, Inst. geol. México Bol. 25, p. 109, pl. 18, figs. 6–9, 11, 12; pl. 19, figs. 1–14.
1927. *Gryphaea tucumcari* Marcou. Adkins, Texas Univ. Bull. 2738, pl. 4, fig. 1.
1928. *Gryphaea tucumcari* Marcou. Adkins, Texas Univ. Bull. 2838, p. 107, pl. 6, fig. 1.
1939. *Gryphaea pitcheri* Morton var. *tucumcarii* Marcou. Müllerried, Escuela nac. cien. biol., Anales, vol. 1, No. 2, p. 234, Mexico.

Typical forms of this variety are distinguished from *Gryphaea corrugata* var. *belviderensis* by their greater convexity, more incurved beaks, deeper radial sinus, thinner shell, greater basal flare, and more rounded outline. The variety is widespread in northern trans-Pecos Texas and in eastern New Mexico, and has recently been recorded from the State of Hidalgo in southern Mexico.

Plesiotypes: U.S.N.M. 22233.

Gryphaea hilli Cragin

Plate 17, figures 1–4, 6–9

1891. *Gryphaea pitcheri* var. *hilli* Cragin (part), Am. Geologist, vol. 7, p. 181.
1894. *Gryphaea pitcheri* var. *hilli* Cragin (part), Am. Geologist, vol. 14, pp. 6, 10.
1895. *Gryphaea hilli* Cragin, Am. Geologist, vol. 16, pp. 368, 369, 371.
1898. *Gryphaea corrugata* var. *hilli* Cragin. Hill and Vaughan, U. S. Geol. Survey Bull. 151, p. 56, pl. 8, figs. 8, 9, 11, 13, 14.
1924. *Gryphaea corrugata hilli* Cragin. Twenhofel, Kansas Geol. Survey Bull. 9, p. 71, pl. 23, figs. 3, 4.
1928. *Gryphaea corrugata* var. *hilli* Cragin. Adkins, Texas Univ. Bull. 2838, p. 107.

Shell small, rather slender; upper valve ovate to subtriangular in outline, commonly slightly concave and irregularly bent, with rather long lamellae of growth on all except the first stages; lower valve slender, in well-developed specimens with narrow, strongly incurved, slightly deflected beaks; dorsal furrow variable but in most specimens very distinctly marked, though narrow, and separating an

inconspicuous dorsal wing from the body of the shell; growth lines irregular, moderately inconspicuous, generally less prominent than in *Gryphaea mucronata;* rather prominent radiating lines present on many immature forms and on a few adult forms.

One of the largest specimens seen (lower valve) measures 42 mm. in length, 31 mm. in breadth, and 19 mm. in convexity. Corresponding dimensions of an average specimen are probably not more than two-thirds as great.

The nearest relative of this little form is *Gryphaea mucronata* Gabb, (1895a, pp. 368–371) which Cragin identified with it. Specimens may be selected from the 2 species that almost exactly duplicate each other, but taken as a whole *G. hilli* is smaller, smoother, and has the dorsal furrow and wing less developed.

Hill and Vaughan considered it only a variety of *Gryphaea corrugata,* but the collections studied by them did not include any well-developed specimens. The largest one figured by them is much broader and has a better developed wing than the average, and thus resembles the young of *G. corrugata,* but in Comanche Gryphaeas specific identity cannot be proved by comparison of young shells, as Hill and Vaughan have shown.

Cragin was nearer the truth in uniting this species with *Gryphaea mucronata* Gabb (= *G. marcoui* Hill and Vaughan) which must be considered its immediate progenitor. Through it the connection should probably be sought between *G. mucronata* and *G. graysonana,* with *G. navia* as a possible offshoot from the same line. In this connection it may be mentioned that at Kent Station in western Texas a small *Gryphaea,* in many respects intermediate between *G. hilli* and *G. graysonana,* occurs sparingly throughout the Washita group.

Plesiotypes: U.S.N.M. 28772, 103186, 103187.

Locality and position: Very abundant in the region about Belvidere, Kiowa County, Kans., where it makes up a large part of Cragin's Champion Shell-bed, a stratum 1 to 2 feet thick at the base of the Kiowa shale.

Gryphaea navia Hall

Plate 19, figures 1, 2

For synonymy to 1898, see Hill and Vaughan, U. S. Geol. Survey Bull. 151, p. 57.

1898. *Gryphaea navia* Hall. Hill and Vaughan, U. S. Geol. Survey Bull. 151, p. 57, pl. 13, figs. 1–3 (inadvertently referred to *G. corrugata*); pl. 16, fig. 4; pl. 17, figs. 2–4; pl. 18, figs. 4–12.

1901. *Gryphaea navia* Hall. Hill, U. S. Geol. Survey 21st Ann. Rept., pt. 7, pl. 35, fig. 1.

1906. *Gryphaea navia* Hall. Veatch, U. S. Geol. Survey Prof. Paper 46, pl. 7, figs. 1, 1a.

1910. *Gryphaea navia* Hall. Böse, Inst. geol. México Bol. 25, p. 106, pl. 17, figs. 2–9; pl. 18, figs. 1–5, 10.

1920. *Gryphaea navia* Hall. Adkins and Winton, Texas Univ. Bull. 1945, p. 62, pl. 15, figs. 13, 14.

1924. *Gryphaea navia* Hall. Twenhofel, Kansas Geol. Survey Bull. 9, p. 71, pl. 22, figs. 1, 2; pl. 10, fig. 2.

1925. *Gryphaea navia* Hall. Winton, Texas Univ. Bull. 2544, p. 51, pl. 7, figs. 3, 4.

1927. *Gryphaea navia* Hall. Bybee and Bullard, Texas Univ. Bull. 2710, p. 50, pl. 3, figs. 1–3.

1928. *Gryphaea navia* Hall. Adkins, Texas Univ. Bull. 2838, p. 106, pl. 12, fig. 9.

Hall (1856, p. 100, pl. 1, figs. 7–10) and Conrad (1857, p. 155, pl. 7, fig. 3d) both published the name *Gryphaea pitcheri* var. *navia* independently without either making direct reference to the work of the other. Hall's report was published a short time in advance of Conrad's and his figures of the form are copies of Marcou's figures 5, 5b, and 6, thus adopting as his type the carinated form with laterally deflected beaks. (The type of White's *Exogyra forniculata* (1880, p. 293, pl. 4, fig. 384) has precisely the same form.) At the beginning of Blake's geological report, in which Hall's description was published, on a page of additional errata the statement is made that "Mr. Conrad has very recently proposed for the narrow and much incurved variety of *Gryphaea pitcheri* (if it be indeed that species) the name *navia.*" It thus appears that *navia* was Conrad's manuscript name when Hall's description was published. Both these authors referred to Roemer's figure of *G. pitcheri,* evidently intending to include in their variety the form here named *G. graysonana.*

Among the specimens of *G pitcheri* studied by Conrad and now preserved in the National Museum (no. 9880) is one typical example of *G. navia* but the specimen figured by him under that name is an abnormal one without any carina and with the beak only very slightly deflected laterally. This is spoken of by Hill and Vaughan as "somewhat intermediate between *G. corrugata* and *G. navia,* but it is more closely related to the latter species." It may also be compared profitably with the large specimen of *G. mucronata* (pl. 18, figs. 22, 24, 26), and it can be almost duplicated in the collections of *G. graysonana* from the upper part of the Washita group.

Plesiotypes: U.S.N.M. 28780, 28781, 8022.

Gryphaea wardi Hill and Vaughan

Plate 14, figures 1–3, 6–11, 13

1898. *Gryphaea wardi* Hill and Vaughan, U. S. Geol. Survey Bull. 151, p. 49, pl. 1, figs. 1–16.

1928. *Gryphaea wardi* Hill and Vaughan. Adkins, Texas Univ. Bull. 2838, p. 106.

1933. *Gryphaea wardi* Hill and Vaughan. Arkell, Cotteswold Naturalists Field Club Proc., vol. 25, pt. 1, p. 60, pl. 6, figs. 16–24, Gloucester, England.

All the collected specimens of this species are small, deformed, or at least depauperate, like the known examples of *Exogyra paupercula* with which they occur. It is possible that specimens not distinguishable from *Gryphaea mucronata* may yet be found in the Glen Rose formation, but for the present it is necessary to retain as a separate species this obscure oldest representative of the Comanche Gryphaeas.

Cotypes: U.S.N.M. 28775.

Gryphaea mucronata Gabb

Plate 18, figures 1–26

1849. *Gryphaea pitcheri* Roemer (not Morton) (part), Texas, p. 395, Bonn.
1852. *Gryphaea pitcheri* Roemer (not Morton) (part), Die Kreidebildungen von Texas, p. 74 (not the figured specimen), Bonn.
1856. *Gryphaea pitcheri* Blake (not Morton), in Pope, P., U. S. Pacific R. R. Expl. Rept., U. S. 33rd Cong., 2d sess., S. Doc. 78, p. 39.
1869. *Gryphaea mucronata* Gabb (part), California Geol. Survey, Paleontology, vol. 2, p. 274.
1890. *Gryphaea mucronata* Gabb. Heilprin, Acad. Nat. Sci. Philadelphia Proc., p. 452.
1891. *Gryphaea pitcheri* var. *hilli* Cragin (part), Am. Geologist, vol. 7, p. 181.
1898. *Gryphaea marcoui* Hill and Vaughan, U. S. Geol. Survey Bull. 151, p. 50, pls. 2–4; pl. 5, figs. 1–7.
1901. *Gryphaea marcoui* Hill and Vaughan. Hill, U. S. Geol. Survey 21st Ann. Rept., pt. 7, pl. 27, figs. 2a, 2b.
1906. *Gryphaea marcoui* Hill and Vaughan. Veatch, U. S. Geol. Survey Prof. Paper 46, pl. 6, figs. 2a, 2b.
1920. *Gryphaea marcoui* Hill and Vaughan. Adkins and Winton, Texas Univ. Bull. 1945, p. 61, pl. 15, figs. 15–18.
1928. *Gryphaea marcoui* Hill and Vaughan. Adkins, Texas Univ. Bull. 2838, p. 106, pl. 2, fig. 3.
1933. *Gryphaea marcoui* Hill and Vaughan. Arkell, Cotteswold Naturalists Field Club Proc., vol. 25, pt. 1, p. 60, pl. 6, figs. 1–15, Gloucester, England.
1938. *Gryphaea marcoui* Hill and Vaughan. Jones, Geol. Soc. America Bull., vol. 49, no. 1, p. 106, pl. 2, figs. 9, 10.
1939. *Gryphaea mucronata* Gabb. Adkins, in King, Geol. Soc. America Bull., vol. 50, pp. 1669, 1670.

Gabb's original definition of *Gryphaea mucronata* would include both *G. mucronata* and *G. marcoui* as currently recognized. However, the types of *G. mucronata*, illustrated for the first time on plate 18, figures 1–8, 13, show that the species is the same as the narrow variety of *G. marcoui*. The types of *G. mucronata* were obtained near Arivechi, Sonora, Mexico, where the species is associated with other fossils of definite Fredericksburg age. Therefore, the common upper Washita species usually assigned to *G. mucronata* must be renamed. These facts were first discovered by W. S. Adkins (King, 1939, p. 1669), and have now been substantiated.

The description and illustrations of *G. marcoui* by Hill and Vaughan may now be applied to *G. mucronata* as defined here. It is evident that both Roemer and Blake had specimens of the species. In Roemer's description of *G. pitcheri* he mentions "a much smaller, broader form, scarcely an inch long, with blunt, not conspicuously incurved beaks" occurring on the hills near Fredericksburg. This could refer only to *G. mucronata*, though apparently the specific characters were not well developed on his specimens.

When Cragin (1891, p. 181) named the southern Kansas form, *Gryphaea pitcheri* var. *hilli*, giving an incomplete description and no illustrations, he also stated that the form occurs in the Fredericksburg group of Texas, mentioning especially localities near Weatherford. The reference is evidently to the form subsequently named *G. marcoui* by Hill and Vaughan and now corrected to *G. mucronata* Gabb. Cragin has repeatedly asserted the identity of the Kansas and the Texas forms. They are closely related, and specimens may be selected from each that are almost identical in appearance. When full collections are compared, it is seen that the average size of *G. mucronata* is considerably larger than *G. hilli*, the dorsal sinus and wing are generally more developed, and there are other differences that seem to justify their specific separation.

Types: Four cotypes (4773) in Philadelphia Academy of Natural Sciences; plesiotypes, U.S.N.M. 28776 to 28778.

Gryphaea graysonana Stanton, n. sp.

Plate 11, figures 2, 5–11; plate 12, figures 1–7;

plate 14, figures 5, 12, 14–16

1849. *Gryphaea pitcheri* Roemer (not Morton) (part), Texas, pp. 394, 395, Bonn.
1852. *Gryphaea pitcheri* Roemer (not Morton) (part) Die Kreidebildungen von Texas, pp. 73, 74, pl. 9, figs. 1a–1c, Bonn.
1856. *Gryphaea pitcheri* var. *navia* Hall (part), in Whipple, A. W., U. S. Pacific R. R. Expl. Rept., U. S. 33d Cong., 2d sess., S. Doc. 78, vol. 3, pt. 4, p. 100.
1857. *Gryphaea pitcheri* var. *navia* Conrad (part), U. S. and Mex. Boundary Survey Rept., vol. 1, pt. 2, p. 155.
1860. *Gryphaea pitcheri* Owen (not Morton), Second report of a geological reconnaissance of the middle and southern counties of Arkansas, pl. 7, fig. 6 Philadelphia.
1869. *Ostrea pitcheri* Coquand (not Morton) (part), Monographie du genre Ostrea, terrain crétacé, p. 40, pl. 9, figs. 9–12, Marseilles.
1884. *Gryphaea pitcheri* var. *navia* Conrad (part). White, U. S. Geol. Survey 4th Ann. Rept., p. 302, pl. 49, figs. 4–6.
1898. *Gryphaea mucronata* Hill and Vaughan (not Gabb), U. S. Geol. Survey Bull. 151, p. 63, pls. 24–30; pl. 23, figs. 4–9 (not fig. 10, which represents an *Exogyra*).

1901. *Gryphaea mucronata* Hill (not Roemer, not Gabb), U. S. Geol. Survey 21st Ann. Rept., pt. 7, pl. 37, fig. 1.
1903. *Gryphaea mucronata* Shattuck (not Gabb), U. S. Geol. Survey Bull. 205, p. 21, pl. 9.
1906. *Gryphaea mucronata* Veatch (not Gabb), U. S. Geol. Survey Prof. Paper 46, pl. 7, figs. 5, 5a.
1920. *Gryphaea mucronata* Adkins and Winton (not Gabb), Texas Univ. Bull. 1945, p. 63, pl. 15, figs. 1–4.
1925. *Gryphaea mucronata* Winton (not Gabb), Texas Univ. Bull. 2544, p. 60, pl. 7, figs. 1, 2.
1927. *Gryphaea mucronata* Bybee and Bullard (not Gabb), Texas Univ. Bull. 2710, p. 51, pl. 8, figs. 6, 7; pl. 9, fig. 2.
1928. *Gryphaea mucronata* Adkins (not Gabb), Texas Univ. Bull. 2838, p. 108, pl. 22, fig. 4.

Gryphaea graysonana includes the common upper Washita species which has been mistakenly assigned to *G. mucronata* by Hill and Vaughan (1898b, p. 63, pl. 23, figs. 4–9; pls. 24–30) and by many subsequent writers. As discussed on page 28, the types of *G. mucronata* Gabb (1869, p. 274) show that the species is the same as *G. marcoui* (Hill and Vaughan, 1898b, p. 50, pls. 2–4; pl. 5, figs. 1–7). The comprehensive description by Hill and Vaughan of the form they referred to *G. mucronata* may now be applied to the new species by making the systematic changes indicated above.

Gryphaea graysonana is distinguished from *G. mucronata* by being larger, heavier, more flared basally, less straight-sided, less elongate, broader in the umbonal region, more variable, and by having a less incurved beak, coarser growth lines, and a less prominent radial sinus which generally develops at a slightly younger stage.

Types: Cotypes U.S.N.M. 28779 comprise the specimens figured by Hill and Vaughan in U. S. Geological Survey Bulletin 151, and were obtained from Shoal Creek, near Linders Spring, Travis County, Tex.; Plesiotypes, U.S.N.M. 30226.

Gryphaea washitaensis Hill

Plate 16, figures 1–4, 7–9

For fairly complete synonymy to 1898 see Hill and Vaughan, U. S. Geol. Survey Bull. 151, p. 59.

1884. *Gryphaea pitcheri* White (part) (not Morton), U. S. Geol. Survey 4th Ann. Rept., p. 302, pl. 49, figs. 1, 2.
1898. *Gryphaea washitaensis* Hill. Hill and Vaughan, U. S. Geol. Survey Bull. 151, p. 59, pl. 19, figs. 3–5, 7–19; pls. 19–22; pl. 23, figs. 1–3.
1901. *Gryphaea washitaensis* Hill. Hill, U. S. Geol. Survey 21st Ann. Rept., pt. 7, pl. 36, fig. 3.
1906. *Gryphaea washitaensis* Hill. Veatch, U. S. Geol. Survey Prof. Paper 46, pl. 7, fig. 2, 2a.
1910. *Gryphaea pitcheri* var. *washitaensis* Hill, Böse, Inst. geol. México Bol. 25, p. 110, pl. 20, figs. 1–13.
1920. *Gryphaea washitaensis* Hill. Adkins and Winton, Texas Univ. Bull. 1945, p. 62, pl. 15, figs. 5–12.
1925. *Gryphaea washitaensis* Hill. Winton, Texas Univ. Bull. 2544, p. 53, pl. 7, fig. 7.
1925. *Gryphaea washitaensis* Hill. Mahon, in Winton, Texas Univ. Bull. 2544, p. 68, pl. 24, fig. 7.
1927. *Gryphaea washitaensis* Hill. Bybee and Bullard, Texas Univ. Bull. 2710, p. 50, pl. 7, figs. 10, 11.
1928. *Gryphaea washitaensis* Hill. Adkins, Texas Univ. Bull. 2838, p. 107.
1938. *Gryphaea washitaensis* Hill. Jones, Geol. Soc. America Bull., vol. 49, no. 1, p. 107, pl. 3, figs. 14–16.

A variety apparently belonging to this species is occasionally seen, in which the growth lines of the lower valve are very prominent and rough, contrasting with the usual smooth surface of the species. A very large, massive form to which Cragin gave the name *Gryphaea gibberosa* is very rare in all the collections I have seen. It differs so materially from the ordinary form of *G. washitaensis* in size, shape, and thickness of shell that it should probably be recognized as a distinct species.

Cotypes: U.S.N.M. 28782–85.

Locality and position: Widespread in Texas and southern Oklahoma, where it ranges from the Kiamichi formation to the Main Street limestone (Adkins, 1928, pp. 107, 108). But in northern Mexico it has been recorded in beds ranging in age from Kiamichi to early Upper Cretaceous (Jones, 1938, p. 107, pl. 3, figs. 14–16).

Gryphaea gibberosa Cragin

Plate 16, figures 5, 6; plate 17, figures 5, 10

1893. *Gryphaea gibberosa* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 189, pl. 30, figs. 1, 2.
1898. *Gryphaea washitaensis* var. *gibberosa* Cragin. Hill and Vaughan, U. S. Geol. Survey Bull. 151, pp. 59, 62, pl. 23, figs. 1, 2.
1928. *Gryphaea gibberosa* Cragin. Adkins, Texas Univ. Bull. 2838, p. 108.

Cragin's original description is as follows:

Shell large and very inequivalve, of moderate thickness, the margins mostly rather thin; lower valve very deeply excavated, the outline, as seen in interior view, rather elongate ovate-rhomboidal to ovate-triangular, the exterior with rather distant, more or less prominent but thin-edged imbrications, the lateral lobe falling far short of the basal margin and much less deeply excavated than the disc of the valve, placed either at or beyond the middle of the posterior part, and springing subperpendicularly from the steep posterior slope, its beak turned more or less abruptly inward from the very gibbous and narrow discal region of the valve, and not spirally incurved; upper valve much smaller than the lower, rhomboidal-ovate, its concave outer surface presenting, near the posterior side, an oblique ridge, or fold, corresponding to the inter-lobular sulcus of the lower valve.

Measurements: Height 115, length 72, breadth 65 mm.

Occurrence: Of this fine, large *Gryphaea* only two examples have thus far come to light. One of these was obtained two miles west of Austin by Mr. Jermy, and occurred in contact with *Gryphaea washita* Hill, and *Ostrea carinata* Lam. The second was found by Mr. Leverett in the base of the Fort Worth limestone at Round Rock.

Since the above was written, Mr. Dumble has observed four specimens in the Fort Worth limestone at the Sixth

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street cut of the International and Great Northern Railway. These, and fragments of others which were observed and belong apparently to the same species, indicate that it attains a considerably larger size than that above given.

The mature individual of this rather rare species differs from *Gryphaea washitaensis* by being larger, more elongate, and thicker shelled, and by lacking, or having less well-developed marginal flares.

Paratype: In the Texas State collections at Austin; plesiotype: U.S.N.M. 28784.

Locality and position: The collections of the Geological Survey contains specimens from the Fort Worth member of the Georgetown limestone at the railroad cut near West Pecan street in Austin; Mount Bonnell west of Austin: top of bluff on south side of Bartons Creek about half a mile above Bartons Springs near Austin; and on the south side of Taylors Creek in Travis County, Tex. Adkins (1928, p. 108) records the species from the Fort Worth limestone near Denison, Grayson County, Tex. One of Cragin's unfigured types, obtained an eighth of a mile southwest of Bartons Springs, near Austin, is shown here. (See pl. 16, figs. 5, 6.)

Genus EXOGYRA Say, 1820

Exogyra arietina Roemer

Plate, 19, figures 3–12, 14; plate 20, figures 5, 6

1849. *Exogyra arietina* Roemer, Texas, p. 397, Bonn.
1852. *Exogyra arietina* Roemer, Die Kreidebildungen von Texas, p. 68, pl. 8, figs. 10a–10e, Bonn.
1853. *Exogyra arietina* Roemer. Giebel, Naturwiss. Ver. Halle, Jahresber. 1852, p. 371.
1853. *Exogyra caprina* Conrad, Acad. Nat. Sci. Philadelphia Jour., ser. 2, vol. 2, p. 273, pl. 24, figs. 3, 4.
1857. *Exogyra arietina* Roemer. Conrad, U. S. and Mex. Boundary Survey, vol. 1, pt. 2, p. 153, pl. 7, figs. 1a–1e.
1884. *Exogyra arietina* Roemer. White, U. S. Geol. Survey genre Ostrea, terrain crétacé, p. 32, pl. 5, figs. 10-13, Marseilles.
1884. *Exogyra arietina Roemer*. White, U. S. Geol. Survey 4th Ann. Rept., p. 303, pl. 51, figs. 3–5.
1901. *Exogyra arietina* Roemer. Hill, U. S. Geol. Survey 21st Ann. Rept., pt. 7, pl. 37, fig. 2; pl. 38.
1906. *Exogyra arietina* Roemer. Veatch, U. S. Geol. Survey Prof. Paper 46, pl. 7, figs. 6, 6a.
1919. *Exogyra arietina* Roemer. Böse, Texas Univ. Bull. 1902, p. 19, pl. 4, figs. 1–18; pl. 5, figs. 1–23.
1920. *Exogyra arietina* Roemer. Adkins and Winton, Texas Univ. Bull. 1945, p. 66, pl. 13, figs. 1–6.
1925. *Exogyra arietina* Roemer. Winton, Texas Univ. Bull. 2544, p. 61, pl. 11, fig. 1.
1927. *Exogyra arietina* Roemer. Bybee and Bullard, Texas Univ. Bull. 2710, p. 51, pl. 8, figs. 1–3.
1928. *Exogyra arietina* Roemer. Adkins, Texas Univ. Bull. 2838, p. 112, pl. 15, fig. 1; pl. 22, figs. 1–3.
1938. *Exogyra arietina* Roemer var. *coahuilensis* Jones, Geol. Soc. America Bull., vol. 49, p. 105, pl. 2, figs. 21–24.

Shell small, slender, very inequivalve, spirally coiled, and with relatively thick test; lower valve forming an elevated, somewhat irregular open spiral of 2 or 2½ whorls, very convex, with a broad rounded umbonal ridge bordered on either side by a depressed band or groove that becomes especially prominent on the adult portions of the shell; young shell and the umbonal portions of well-preserved adults marked by numerous, rather coarse radiating lines that ordinarily disappear at the distance of 10 to 15 mm. from the beak; surface also marked by very sinuous growth lines that become prominent and give the adult shell a rugose appearance. Upper valve small, operculiform, ranging from almost circular to elongate-ovate in outline, and from almost flat to strongly convex; beak not elevated but having the spiral character almost as well-developed as in the lower valve, often subcentral in position; surface of upper valve marked by concentric or subspiral, more or less lamellose, closely arranged growth lines; margins of the interior obscurely crenulated in both valves, especially near the beak; muscle impressions ovate, rather small, and in the upper valve extremely deep and situated exactly under the beak.

A specimen larger than the average measures 44 mm. in its longest straight dimension and 27 mm. in breadth measured across the coil. The upper valve of the same specimen is 29 mm. in length and 17 mm. in breadth, and the convexity of the two valves united is about 23 mm.

The variations in the upper valve are illustrated by the following measurements of three small specimens: Length 18, 16, 16 mm.; breadth 12, 13, 13 mm.; convexity 6, 7, 3 mm., respectively.

This very distinct and easily recognized species shows some variations, as indicated in the description, but it is more constant than most species of the Ostreidae. The variations in convexity and outline of the upper valve have already been mentioned. The lower valve varies somewhat in relative length and breadth, in the greater openness and elevation of the spiral in some specimens, and in the tendency of the radiating sculpture of the early stages to disappear.

In the first of Conrad's publications above cited this species was described as new under the name *Exogyra caprina*, Roemer's earlier name and description having evidently been overlooked. In his second publication he cites this name as *E. arietina* var. *caprina* and refers to it the specimens with radiating sculpture. This distinction does not seem to me to have varietal value, as it is due mainly to the accidents of preservation. It should be noted, however, that specimens from the Main Street limestone at Denison have the radiating sculpture unusually well developed.

In White's treatment of the species it was suggested that it may possibly be identical with *Delphinula laxa* Say, which was described as a Recent shell and was said to have come from Sullivan's Island, near Charleston, S. C. White republished Say's figure for comparison with *Exogyra arietina*, and these figures have since been inadvertently copied by Hill and Vaughan (1898a, pl. 57, figs. 2b, 2d) as actually belonging to the latter species.

The figure of Say's species has only the most general resemblance to the *Exogyra* in form, and differs in all details, and especially in being a dextral shell, whereas *E. arietina*, like all other species of the genus, is sinistrally coiled. It is probable that Say's species was based on an abnormal individual of some recent naticoid shell.

The nearest relative of *Exogyra arietina* in the Comanche Series, and most probably its direct ancestor is *E. plexa* Cragin (see p. 35) which occurs in the Duck Creek formation. It is a broader, more robust shell, with the left valve not drawn out in such an open spiral and with its entire surface commonly covered with radiating lines, its form and sculpture almost exactly duplicated in miniature by the young of *E. arietina*.

Some of the illustrations of *Ostrea africana* (Lamarck), from the Cenomanian of northern Africa, as given by Coquand (1869, pl. 55, figs. 10–12), have considerable resemblance to *E. arietina*, but most of the figures indicate a larger and entirely different form, more like *E. cartledgei* Böse. (See p. 32.)

Plesiotypes: U.S.N.M. 9866, 21752, 103188–92, 103193a-e.

Locality and position: The species is very abundant and widespread in the Grayson clay equivalents throughout the Texan region, the consolidated masses of shells often making layers of considerable thickness.

The localities cited by Roemer are Waco camp and Mission Hills near New Braunfels, springs of San Marcos River, Brazos River above Torrey's trading house, and near Austin. Conrad's specimens are from San Felipe Creek near the present site of Del Rio, and Leon Springs about 9 miles west of Fort Stockton. The specimens here figured are from Shoal Creek and Bartons Creek near Austin, from Del Rio, and from 3 miles northwest of New Braunfels. The National Museum and the Geological Survey collections contain representatives from many localities within the limits just named, and from others as far north as Denison in Grayson County and as far west as El Paso. There is also one typical weathered specimen labeled "summit of second to the highest peak of the Huachuca Mountains, Arizona." Adkins (1928, p. 113; 1933, pp. 383, 400) notes that the species ranges from the Main Street limestone into the basal Buda limestone, and that "an individual, doubtless ancestral, practically indistinguishable from *Exogyra arietina*, was found in the upper Weno, three miles southeast of Fort Worth." The variety *coahuilensis* Jones (1938, p. 105, pl. 2, figs. 21–24), of northern Mexico, ranges from the upper part of the Washita group to the Eagle Ford shale.

Exogyra aquila (Brongniart)

Plate 19, figure 13; plate 20, figures 1, 12

For foreign synonymy consult the following:

1869. *Ostrea aquila* D'Orbigny. Coquand, Monographie du genre Ostrea, terrain crétacé, p. 158, Marseilles.
1871. *Ostrea aquila* Brongniart. Pictet and Campiche, Matériaux Paléontologie Suisse, 5e sér., p. 289.
1910. *Gryphaea latissima* Lamarck. Pervinquière, Palaeontologia Universalis, fasc. 2, sér. 3, fiche 194 (types).
1912. *Exogyra latissima* (Lamarck). Pervinquière, Études de paléontologie tunisienne, vol. 2, p. 176, Paris.
1913. *Exogyra sinuata* (Sowerby). Woods, Cretaceous Lamellibranchia of England, vol. 2, pt. 9, p. 395, in Palaeontographical Soc. mon., 1912.

North American synonymy is as follows:

1884. *Exogyra aquila* Goldfuss. White, U. S. Geol. Survey 4th Ann. Rept., p. 304, pl. 53, figs. 1, 2.
1899. *Exogyra aquila* Goldfuss. Hill, Texas Geol. Survey Bull. 4, p. 5 (considered a young variety of *Gryphaea sinuata*).
1893. *Exogyra americana* Marcou (part). Cragin, Texas Geol. Survey 4th Ann. Rept., p. 183.
1939. *Exogyra* aff. *E. latissima* (Lamarck) var. *aquila* (Brongniart). Imlay, Geol. Soc. America Bull., vol. 50, p. 1735.

Shell of medium size, broadly ovate to subcircular in outline, with slightly spiral, inconspicuous beaks; lower valve moderately convex, with a very obscure umbonal ridge posterior to the middle of the shell; upper valve slightly concave; surface of both valves marked only by irregular concentric lines and lamellae of growth; margins not crenulated or striated within.

The specimen figured by White measures 95 mm. in length, 75 mm. in height, and 26 mm. in convexity. Corresponding measurements of another example in the same lot are 100 mm., 88 mm., and 34 mm. A specimen from the Travis Peak beds on Cow Creek is 115 mm. in length and 109 mm. in breadth.

This description is drawn from Texan specimens that agree closely with figures of the European *Exogyra aquila* (Brongniart) from the Lower Cretaceous. The form has been confused by Hill and Cragin with *E. walkeri* White, which differs completely in the form of the lower valve and in many of the internal features. *E. quitmanensis* is much

more similar, but typically is a larger, heavier shell, generally differing considerably in outline, and much more convex. However, shells intermediate between the typical forms of the two species are fairly common.

Plesiotypes: U.S.N.M. 9609, 103194.

Locality and position: Three specimens, including the one figured by White, are labeled "Bexar County, Texas" (cited as Bell County in White's report), without more definite reference to locality or stratigraphic position. A single specimen that, though somewhat larger, evidently belongs to the same species was collected in the Travis Peak formation on Cow Creek, Travis County, Tex. The species is fairly common in beds of upper Aptian age in northern Mexico, according to the studies of Imlay (1939, p. 1735).

Exogyra drakei Cragin

Plate 22, figures 1, 2, 9, 10; plate 23, figures 2, 3, 5

1893. *Exogyra drakei* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 184, pl. 29, figs. 8–11.
1919. *Exogyra drakei* Cragin. Böse, Texas Univ. Bull. 1902, p. 9.
1928. *Exogyra drakei* Cragin. Adkins, Texas Univ. Bull. 2838, p. 114.

Shell small to medium in size, subovate, with the spiral beaks little elevated above the valves; lower valve very convex, with a more or less angular umbonal ridge, ornamented by strong concentric imbrications that are commonly crossed by a variable number (10 to 20) of narrow radiating plications and that tend to form spines at the intersections; area of attachment ordinarily large; upper valve flat or slightly convex, marked only by concentric lines and laminae of growth that in some specimens retain traces of the marginal crenulations; inner margins of both valves crenulated for some distance on each side of the beak; upper valve with a conspicuous toothlike projection which fits into a pit in the lower valve; muscular impression ovate, large.

A rather slender specimen of about average size measures 55 mm. in length, 33 mm. in breadth, and 21 mm. in convexity of both valves. Most specimens are considerably broader and more convex. The large specimen figured on plate 22, figures 2, 9, measures 82 mm. in length, 59 mm. in breadth, and 35 mm. in convexity of both valves.

The species was originally based on two specimens from near Bosqueville, McLennan County, and one from the Arietina clay on Denton Creek, a locality about a mile east of Roanoke, Denton County, Tex. In these specimens the lower valve is abnormal in form on account of the large area of attachment. The species most nearly resembles *E. clarki* Shattuck from the Buda limestone, but is distinguished by its smaller size, more angular umbonal ridge, and its fewer but stronger radial plications.

Plesiotypes: U.S.N.M. 10319a-b, 103347, 103348.

Locality and position: Besides the types mentioned from McLennan and Denton Counties I have examined specimens from Shoal Creek; from near Bartons Springs in the neighborhood of Austin, Travis County; 4 miles south of Denison in Grayson County; 6 miles north of Fort Worth in Tarrant County; and 3 specimens collected by Cragin in an abandoned railway cut half a mile east of the depot at Denison. These are from the Grayson formation and its equivalents, and from the Main Street limestone, Texas. A specimen figured by Hill and Vaughan (1898, pl. 23, fig. 10) as an upper valve of *Gryphaea mucronata* (= *G. graysonana*, n. sp.) is certainly an *Exogyra* and probably belongs to this species.

The Geological Survey collections likewise contain specimens from the Grayson marl half a mile southwest of Smithfield in Tarrant County; 5 miles northeast of Roanoke in Denton County; 4 miles northeast of Belton in Bell County; 1 mile east of Burleson in Johnson County; and from just north of Round Rock in Williamson County, Tex.

Exogyra cartledgei Böse

Plate 21, figures 1–5

1919. *Exogyra cartledgei* Böse, Texas Univ. Bull. 1902, p. 17, pl. 1, figs. 7–13; pl. 2, figs. 1–4; pl. 3, figs. 1–8.
1928. *Exogyra cartledgei* Böse. Adkins, Texas Univ. Bull. 2838, p. 115, pl. 22, figs. 5–7.

Shell of medium size, elongate-ovate or subtriangular in outline, very inequivalve, thick-shelled. Lower valve very convex, regularly rounded or subangular, with somewhat elevated, strongly coiled spiral beaks, and with the surface marked by strong, irregular, concentric imbrications crossed by variable radiating sculpture, which in some specimens consists of rather prominent plications, and in others is nearly obsolete. Upper valve, as in *Exogyra drakei* Cragin, flat or slightly convex and marked by concentric lines and laminae of growth that commonly show radiating lines formed by the crenulations of the margin. Interior of both valves as in *E. drakei*.

The 3 specimens figured measure 58, 56, and 44 mm. in length; 40, 37, and 40 mm. in breadth; and 30, 29, and 27 mm. in convexity. Other imperfect specimens are somewhat larger.

The relationship of this form with *Exogyra drakei* is shown by the close agreement of the upper valves, but the more regularly developed lower valves and small area of attachment differ conspicuously from the irregular, deformed lower valves of *E. drakei* as found in northern and central Texas.

Exogyra cartledgei closely resembles the larger specimens of *Ostrea africana* Lamarck, from the Cenomanian of northern Africa and Sicily, as figured by Coquand (1869, p. 134, pl. 39, figs. 5, 6, 8, 9). It also has many points of resemblance with *E. arietina* Roemer, with which it is associated, but it is much larger and more robust. It has already been suggested that both these forms may have been derived from *E. plexa*.

Plesiotypes: U.S.N.M. 103197a-c.

Locality and position: Grayson marl and its equivalents. Specimens in the collections of the Geologic Survey are from a locality "north of Pass in Eagle Mountains" in southwest Texas; from the Rio Grande near the southern end of the Quitman Mountains, and from the base of Sierra Blanca, both in Hudspeth County, Tex.; and from northern Coahuila in Mexico. Adkins (1928, p. 115) records the species from Georgetown and Round Rock in Williamson County, and from Terlingua and Reed Plateau in the Big Bend region, Tex.; and from Coahuila, Mexico.

Exogyra whitneyi Böse

Plate 33, figure 1; plate 34, figure 1

1910. *Exogyra ponderosa* var. *clarki* Shattuck (Part). Böse, Inst. geol. México Bol. 25, p. 115, pl. 23, fig. 17; pl. 24, fig. 6; pl. 25, fig. 8 (not pl. 26, figs. 4–12).
1919. *Exogyra whitneyi* Böse (part), Texas Univ. Bull. 1902, p. 10.
1928. *Exogyra whitneyi* Böse. Adkins, Texas Univ. Bull. 2838, p. 110, pl. 22, fig. 8.

Shell very large, massive, elongate-subovate in outline. Lower valve extremely thick, very convex, without definite umbonal ridge; beak laterally coiled, not much elevated above the general surface of the valve; surface marked only by irregular lines of growth which tend to become somewhat rugose in old age; ligamental groove rather broad, spirally curved; free margins near the beak finely crenulated in some specimens; adductor muscular impression near the middle of the valve, oval, deeply excavated. Upper valve relatively thin, flat, or more commonly concave, with distinctly spiral beaks; surface marked by lines and lamellae of growth which are more prominent near the anterior border; interior as in the lower valve.

A medium-sized specimen measures 175 mm. in length, 126 mm. in greatest breadth, and 89 mm. in convexity. The shell of the lower valve is about 70 mm. thick in the neighborhood of the hinge. A very large proportion of the shell is thus made up of the greatly thickened lower valve; the living tissue was small in bulk compared with the size of the shell.

The species is about the same size as *Exogyra ponderosa* Roemer, from the Upper Cretaceous Taylor marls of Texas, and very similar to it in general appearance, especially the lower valve. *Exogyra ponderosa*, however, is ordinarily broader, has a more elevated beak, a more or less distinctly developed angular umbonal ridge, irregular radiating plications on the umbonal region of some specimens, and concentric lamellae of growth much more prominent; its upper valve also is relatively thicker, more convex, and more strongly lamellose. These differences as a rule easily distinguish the two species, though in some individuals the resemblances may be perplexing.

The specimens from Cerro Muleros, Chihuahua, Mexico, which Böse (1910, p. 115, pl. 23, fig. 17; pl. 24, fig. 6; pl. 25, fig. 8; pl. 26, figs. 4–12) described as *Exogyra ponderosa* var. *clarki* Shattuck, actually belong to 3 species. The specimens figured by Böse on his plate 26, figures 5–7, 11, represent *E. arietina* Roemer; those figured on his plate 26, figures 4, 8–10, 12, represent *E. clarki* Shattuck, and those figured on his plates 23–25 as the mature forms of *E. ponderosa* var. *clarki*, remain as the types of *E. whitneyi* Böse. It should be emphasized that *E. whitneyi* does not possess radiating plications on the umbonal region of the left valve at any stage of growth. This fact is well shown by several dozen specimens of various sizes in the collections of the Geological Survey.

Plesiotypes: U.S.N.M. 103198, 103199.

Locality and position: Main Street limestone and Grayson (Del Rio) marl on the Rio Grande 4 miles above El Paso, Texas, near the initial monument of the U.S. and Mexican Boundary Survey; and also in the Cerro Muleros section just south of the boundary in Chihuahua, Mexico. Adkins (1928, p. 110) records the species from the Grayson marl between Sanderson and Dryden in Terrell County, Tex.

Exogyra hilli Cragin

Plate 24, figure 7; plate 25, figures 1–14.

1893. *Exogyra hilli* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 186.
1888. cf. *Ostrea franklini* Hill (part), Arkansas Geol. Survey Ann. Rept. for 1888, vol. 2, p. 131, pl. 5, figs. 1–9.
1928. *Exogyra hilli* Cragin. Adkins, Texas Univ. Bull. 2838, p. 113.

Shell of small or medium size, rather narrow, arcuate or falcate, posterior end more or less prolonged and narrow; beaks strongly exogyrate; lower valve moderately convex, capacious, obtusely subcarinate, and bearing a few irregular plications that extend from the umbonal ridge to the anteroventral border where they form more or less distinct undulations or digitations; the rest of the valve marked only by irregular lines of growth;

upper valve nearly flat or slightly concave and almost smooth over most of the surface; the anteroventral border slightly convex, considerably thickened, marked by strong lamellae of growth, and with the margin more or less undulated to fit the plications of the lower valve; muscular impression subovate, moderately large, rather near the posterodorsal border; interior submargin of both valves closely milled or marked by short transverse striae; ligamental groove strongly curved, rather broad and shallow.

A specimen somewhat above the average measures 59 mm. in length, 33 mm. in breadth, and 22 mm. in convexity of both valves. Corresponding measurements of the type given by Cragin are just about half as large.

The species is identified from Cragin's description, and from examination of the types in the Texas State collection at Austin. According to Cragin the small exogyrate form figured by Hill as the young of *Ostrea franklini* belongs to this species, and it seems to me that the figures cited above really do belong here, though the Arkansas localities have not yielded any specimens of this form nearly as large as those here figured. The types also are considerably smaller.

The species varies considerably in form and in sculpture, some specimens having the plications of the lower valve scarcely developed. It is rather closely simulated by falcate individuals of *Ostrea crenulimargo* Roemer, but in the latter the beaks are never distinctly coiled. It may be compared also with *Exogyra texana* Roemer, from which it is distinguished by its more slender falcate form, the absence of radiating plications on the upper valve, their irregularity and relatively greater size on the lower valve, the absence of a cardinal tooth, the less central position of the muscular scars, and the shorter transverse striae around the pallial border. In most of these features it also differs from *E. texana* var. *weatherfordensis* Cragin to which it is probable that Cragin referred some of the larger examples in the Texas State collection.

Types: Cotypes in Texas State collections; 10 plesiotypes, U.S.N.M. 103200a–j.

Locality and position: In the original description it is stated the types were "collected by Messrs. Taff and Drake, in [bed] no. 3 of their Camp Creek section," Travis County, Tex., and that the species also was obtained in [bed] no. 2 of the Cow Creek section of the same county, and also on Hickory Creek, Burnet County, Tex. These units are assigned to the Travis Peak formation. The Arkansas specimens figured by Hill are from Pike County, from beds now known to be equivalent to the Glen Rose limestone of Texas. The collection here described consists of over a hundred specimens obtained at the crossing of Pedernales River on the road from Bee Caves to Corwin, Tex., in beds that belong either in the upper part of the Travis Peak formation or in the lower part of the Glen Rose limestone.

Exogyra clarki Shattuck

Plate 23, figures 1, 4; Plate 24, figure 8

1903. *Exogyra clarki* Shattuck, U. S. Geol. Survey Bull. 205, p. 22, pls. 10, 11.
1910. *Exogyra ponderosa* var. *clarki* Shattuck (part). Böse, Inst. geol. México Bol. 25, p. 117, pl. 26, figs. 4, 8–10, 12 (not pl. 26, figs. 5–7, 11; not pl. 23, fig. 17; not pl. 24, fig. 6; not pl. 25, fig. 8).
1919. *Exogyra whitneyi* Böse (part), Texas Univ. Bull. 1902, p. 10 (includes the medium-sized specimens mentioned by Böse).
1928. *Exogyra clarki* Shattuck. Adkins, Texas Univ. Bull. 2838, p. 116.

Shell of moderate size, ovately triangular in outline. Lower valve moderately convex, bearing a more or less distinctly angular umbonal ridge; beak laterally coiled, not elevated above the general surface of the valve; surface marked by numerous irregularly branching, radiating ribs crossed by concentric imbricating lamellae that are almost as prominent as the radiating sculpture. Upper valve slightly convex; beak strongly spiral; surface showing numerous fine lamellae of growth with some traces of fine radiating sculpture; margins finely crenulated and striated for some distance on each side of the beak, and a striated hinge tooth more or less developed in the upper valve; ligamental groove rather narrow, well-defined, spiral and with its margins crenulated.

An average specimen measures 87 mm. in length, 66 mm. in breadth, and 40 mm. in convexity of the two valves. The species is represented by 13 specimens in collections of the Geological Survey and the U. S. National Museum.

This species resembles the young of *Exogyra ponderosa* in general form and character of sculpture, except that the radiating ribs of the lower valve and the concentric lamellae of the upper valve are much finer and more numerous. This might cause one to suspect that these shells are the young of *E. whitneyi* Böse, but none of the several dozen examples of that species examined shows radiating sculpture at any stage of growth. The sculpture suggests that of *E. costata* Say, but it is not nearly so strong nor so regular.

Types: Holotype, U.S.N.M. 30227; 2 plesiotypes, 103201a-b.

Locality and position: Associated with *Exogyra whitneyi* Böse in the Grayson (Del Rio) formation on the Rio Grande 4 miles above El Paso, Tex. The

types are from the Buda limestone on Shoal Creek near Austin, Tex.

Exogyra paupercula Cragin

Plate 20, figures 2–4, 7–11

1893. *Exogyra paupercula* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 186, pl. 30, figs. 7, 8.
1928. *Exogyra paupercula* Cragin. Adkins, Texas Univ. Bull. 2838, p. 113.

Original description:

Shell small, commonly agglomerate, sometimes solitary, inequivalve, for the most part narrowly pyramidal-ovate; subject to varied deformity; area narrow and oblique, often concealed; left valve deeply excavated, the cavity often forming an umbonal *cul-de-sac*, the exterior commonly presenting two to four irregular-topped, angular, radial folds, the beak exogyrate, the anterior margin of the shell often overlapping and completely concealing the hinge-area, the apex of the beak being flung back obliquely across the proximal part of the posterior slope of the valve, the spiral in exceptional cases rising freely as in *Exogyra arietina;* right valve much shorter than the left, flat and rather thin, subovate, the anterior outline straight, or with a slight proximal concavity, the beak spiral or sometimes merely subspiral (in general less marked in the spiral character than that of the corresponding valve of *Exogyra arietina)*, not raised above the general plane of the exterior; the adductor scar situated about midway of the height of the valve.

The relative dimensions vary greatly, especially the ratio of length to breadth. A small, slender specimen measures 26 mm. in length, 16 mm. in breadth, and 10 mm. in convexity. Corresponding dimensions of a larger, broader specimen are 30 mm., 24 mm., and 18 mm. Other specimens show every variation in proportions between these limits. The types described by Cragin are somewhat larger.

These very irregular, abnormal little shells are abundant at a number of localities in the upper part of the Glen Rose formation. They are generally attached to each other in clusters, are pierced by burrows of other Mollusca, and have the lower valves thickened by irregular knobs and protuberances, giving every evidence of being deformed individuals that grew under unfavorable conditions. They are associated with specimens of *Exogyra texana* var. *weatherfordensis* Cragin, to which they may really belong. For convenience in museum classification it is well to keep them under the separate name.

Plesiotypes: U.S.N.M. 103202a-e.

Locality and position: The types are from the Glen Rose limestone, 3 or 4 miles south of Dublin, Erath County, Tex. The specimens in the Geological Survey collections are from the upper beds of the Glen Rose formation 11 miles southwest of Fredericksburg, Gillespie County, and from a locality 10 miles northeast of Kerrville, Kerr County, Tex.

Exogyra plexa Cragin

Plate 22, figures 3–8

1893. *Exogyra plexa* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 187, pl. 30, figs. 3–6.
1919. *Exogyra plexa* Cragin. Böse, Texas Univ. Bull. 1902, p. 8, pl. 1, figs. 3, 4.
1919. *Exogyra* sp. *Exogyra plexa* Cragin. Böse, Texas Univ. Bull. 1902, p. 8, pl. 1, fig. 6.
1919. *Exogyra*, nov. sp. aff. *Exogyra plexa* Cragin. Böse, Texas Univ. Bull. 1902, p. 8, pl. 1, fig. 3.
1920. *Exogyra plexa* Cragin. Adkins and Winton, Texas Univ. Bull. 1945, p. 65, pl. 13, figs. 7–10.
1928. *Exogyra plexa* Cragin. Adkins, Texas Univ. Bull. 2838, p. 112.
1928. *Exogyra* n. sp., aff. *Exogyra plexa* Cragin. Adkins, Texas Univ. Bull. 2838, p. 114.
1938. *Exogyra plexa* Cragin. Jones, Geol. Soc. America Bull., vol. 49, p. 106, pl. 2, figs. 25, 26.

Original description:

Shell small, very inequivalve, arcuate-subovate; dorso-ventral axis one and a half times to twice as large as the antero-posterior; section across dorso-ventral axis triangular; lower valve deeply excavated, its exterior divided into an anterior and a posterior slope by an obtuse (to subacute) angle, or carina; the anterior slope even, or thrown into four or five pronounced radial folds, and ornamented with numerous and crowded, oblique, striaeform wrinkles; the posterior slope very rarely presenting one or two radial folds, and usually decussately striate-wrinkled or granulate-striate; the beak spirally recurved, and either reposing in the plane of the posterior slope or rising more or less freely above it, often marked at or near the apex with a small scar of attachment; upper valve small, flat or concave, the beak depressed, the surface largely smooth, the anterior border imbricate, thickened, and sometimes abruptly elevated; adductor impression auriform, that of the upper valve situated about midway between the dorsal and ventral borders of the valve, and rather nearer to the former than to the latter.

Measurements: Of a fair-sized lower valve, major diameter 29, antero-posterior diameter 16, convexity 12 mm.; of a specimen considerably larger than any other of some ninety specimens, 32, 21, 16 mm.; of a small plicate specimen 19, 11 and 11 mm.

Occurrence: In bluish gray to yellowish clayey limestone on Duck Creek, Grayson County, and on the Texas Pacific Railway, Tarrant County, three miles east of Benbrook. At the latter locality twenty feet below the top of a bed of *Exogyra texana;* **Fredericksburg division of Lower Cretaceous.** Collected by Messrs. Taff, McLaughlin, and Wooldridge. The species also occurs in Nos. 2 and 3 of Mr. Cummins' (inverted) Kent section (Third Ann. Rept., p. 214), this being the species referred to in No. 2 of that section under the name *Exogyra arietina.*

The Geological Survey collections contain 20 lower and 2 upper valves. The typical and most abundant form has a broadly triangular outline and finely striated surface, like figures 6 and 7 on plate 22. On a few specimens the striae are almost obsolete, as in figure 4 on plate 22, and in other rare specimens stronger folds are developed, as in figure 8 on plate 22.

The upper valve is auriform or semilunar, more

or less angular behind, and in well-preserved specimens shows minute radiating striae. In both valves the ligamental groove is narrow, sharply defined, and spiral, and the inner margins are distinctly crenulated for some distance on each side of the beak.

As Cragin (1893, p. 188) has pointed out, *Exogyra plexa* has considerable resemblance to *Exogyra decussata* Goldfuss (Goldfuss and Münster, 1863, p. 33, pl. 86, figs. 11a-c) from which it differs mainly in its smaller size and somewhat more slender form.

Three Comanche forms may be compared with *Exogyra plexa* and may probably be derived from it. These are *E. arietina* Roemer, *E. drakei* Cragin, and *E. cartledgei* Böse. Mature individuals of *E. arietina* are much more slender and have a more elevated, distinctly spiral coil and a much thicker shell than *E. plexa*, but the young of *E. arietina* is very similar both in form and sculpture, indicating its origin. Imperfect young specimens might easily be mistaken for *E. plexa*, and it is probable that Cragin was thus misled by the specimens from Kent, which I think really belong to *E. arietina*, as they come from the proper stratigraphic position for that species. *E. drakei* is much larger and more robust and shows little radiating sculpture, but the resemblances are at least close enough to suggest another line of descent from *E. plexa*, leading up to *E. laeviuscula* Roemer, *E. ponderosa* Roemer, and *E. costata* Say.

Plesiotypes: U.S.N.M. 103203, 103204a-c.

Locality and position: Goodland limestone between Benbrook and Fort Worth, Tarrant County; Kiamichi formation in Tarrant County; Kiamichi and Duck Creek formations on Duck Creek north of Denison, and at Thompson's Ferry near Preston, Grayson County, Tex.

Exogyra quitmanensis Cragin

Plate 26, figures 1, 2; plate 27, figure 5; plate 28, figure 6

1893. *Exogyra americana* Marcou var. *quitmanensis* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 183, pl. 31.
1928. *Exogyra quitmanensis* Cragin. Adkins, Texas Univ. Bull. 2838, p. 110.

Shell large, massive, varying from ovate to elongate-ovate in outline, with beaks slightly coiled and inconspicuous. Lower valve very convex, some specimens almost uniformly convex, but most specimens with a broad, more or less obscure umbonal ridge curving back from the beak over the middle of the valve; surface marked only by irregular lines and ridges of growth; beak not elevated above the general surface of the valve. Upper valve slightly concave, or irregularly bent so as to become convex in the later stages; surface marked by rather strong lines and lamellae of growth; beak marginal, laterally twisted; margins of the valves smooth within.

A large specimen in the Geological Survey collections measures 200 mm. in length, 157 mm. in breadth, and 90 mm. in convexity of both valves. Corresponding dimensions of a small specimen with more nearly normal proportions are 142 mm., 98 mm., and 65 mm. Cragin's type is a still more slender specimen, relatively more elongate than any others I have seen from the type locality.

The name *quitmanensis* was first proposed by Cragin without formal description as a varietal designation under *Exogyra americana* Marcou, under which species he also included *E. walkeri* White and *E. aquila*, as figured by the same author. The present study, based on Cragin's types and on additional material from the same formation at the type locality and at other places in the same region, has led to the conclusion that this is a variable species distinct from both of those described by White. It does not even belong in the same section with *E. walkeri*, the form of the lower valve being entirely different. It is closely related to *E. aquila* (Brongniart), but the American fossils referred to that species are smaller, less convex, smoother, and less massive than the present species.

Plesiotypes: U.S.N.M. 103205a-d, 103206a-b.

Locality and position: Cragin's type was collected in the Quitman formation of Taff in the foothills south of the Quitman Mountains, Hudspeth County, Tex. The Geological Survey specimens are from the type locality; from the Quitman formation on the Rio Grande at the A. L. Ranch southwest of the Quitman Mountains; on the trail to Hot Springs south of the same mountains; and from the lower part of Mayfield Canyon in the southern Quitman Mountains. Specimens likewise have been recorded from the Trinity group at the top of Bluff Mesa southwest of the town of Sierra Blanca, Hudspeth County; from 1 mile southwest of Eagle Spring in the northeast part of Eagle Mountain; the east side of Van Horn Mountains, Culberson County; and the Solitario region, Presidio and Brewster Counties, Tex. It also occurs in the Trinity section of the Little Hatchet Mountains in southwestern New Mexico.

Exogyra texana Roemer

Plate 28, figures 1–5; plate 29, figures 1–6; plate 30, figures 1, 2

1849. *Exogyra texana* Roemer, Texas, p. 396, Bonn.
1850. *Exogyra matheroniana* D'Orbigny (part), Prodrome de Paléontologie, vol. 2, p. 255, Paris.
1852. *Exogyra texana* Roemer, Die Kreidebildungen von Texas, p. 69, pl. 10, figs. 1a–1e, Bonn.
1854. *Exogyra texana* Roemer. Shumard, in Marcy, R. B., Exploration of the Red River of Louisiana in the year 1852; U. S. 32d Cong., 2d sess., S. Doc. 54, p. 205, pl. 3, fig. 5; pl. 5, figs. 1a, 1b.

1855. *Exogyra fragosa* Conrad, Acad. Nat. Sci. Philadelphia Proc., vol. 7, p. 269.
1857. *Exogyra fragosa* Conrad, U. S. and Mex. Boundary Survey, vol. 1, pt. 2, p. 155, pl. 8, figs. 2a, 2b.
1857. *Exogyra matheroniana* D'Orbigny (part). Conrad, U. S. and Mex. Boundary Survey, vol. 1, pt. 2, p. 154; pl. 8, figs. 1a–1l.
1858. *Exogyra flabellata* Marcou (not Goldfuss), Geology of North America, p. 41.
1869. *Ostrea texana* (Roemer). Coquand, Monographie du genre Ostrea, terrain crétacé, p. 42, pl. 9, figs. 4–8, Marseilles.
1869. *Exogyra fragosa* Conrad. Coquand, Monographie du genre Ostrea, terrain crétacé, p. 53, pl. 23, figs. 6, 7, Marseilles.
1869. *Exogyra plicata* Gabb (not Lamarck), California Geol. Survey, Paleontology, vol. 2, p. 275, pl. 36, figs. 19, 19a.
1884. *Exogyra texana* Roemer. White, U. S. Geol. Survey 4th Ann. Rept., p. 306, pl. 51, figs. 1–5.
1884. *Exogyra fragosa* Conrad. White, U. S. Geol. Survey 4th Ann. Rept., p. 305.
1895. *Exogyra texana* Roemer. Cragin, Am. Geologist, vol. 16, p. 374.
1895. *Exogyra texana* Roemer. Stanton, Am. Jour. Sci., 3d ser., vol. 50, p. 216.
1900. *Exogyra texana* Roemer. Herrick and Johnson, Denison. Univ. Sci. Lab. Bull., vol. 11, p. 204.
1901. *Exogyra texana* Roemer. Hill, U. S. Geol. Survey 21st Ann. Rept., pt. 7, pl. 27, figs. 1a, 1b.
1906. *Exogyra texana* Roemer. Veatch, U. S. Geol. Survey Prof. Paper 46, pl. 6, figs. 1, 1a, 1b.
1910. *Exogyra texana* Roemer. Böse, Inst. geol. México Bol. 25, p. 112, pl. 20, figs. 14–16; pl. 21, figs. 1–11; pl. 22, figs. 1–9.
1920. *Exogyra texana* Roemer. Adkins and Winton, Texas Univ. Bull. 1945, p. 64, pl. 13, figs. 15, 16.
1924. *Exogyra texana* Roemer. Twenhofel, Kansas Geol. Survey Bull. 9, p. 68, pl. 20, fig. 9; pl. 21, fig. 3.
1925. *Exogyra texana* Roemer. Winton, Texas Univ. Bull. 2544, p. 47, pl. 11, fig. 5.
1928. *Exogyra texana* Roemer. Adkins, Texas Univ. Bull. 2838, p. 114, pl. 2, figs. 1, 2; pl. 15, fig. 5.
1939. *Exogyra texana* Roemer. Müllerried, Escuela nac. cien. biol. Anales, vol. 1, No. 2, p. 233.

Shell of medium size, beaks strongly coiled, outline varying from auriform to oval or subtriangular, strongly convex on one side, nearly straight or slightly emarginate near the beak on the other, generally more or less angulated at the posterior end; lower valve strongly convex, though varying considerably in this respect, the greatest convexity formed by a well-marked umbonal ridge or rounded carina, extending back in a spiral curve from the beak and dividing the surface of the valve into a larger, obliquely flattened area, and a smaller, convex, almost vertical area; surface of the lower valve in the typical variety marked by strong, more or less rugose, or tuberculated, irregularly branching ribs that radiate from the umbonal ridge and the beak and generally undulate the margin of the shell; upper valve much less convex, in some specimens nearly uniformly flat or slightly concave, but in most specimens more or less carinated and divided into 2 areas similar and corresponding in position to those of the other valve; the larger flat area marked by curved, radiating ribs except near the beaks, where the surface bears irregular fine granules and lines; the convex, nearly vertical area marked by strong concentric lamellae representing the successive layers of the greatly thickened margin of the shell, crossed at right angles by ribs corresponding to those of the other valve; muscular impression rather large, subovate, almost central; ligamental groove moderately broad, shallow, spirally curved; upper valve with a rather well-defined cardinal tooth with granulated surface, fitting into a socket in the lower valve; free margins of the interior of both valves with closely arranged transverse striae, which on some specimens are broken up into fine granulations; margins also generally crimped or folded at the extremities of the larger surface ribs.

A specimen somewhat larger than the average measures 90 mm. in length, 63 mm. in breadth, and 40 mm. in greatest convexity of the 2 valves united. The proportions vary considerably, the breadth varying from 66 to 80 percent of the length, and the convexity from 35 to 45 percent of the length.

Roemer's beautiful figures of this species, which have been copied by Coquand and White, represent an unusually well-preserved specimen that has exceptionally strong and regular radiating sculpture, with the ribs of the lower valve all radiating from the beak, whereas in most specimens the ribs on the posterior portion diverge from the umbonal ridge. The latter difference may be due to erroneous restoration by the draftsman.

Besides the variations in outline and convexity, the most common modification is the weakening of the radial sculpture until the surface becomes very smooth. This takes place especially on the posterior portion of the umbonal ridge, which is also commonly much inflated.

Conrad's *Exogyra fragosa* is not worthy of even varietal distinction, as it is based on a specimen with the typical sculpture of *E. texana* and differs from the type only in its more regularly rounded and somewhat shorter, broader form, though its shortness is more apparent than real, owing to the fact that the posterior end is broken off.

Two forms described by Cragin, *Exogyra hilli* and *E. weatherfordensis*, regarded by Hill and Vaughan (1898b, p. 30) as varieties of *E. texana*, are treated separately here,

E. texana has been referred by different authors to several European species. The European Cretaceous contains a series of similar and related forms, usually treated as distinct species, ranging

from the Neocomian to the Senonian. These are *Exogyra minos* Coquand (1869, p. 183, pl. 64, figs. 1-3; pl. 73, figs. 5-9; pl. 74, figs. 14, 15) from the Neocomian, *E. tuberculifera* Koch and Dunker (Pictet and Campiche, 1871, p. 280, pl. 186, figs. 1-11), from the Neocomian to the Aptian, *E. flabellata* Goldfuss (=*E. plicata* Lamarck) (Goldfuss and Münster, 1863, p. 35, pl. 87, figs. 5-7), from the Cenomanian, and *E. matheroniana* D'Orbigny (1847, p. 737, pl. 485, figs. 1-7) from the Senonian. These European forms are all more or less variable, generally difficult to distinguish from each other, and most of them may be almost duplicated by selected specimens of *E. texana.* For these reasons Gabb adopted the easiest solution of the difficulty by treating all the European forms as one species under the name *E. plicata* Lamarck and referring the American specimens to it. Although it is true that the published figures of these named species do not show much more variation than is found within the limits of *E. texana,* and, although it seems impossible to divide *E. texana* when large collections are studied, I would not venture to unite these species from the evidence of the literature alone without the opportunity of studying good collections of specimens. Their range throughout the Cretaceous, almost from the base to the top, is greater than would be expected for one species.

D'Orbigny regarded *Exogyra texana* as a synonym for *E. matheroniana,* but other European paleontologists who have studied it have generally considered it a distinct species, and detailed comparisons seem to justify this conclusion. Although *E. texana* in a general way resembles all the species mentioned, and in some specimens the resemblance is striking, it presents a combination of characters not found in any one of them. *Exogyra minos* has the radial plications of the upper valve less distinct, and in some specimens even obsolete, the beaks are generally less coiled, the ligamental area is broader and less distinctly defined, the cardinal tooth is not developed, and the internal margin is generally not striated. *E. tuberculifera* is a much smaller species, with a lower valve closely resembling the young of *E. texana,* but the upper valve has no radial ribs, and there is no cardinal tooth. *E. flabellata* has more nearly the form and sculpture of *E. texana* but lacks the cardinal tooth, and *E. matheroniana* which has the cardinal tooth developed is generally more slender and falcate.

In these comparisons Pictet and Campiche are followed in referring to *Exogyra minos* and *E. tuberculifera* all the European forms that have been identified with *E. boussingaulti* D'Orbigny (1842, p. 57, pl. 3, fig. 20; pl. 5, figs. 8, 9). *E. boussingaulti,* however, as originally described from Columbia, South America, is very different in form from *E. texana.*

Plesiotypes: U.S.N.M. 8299, 103188, 103207a–b, 103208a–c, 103209, 103210a–d.

Locality and position: *Exogyra texana* is one of the most abundant and widely distributed species in the Comanche series. Its greatest development is in the Fredericksburg group, especially the Comanche Peak limestone and Walnut clay. The Walnut clay has long been known as the *Exogyra texana* bed, because of the abundance of the species. A list of localities for the species in Texas would include almost every known exposure of these formations. The collections described by Roemer were from one or both of these formations on the hills near Fredericksburg; in the San Saba Valley near the old Spanish fort; at several places on the road from New Braunfels to Fredericksburg; and in the neighborhood of the Waco camp on the Guadalupe River above New Braunfels.

The specimens here figured are from the Walnut clay 9 miles from Austin, Tex., on the road to Bee Caves in Travis County; Horse Creek half a mile east of Greenwood and 12 miles northeast of Decatur in Wire County; and Black Creek 7 miles northeast of Decatur and 1½ miles north of Fredericksburg in Gillespie County; from the Comanche Peak limestone at Post Mountain 1 mile west of Burnet in Burnet County; and 1 specimen from Bell County, exact locality and stratigraphic position unknown but probably from the Walnut.

The species has been reported from several localities in the Glen Rose limestone, but most of them that I have been able to examine are referable to the variety *weatherfordensis* rather than to the typical form of the species.

Near Belvidere and in Clark County in southern Kansas the species occurs in the Kiowa shale associated with a fauna that agrees in most of its elements with the Washita fauna. In western Texas, also near Kent, *Exogyra texana* is found in the lower part of the local section in which only the Washita group appears to be represented. Farther west, however, in the Quitman and Finlay Mountains and near El Paso it is confined to the Fredericksburg group, as in central Texas. The most westerly locality known is the Sierra de los Conchas, near Arivechi, Sonora, Mexico.

Exogyra texana weatherfordensis Cragin

Plate 30, figures 3–12

1893. *Exogyra weatherfordensis* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 188, pl. 45, figs. 7–10.

1898. *Exogyra texana* Roemer var. *weatherfordensis* Cragin. Hill and Vaughan, U. S. Geol. Survey Bull. 151, p. 30.

1919. *Exogyra weatherfordensis* Cragin. Böse, Texas Univ. Bull. 1902, p. 5, pl. 1, figs. 1, 2.

1920. *Exogyra weatherfordensis* Cragin. Adkins and Winton, Texas Univ. Bull. 1945, p. 65, pl. 13, figs. 11–14.

1928. *Exogyra weatherfordensis* Cragin. Adkins, Texas Univ. Bull. 2838, p. 114.

This variety is considerably smaller than the average adult of the typical *Exogyra texana* and varies in outline through about the same limits. The lower valve is generally less convex, usually has a large area of attachment, is rarely carinate and is more commonly nearly smooth, the radiating sculpture being much less prominent than in the typical variety and ordinarily developed only on the anterior portion. The upper valve is flat or concave, nearly smooth over the larger area, more or less thickened, with lamellae of growth on the anterior portion; radiating sculpture generally not developed and rarely distinct. The features of the interior of the shell are very similar to those of the typical variety except that the cardinal tooth is not so well-developed.

One of the figured specimens larger than the average measures 53 mm. in length, 42 mm. in breadth, and 14 mm. in convexity of the two valves. Corresponding dimensions of another specimen are 48 mm., 25 mm., and 15 mm.

Although these differences will generally serve to distinguish this variety from the more typical forms of the species, of which it is evidently the immediate ancestor, there are some specimens, especially of immature individuals, associated with it and apparently belonging to it that can be exactly duplicated in the higher beds where the more regular and highly sculptured form prevails.

In the original description Cragin speaks of "caudate specimens," though none is figured. It is possible that some of those may belong to *Exogyra hilli*, which seems to be a distinct species.

Cotypes in the Texas State collections at Austin: 5 topotypes, U.S.N.M. 103212a-e; plesiotypes, 103211a-b.

Locality and position: The specimens in the Geological Survey collections are mainly from the upper beds of the Glen Rose limestone in Travis, Hays, and Blanco Counties, west of Austin, and 10 miles northeast of Kerrville in Kerr County. Some are labeled "Cowhouse Creek, Coryell County, Texas," and are presumably from the Glen Rose limestone. Cragin's types are from the Glen Rose limestone a quarter of a mile west of Weatherford in Parker County, and 4 miles west of Montell in Uvalde County, Tex.; some specimens from the type locality have been received through the courtesy of Professor Cragin, and figures of 3 of them are given to show the range of variation. (See pl. 30, figs. 5–8.) The variety likewise occurs in the Fredericksburg group of north-central Texas.

Exogyra walkeri White

Plate 31, figures 1, 2; plate 32, figures 1, 2

Not 1821. *Ostrea americana* Defrance, Dictionnaire des sciences naturelles, tome 22, p. 23, Paris.

Not 1830. *Ostrea americana* Deshayes, Encyclopédie méthodique, Hist. nat. des Vers, tome 2, p. 304, Paris.

1858. *Gryphaea sinuata* var. *americana* Marcou, Geology of North America, p. 37, pl. 3, fig. 1.

1869. *Ostrea torosa* Coquand (part), Monographie du genre Ostrea, terrain crétacé, p. 38, Marseilles (not *O. torosa* Morton, 1834).

1879. *Exogyra valkeri* White, U. S. Geol and Geog. Survey Terr. 4th Ann. Rept., p. 278, pl. 1, figs. 1a, 1b.

1884. *Exogyra walkeri* White, U. S. Geol. Survey 4th Ann. Rept., p. 307, pl. 54, figs. 1, 2.

1893. *Exogyra americana* (Marcou) (part), Cragin, Texas Geol. Survey 4th Ann. Rept., p. 183.

1920. *Exogyra americana* (Marcou). Adkins and Winton, Texas Univ. Bull. 1945, p. 66, pl. 14, figs. 1, 2.

1925. *Exogyra americana* (Marcou). Winton, Texas Univ. Bull. 2544, p. 55, pl. 11, fig. 4.

1928. *Exogyra americana* (Marcou). Adkins, Texas Univ. Bull. 2838, p. 111, pl. 15, fig. 4.

Shell large, auriform; beaks strongly spiral though not very conspicuous. Lower valve moderately convex, divided by the curved, broadly rounded umbonal ridge into a larger, nearly flat, horizontal area, and a more narrow, almost vertical area; beak generally not elevated above the general surface of the shell; surface marked only by lines of growth on the smaller vertical area, whereas the larger flat portion also bears prominent irregular wrinkles and ridges parallel with the growth lines. Upper valve flat or slightly concave; its spiral beak about as conspicuous as that of the lower valve; surface marked only by lines and lamellae of growth, the latter being conspicuous near the antero-ventral border, which in most specimens is sharply flexed upward. Interior of both valves showing numerous, rather obscure cross-striation around the margin; adductor muscular impressions large, broadly suboovate, deeply excavated; ligamental furrow rather broad, curved, distinctly defined; an incipient striated cardinal tooth in the upper valve fitting in a pit in the lower.

White's type, which is somewhat broader and less convex than the average, measures 150 mm. in length, 120 mm. in breadth, and 48 mm. in convexity. Marcou's figure of his *Gryphaea sinuata* var. *americana* is 165 mm. in length and 126 mm. in breadth. Another specimen is 150 mm. in length, 115 mm. in breadth, and 66 mm. in convexity. Corresponding dimensions of still another example,

perhaps more nearly normal, are 154 mm., 106 mm., and 54 mm.

This large and well-marked species has been much confused with several totally different forms. Marcou published a good figure of the lower valve, but he supposed it to be only a variety of *Gryphaea sinuata* Sowerby (1822, p. 43, pl. 336), a species with which it has little in common, except large size and a somewhat similar outline. Coquand, supposing it to be identical with the forms commonly known as *E. costata* Say and *E. ponderosa* Roemer, listed it with them under the name *Ostrea torosa*, which was given by Morton (1833, p. 130, pl. 10, fig. 1) to a poorly preserved specimen probably belonging to *E. costata*. These forms are confined to much younger beds and are wholly different in form from *E. walkeri*, which, like *E. texana*, belongs in the section *Ceratostreon* Bayle. White described the species without referring to Marcou's figure and description, which he apparently overlooked. Marcou's varietal name, *americana*, would be the proper designation of the species if it had not already been used for an *Exogyra* by Deshayes (1830, p. 304), who described as *Ostrea americana* a form from Delaware that seems to be a nearly smooth variety of *E. costata*. An *Ostrea americana* had been described still earlier by Defrance (1821, p. 23), but as it was not an *Exogyra* I do not consider it as having any bearing on this question. However artificial *Exogyra* may be as a genus, it is an easily distinguished and useful group, the distinctly spiral character of the beaks of both valves, and the marked tendency to develop a hinge tooth, separating it readily from *Ostrea*. The many changes in specific names made by Coquand and others in transferring the species *Exogyra* to *Ostrea* seem to me unnecessary and undesirable.

Exogyra walkeri White thus stands as the earliest available name for the species. No other described American forms seem to be sufficiently close to require detailed comparison, though it has also been confused with *E. quitmanensis* Cragin and *E. aquila* (Brongniart).

Types: Cotypes, U.S.N.M. 8039; plesiotypes, 7068, 103213.

Locality and position: White's types came from Salado, Bell County, Tex., from the Fort Worth limestone. Marcou's figured specimen was found on Red River near Preston in Grayson County. Of the other specimens now figured the larger is from Hays County, and the other from Denison in Grayson County, Tex. It has also been obtained at a number of localities in south-central and western Texas. The species is a widespread marker of the Forth Worth limestone, but has been recorded also from the Duck Creek limestone (Adkins, 1928, p. 111). A specimen that possibly belongs to this species was obtained from the Goodland limestone of Little Mineral Creek in Grayson County, Tex., at U. S. Geological Survey Mesozoic locality 7492.

Genus PECTEN Mueller, 1776

Pecten (Syncyclonema) inconspicuus Cragin

Plate 15, figures 1–9

1895. *Pecten inconspicuus* Cragin, Colorado College Studies, Ann. Pub. 5, p. 51.

1895. *Pecten inconspicuus* Cragin, Am. Geologist, vol. 16, p. 375.

1920. *Pecten inconspicuus* Cragin. Adkins, Texas Univ. Bull. 1856, p. 123, pl. 11, fig. 4.

1928. *Pecten (Camptonectes?) inconspicuus* Cragin. Adkins, Texas Univ. Bull. 2838, p. 124.

Shell small, subcircular to ovate in outline, compressed, subequivalve; ears relatively large, triangular with the external angles rounded; anterior ear larger and differing in form from the posterior ear, and in the right valve having a small, distinct byssal notch; surface almost smooth but showing under a lens numerous very fine growth lines, which are coarser and more prominent on the ears, especially near the line of their junction with the body of the shell. Some specimens also show somewhat more prominent concentric sculpture near the beak and a few distant, impressed growth lines at later stages. In a few examples, traces of minute, radiating sculpture consisting of curved striae like those of *Camptonectes*, were detected.

A specimen somewhat larger than the average measures 12 mm. in height and 11 mm. in length. The convexity of both valves united is not more than 2 mm.

Types: 3 cotypes, U.S.N.M. 32684; plesiotypes, 103214a-c, 103215a-b.

Locality and position: The types were obtained in the Pawpaw formation on the east slope of Pawpaw Creek near Denison in Grayson County, Tex., where the species is abundant. The species also occurs sparingly in the Kiowa shale near Belvidere, Kans., and a few imperfect molds that may belong to it have been collected in the Washita group near Kent and El Paso in western Texas. It is recorded from the Weno clay of Grayson and Cooke Counties, Tex. (Adkins, 1920, p. 124).

Pecten (Syncyclonema) inconspicuus pecosensis Stanton, n. var.

Plate 15, figures 10–12

This variety has almost exactly the form of typical *Pecten inconspicuus*, except that it is somewhat more convex, and the ears are relatively not

so large. It appears also to be uniformly smaller. In a collection of 20 specimens the largest measures only 8 mm. in height, and the average height is not more than 5 mm. The sculpture is even less conspicuous than in the typical variety.

Types: Cotypes, U.S.N.M. 103216a-c; 3 unfigured paratypes, 103217a-c.

Locality and position: Common in the upper part of the Devils River limestone of Washita age, at the high bridge across Pecos River near its mouth. It occurs 6 miles northeast of Kerrville in Kerr County, and near Kickapoo Springs at the head of the west branch of Nueces River in Edwards County, Tex., in rocks that are referred to the Edwards limestone.

Pecten (Chlamys?) catherina (Cragin)

Plate 6, figures 3, 4, 6, 7

1893. *Vola catherina* Cragin, Geol. Survey Texas 4th Ann. Rept., p. 216.

The following is Cragin's original description:

Apiculate-subrotund, compressed; ornamented with about twenty remote, narrowly compressed, abruptly elevated, round-backed, spinigerous, radiating ribs; the spines delicate and of moderate length, arranged in irregular concentric rows, which are moderately remote upon the proximal part and increasingly so toward the base; right valve moderately convex, left valve flat or slightly concave; ears not preserved in the type.

Measurements (approximate): Height 38.5, length 36, breadth 11 mm.

Occurrence: This rare and prettily ornamented species is based on a single specimen obtained by Mr. Leverett on Barton Creek, about one-eighth of a mile southwest of Barton's Spring, near Austin, in the Fort Worth limestone.

On the basis of the type and of better-preserved material the species may be redescribed as follows:

Shell rather small, subovate in outline, slightly inequivalve, valves gently convex; left valve slightly more convex than right valve; surface of each valve ornamented by 16 to 18 rather prominent, round-topped, radiating ribs, each slightly narrower than the flat interspaces, and bearing scattered, irregular tubercles or incipient spines that are more closely arranged on the middle than toward the margin of the shell; ears of left valve triangular, the anterior ear somewhat the larger and marked by prominent concentric lines.

On Cragin's type specimen the right valve has been flattened considerably, whereas more perfect specimens are more nearly equivalve. The species belongs in the same group with *Pecten generosus* (Cragin), although the sculpture is very much more prominent.

Types: Holotype in Texas State collections at Austin; plesiotype, U.S.N.M. 103218.

Locality and position: Georgetown limestone, about an eighth of a mile southwest of Bartons Spring near Austin in Travis County; Edwards limestone, about 5 miles west of Crawford in McLennan County, Tex.

Pecten (Chlamys?) generosus (Cragin)

Plate 21, figures 8, 9

1893. *Lima generosa* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 193.

1928. *Lima generosa* Cragin. Adkins, Texas Univ. Bull. 2838, p. 133.

Shell of medium size, ovate in outline, moderately convex, the left valve slightly more so than the right; posterior ear rather large, triangular, distinctly separated from the body of the shell; anterior ear not preserved; sculpture consisting of small, obscure radiating ribs and fine lines, crossed by crowded growth lines some of which bear elongated tubercles or incipient spines at some of their intersections with the radiating ribs. The left valve bears about 15 of the low, rounded equidistant ribs on the middle three-fourths of the shell, and 3 to 4 or more unequal fine lines in each interspace, whereas the anterior and posterior portions bear only growth lines and numerous very faint curved radiating lines. On the right valve the ribs are still more obscure and show a tendency to arrange themselves in pairs with fainter, irregularly arranged lines that disappear before reaching the margin. The posterior ears are rather large, triangular, and have a somewhat obtuse outer angle. The anterior ears are not preserved.

Height 62 mm., length 52 mm., convexity of both valves 16 mm.

This description is drawn from the type in the Texas State collection, which is the only authentic specimen I have seen.

Locality and position: The type is from the Georgetown limestone on the San Gabriel River southeast of Georgetown, Williamson County, Tex.

Pecten (Chlamys) stantoni Hill

Plate 24, figures 1–5

1893. *Pecten stantoni* Hill, Biol. Soc. Washington Proc., vol. 8, p. 24, pl. 2, figs. 3, 3a.

1904. *Pecten stantoni* Hill. Stanton, U. S. Geol. Survey Prof. Paper 21, p. 70, pl. 16, fig. 2.

1928. *Pecten (Chlamys) stantoni* Hill. Adkins, Texas Univ. Bull. 2838, p. 123.

Shell rather small, ovate, nearly equivalve, moderately convex; anterior ear of right valve with a distinct byssal sinus; posterior ear rather large, triangular, and distinctly marked off from the body of the shell; sculpture similar on both valves, consisting of numerous small radiating ribs crossed by finer, elevated concentric lines, giving the surface a rough, scabrous appearance, especially on the

ears and the anterior and posterior portions of the valve. On the larger middle part of the valve there are relatively larger flat ribs, each bearing a shallow, longitudinal groove and alternating with simple linear ribs, but toward the anterior and posterior margins the ribs become more nearly equal in size and all are simple.

An average specimen measures about 55 mm. in height, 43 mm. in length, and 18 mm. in convexity of both valves.

Types: Holotype in the Hill collection at Johns Hopkins University; plesiotypes, U.S.N.M. 103219, 103220, 103456.

Locality and position: The types were obtained in the Glen Rose limestone near Glen Rose, Somervell County, Tex., where the species is fairly common. It has also been collected from the same formation 2 miles northwest of Travis Peak post office and near Driftwood, Travis County, Tex. A fragment belonging to this species was collected from beds of Trinity age at Mule Mountain, Ariz.

Pecten (Chlamys) stantoni quitmanensis Stanton, n. var.

Plate 24, figures 6, 9

This variety differs from the typical form of the species in its slightly more convex form and coarser sculpture. The larger ribs on the body of the shell are simple and rounded instead of flat and grooved.

The type of the variety measures 49 mm. in height, 41 mm. in length, and 20 mm. in convexity.

Types: Holotype, U.S.N.M. 103221; figured paratype, 103222.

Locality and position: The type specimen was found in the southern part of Quitman Mountains near the Rio Grande, on the old Indian trail to Hot Spring, Hudspeth County, Tex. Its position is apparently 100 feet or more above the principal fossiliferous zone of the Quitman formation of Taff, but probably within the same formation. Another imperfect specimen was collected from the Trinity group in the southeastern corner of Arizona, near monument No. 73 of the U. S. and Mexican Boundary Survey.

Pecten (Neithea) subalpinus (Böse)

Plate 44, figures 7, 8

1910. *Vola subalpina* Böse, Inst. geol. México Bol. 25, p. 96, pl. 15, figs. 5, 7–9.
1919. *Neithea subalpina* (Böse). Kniker, Texas Univ. Bull. 1817, p. 28, pl. 5, fig. 4.
1919. *Neithea subalpina* var. *linki* Kniker, Texas Univ. Bull. 1817, p. 30, pl. 5, figs. 5, 6.
1920. *Pecten subalpina* (Böse). Adkins and Winton, Texas Univ. Bull. 1945, p. 68, pl. 11, figs. 1, 2; pl. 12, figs. 3–15.
1925. *Pecten subalpina* (Böse). Winton, Texas Univ. Bull. 2544, p. 50, pl. 10, figs. 1, 3.
1928. *Pecten (Neithea) subalpinus* (Böse). Adkins Texas Univ. Bull. 2838, p. 127, pl. 17, figs. 1, 3.
1928. *Pecten (Neithea) subalpinus* var. *linki* Kniker. Adkins, Texas Univ. Bull. 2838, p. 128.
1938. *Pecten (Neithea) subalpinus* (Böse). Jones, Geol. Soc. America Bull., vol. 49, p. 108.

Shell small, slender, very inequivalve; ears small, subequal, triangular, the external angles slightly less than right angles; sculpture of the convex right valve consists of 6 narrow principal ribs which form distinct angulations on the margin of the shell, and of 2 subordinate ribs in each interspace, all the ribs narrow, elevated, and about equal in breadth to the intervening spaces. Left valve slightly concave, with 17 unequal radiating ribs, 2 larger ribs corresponding in position with each of the principal ribs of the other valve, and a small single rib in each space between the pairs.

The figured specimen has the following measurements: Height 23 mm., length 18 mm., convexity 8 mm., hinge line 10 mm., umbonal angle 80°. A larger specimen from Austin measures 31 mm. in height and has an umbonal angle of 90°.

This species has about the proportions of *Pecten occidentalis* (Conrad) and the sculpture of *P. texanus* Roemer, so far as the number and arrangement of the ribs are concerned. Compared with the latter species, with which it is associated, it is more slender, has differently shaped ears, and ribs relatively narrower and more elevated. *Pecten occidentalis* has marked differences in the sculpture of both valves, especially of the left valve.

Plesiotype: U.S.N.M. 8332.

Locality and position: The figured specimens were collected in the Georgetown limestone in Bell County, and at the Gap near Austin in Travis County, Tex. The species is widespread in Texas and Mexico in the Fredericksburg and Washita groups.

Pecten (Neithea) bellulus (Cragin)

Plate 42, figures 3–7

1893. *Vola bellula* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 216.
1919. *Neithea bellula* (Cragin). Kniker, Texas Univ. Bull. 1817, p. 22, pl. 3, figs. 3–11.
1920. *Pecten bellula* (Cragin). Adkins and Winton, Texas Univ. Bull. 1945, p. 69, pl. 11, figs. 3–7.
1925. *Pecten bellula* (Cragin). Winton, Texas Univ. Bull. 2544, p. 55, pl. 10, fig. 5.
1928. *Pecten (Neithea) bellula* (Cragin). Adkins, Texas Univ. Bull. 2838, p. 125, pl. 17, fig. 5.

Shell small, rather slender, very inequivalve, right valve very convex and left valve slightly concave; ventral margin almost a semicircle with 6 slight but distinct projecting angles corresponding with the

small principal ribs; ears small, triangular, subequal; surface of each valve marked by 6 slightly differentiated principal ribs, 45 to 50 subequal linear ribs, and by numerous very fine concentric lines of growth. In well-preserved specimens of the convex right valve the principal ribs are represented by faint angulations which nearly or entirely disappear when the surface is worn or exfoliated. The closely arranged, fine ribs on the convex right valve are somewhat broader than the interspaces, and somewhat narrower on the concave left valve. On the concave valve also the principal ribs are more distinct, forming broad ridges each of which bears 2 or 3 of the linear ribs.

A small specimen has the following measurements: Height 26 mm., length 21 mm., convexity 8 mm., hinge line 7 mm., umbonal angle 100°. A larger specimen is 32 mm. in height and 27 mm. in length. Cragin's types are smaller, immature individuals.

Types: Three cotypes in Texas State collection at Austin; plesiotypes, U.S.N.M. 103223, 103224a-b.

Locality and position: The species appears to be confined to the Fort Worth limestone and upper part of the Duck Creek limestone and their equivalents, and is not very abundant. The material studied by Cragin was from Sycamore Creek near Fort Worth, Tarrant County, and from Austin, Travis County, Tex. Of the specimens here figured the smallest is from the neighborhood of Bartons Springs near Austin, and the other 2 were collected 10 miles north of Fort Worth. In the Geological Survey collections are specimens from Taylors Creek, Travis County, and from a locality near Denison, Grayson County, Tex.

Pecten (Neithea) duplicicosta Roemer

Plate 39, figures 1, 2

1849. *Pecten duplicicosta* Roemer, Texas, p. 398, Bonn.
1852. *Pecten duplicicosta* Roemer, Die Kreidebildungen von Texas, p. 65, pl. 8, figs. 2a, 2b, Bonn.
1859. *Neithea duplicosta* (Roemer). Gabb, Catalogue of the invertebrate fossils of the Cretaceous formation of the United States, with references, p. 14. Philadelphia.
1889. *Pecten duplicosta* Roemer. Hill, Texas Geol. Survey Bull. 4, p. 8.
1893. *Vola duplicicosta* (Roemer). Cragin, Texas Geol. Survey 4th Ann. Rept., p. 217.
1919. *Neithea duplicicosta* (Roemer). Kniker, Texas Univ. Bull. 1817, p. 19, pl. 2, figs. 7, 8; pl. 3, figs. 1, 2.
1928. *Pecten (Neithea) duplicicosta* Roemer. Adkins, Texas Univ. Bull. 2838, p. 126.

Shell rather large, subcircular in outline, very inequivalve, the right valve strongly arched, the left valve slightly concave; surface of the right valve marked by 6 broad, subangular, principal ribs that produce slight angulations on the ventral margin, and by numerous subequal subordinate ribs, of which there are about 3 on each of the principal ribs and 2 in each interspace, all crossed by numerous, regular, fine, concentric lines. No perfectly preserved left valve has been seen, but from molds and fragments it is evident that the sculpture is similar to that of the right valve except that the principal ribs are much less strongly marked. The ears are triangular, subequal, and inconspicuous in the adult, but in a young right valve (pl. 39. fig. 2) they are relatively large, and the anterior one is rounded and shows a distinct byssal notch.

A medium-sized specimen measures 60 mm. in height, 65 mm. in length, and about 25 mm. in convexity; umbonal angle 110° to 120°.

Some specimens from near the head of Frio River show sculpture variously disguised according to the state of preservation. The most common change is a reduction in the size and angularity of the principal ribs between which there are 3 subordinate ribs in each interspace, giving the shell the appearance of a distinct species, but this change is caused by a combination of internal and external features due to the accidents of fossilization.

The sculpture of this species somewhat resembles that of *Pecten roemeri* Hill (1889, p. 8), and the opinion has been expressed that the two might be identical. A comparison of specimens shows that they are not even closely related, *P. roemeri* being a much larger and almost equivalved form.

Plesiotypes: U.S.N.M. 103225, 103226.

Locality and position: The species is not very common and appears to be restricted to the Edwards limestone. Roemer's type came from the upper course of Pedernales River, and Cragin's specimens from South Mountain, Gillespie County, Tex. The smaller of the specimens here figured is from the southern end of the Quitman Mountains in Hudspeth County, and the larger one from the Edwards Plateau near the head of Frio River in Edwards County where the species is common. The Geological Survey collections also contain specimens from Kickapoo Springs at the head of the west fork of Nueces River in Edwards County, from a locality near Belton in Bell County, and from Bluff Creek 5 miles from Crawford in McLennan County, Tex.

Pecten (Neithea) occidentalis (Conrad)

Plate 27, figures 1–4

1849. *Pecten quadricostatus* Roemer (part), Texas, p. 398, Bonn.
1852. *Pecten quadricostatus* var. Roemer, Die Kreidebildungen von Texas, p. 64, pl. 8, figs. 4a–4c, Bonn.
1855. *Neithea occidentalis* Conrad, Acad. Nat. Sci. Philadelphia Proc. for 1854-1855, p. 269.

1857. *Neithea occidentalis* Conrad, U. S. and Mex. Boundary Survey, vol. 1, pt. 2, p. 150, pl. 5, figs. 1a, 1b.
1895. *Vola fredericksburgensis* Cragin, Colorado Coll. Studies Ann. Pub. 5, p. 52.
1895. *Vola occidentalis* (Conrad). Cragin, Am. Geologist, vol. 16, p. 375.
1910. *Vola irregularis* Böse, Inst. geol. México Bol. 25, p. 78, pl. 15, figs. 10–18.
1919. *Neithea irregularis* (Böse). Kniker, Texas Univ. Bull. 1817, p. 18, pl. 2, figs. 1–6.
1924. *Pecten fredericksburgensis* Cragin. Twenhofel, Kansas Geol. Survey Bull. 9, p. 78, pl. 22, fig. 5.
1925. *Pecten irregularis* (Böse). Winton, Texas Univ. Bull. 2544, p. 48, pl. 10, fig. 8.
1928. *Pecten (Neithea) irregularis* (Böse). Adkins, Texas Univ. Bull. 2838, p. 126, pl. 17, fig. 8.
1928. *Pecten (Neithea) occidentalis* (Conrad). Adkins, Texas Univ. Bull. 2838, p. 126.

Shell of moderate size, rather slender, very inequivalve, right valve strongly arched, left valve slightly concave; ears of moderate size, subequal, triangular, with the outer angles 90° or less; sculpture of the convex right valve consists of 6 principal ribs ending in rather prominent angulations of the ventral margin, with 2 smaller ribs in each interspace, the ribs all slender, elevated, more or less angular or narrowly rounded, about equal in breadth to the grooves between them, and crossed by numerous fine, concentric lines. The principal ribs are not simple, but each is buttressed on one side or both sides by a much smaller linear rib. The 2 external principal ribs have these supplementary ribs only on their inner sides, and most of the other 4 commonly have them on both sides, although 1 or more may be buttressed on only one side. The ears, and the area between them and the external principal ribs, are marked by concentric growth lines. The ribs of the concave left valve alternate with those of the convex right valve and are unequal in size and arrangement. In typically developed left valves the arrangement consists of elevated groups of 2 pairs of linear ribs separated by equally wide, depressed spaces, each bearing a single large rib in its middle. The duplication of small ribs forming groups of 4 is directly associated with the supplementary buttressing ribs of the convex valve, and whenever one of these is absent the corresponding pair is represented by a single rib so that the group consists of 3.

One of the specimens figured somewhat larger than the average, has the following measurements: Height 37 mm., length 33 mm., convexity 11 mm., hinge line 14 mm. Corresponding dimensions of the smaller figured specimen are 28 mm., 33 mm., 9 mm., and 12 mm. Roemer's original figure is 40 mm. in height and 38 mm. in length. The umbonal angle varies little from 90°.

A form that occurs in the Quitman formation of west Texas has relatively larger and more angular principal ribs and perhaps deserves recognition as a distinct variety. *Pecten texanus* Roemer, with which the species has sometimes been confused, is easily distinguished by its more robust form and simpler sculpture of both valves. Choffat (1885, p. 89, pl. 5, figs. 8–10) has described a very similar but apparently distinct species under the name *Janira ficalhoi*, from the Province of Angola on the west coast of Africa. The general plan of sculpture is the same, but there are some differences in details. The most closely related Texan form is *Pecten subalpinus* Böse, which differs mainly in its simpler sculpture, the principal ribs of the convex valve being simple, and the corresponding ribs of the other valve a pair instead of 2 pairs.

Types: Paratypes, U.S.N.M. 9872; plesiotypes, 103227, 103228, 103229.

Locality and position: This species is one of the most common and widely distributed Pectens of the Fredericksburg group, especially of the Comanche Peak limestone. It occurs sparingly in the Walnut clay and the Edwards limestone, and in some areas it also ranges both below and above the limits of the Fredericksburg group. In the Quitman Mountains of western Texas many specimens of the angular variety were collected in the Quitman formation of Taff of the Trinity group; one of these is shown on plate 27, figure 4. It was also collected in the Glen Rose limestone at several localities in the Austin region, Tex.

Roemer's type came from the neighborhood of Fredericksburg in Gillespie County, Tex., probably from the Comanche Peak limestone. The smaller of the typical specimens here figured (see pl. 27, figs. 2, 3) is from the Comanche Peak limestone 9 miles northeast of Kerrville in Kerr County, and the large one is from the same formation at Benbrook in Tarrant County (see pl. 27, fig 1).

In the central Texas area the species has not been seen in the Kiamichi formation, but it occurs in that formation at Kent in Culberson County and in west Texas. It also occurs in the Purgatoire formation near Mesa Tucumcari, N. Mex., and in the lower part of the Kiowa shale near Belvidere, Kans.

Pecten (Neithea?) roemeri Hill

Plate 35, figures 1, 2; plate 36, figures 1, 2

1889. *Pecten (Vola?) roemeri* Hill, Paleontology of the Cretaceous formations of Texas, pt. 1, Texas Univ. School Geology, p. [5], pl. 1.
1903. *Pecten roemeri* Hill. Shattuck, U. S. Geol. Survey Bull. 205, p. 15, pls. 2–4; pl. 5, fig. 1.
1919. *Neithea roemeri* (Hill). Kniker, Texas Univ. Bull. 1817, p. 43, pl. 9, figs. 1–3; pl. 10, fig. 1.
1928. *Pecten (Neithea) roemeri* Hill. Adkins, Texas Univ. Bull. 2838, p. 126.

Shell large, broadly subovate in outline, with 6

unequally spaced angulations on the ventral margin, moderately convex, the right valve slightly more arched than the left; ears large, triangular, unequal, the anterior smaller, more distinctly separated from the body of the shell, and with a shallow byssal sinus; sculpture of both valves similar, the ribs of one valve alternating with those of the other. The ears are covered with coarse, radiating striae. The body of the shell bears 6 unequal, radiating principal ribs corresponding with the angulations of the margin, and 2 to 4 unequal subordinate ribs in each interspace. Most of the ribs are subangular, but some are broadly rounded, and rarely one is flat-topped. The sculpture is not symmetrical with reference to a line from the beak to the middle of the base, the third principal rib from the front in the right valve differing from all the others in that it is flanked on either side by a rib as large as itself, or nearly as large. The surface of the shell is also covered with distinct irregular lines and corrugations of growth.

An average specimen has the following measurements: Height 110 mm., length 127 mm., convexity 62 mm., hinge-line 75 mm.

Types: Holotype in the Hill collection at John Hopkins University; 4 paratypes (?), U.S.N.M. 19144a-b; 2 plesiotypes, 30213.

Locality and position: The species is confined to the Buda limestone in central and western Texas. It is most abundant on Shoal Creek in the neighborhood of Austin. It has been found in Reeves County at the San Martine tank on the Texas & Pacific Railroad 8 miles east of Kent, and also near Bosqueville in McLennan County, Tex. (Adkins, 1933, p. 398).

Pecten (Neithea) texanus Roemer

Plate 38, figures 2, 4, 5; plate 39, figures 3–5, 7

1849. *Pecten aequicostatus* Roemer (not Lamarck), Texas, p. 398, Bonn.
1849. *Pecten quadricostatus* Roemer (part) (not Sowerby), Texas, p. 398, Bonn.
1852. *Pecten texanus* Roemer, Die Kreidebildungen von Texas, p. 65, pl. 8, figs. 3a, 3b, Bonn.
1852. *Pecten quadricostatus* Roemer (part) (not Sowerby), Die Kreidebildungen von Texas, p. 64, Bonn.
1853. *Pecten quadricostatus* Shumard (not Sowerby), in Marcy, R. B., Exploration of the Red River of Louisiana: U. S. 32d Cong., 2d sess., S. Doc. 54, p. 204, pl. 2, figs. 2a, 2b; pl. 3, fig. 6.
1857. *Neithea texana* Roemer. Conrad, U. S. and Mex. Boundary Survey Rept., vol. 1, pt. 2, p. 151, pl. 5, figs. 2a, 2b.
Not 1861. *Pecten texanus* Gabb, Acad. Nat. Sci. Philadelphia Proc. for 1861, p. 365.
1903. *Pecten texanus* Roemer. Shattuck, U. S. Geol. Survey Bull. 205, p. 17, pl. 5, figs. 7, 8 (not 6).
1910. *Vola texana* (Roemer) Böse, Inst. geol. México Bol. 25, p. 93, pl. 15, fig. 3.
1910. *Vola texana* var. *elongata* Böse, Inst. geol. México Bol. 25, p. 95, pl. 15, figs. 2, 4, 6.
1919. *Neithea texana* (Roemer). Kniker, Texas Univ. Bull. 1817, p. 25, pl. 4, figs. 4–7; pl. 5, fig. 1.
1919. *Neithea texana* var. *elongata* (Böse). Kniker, Texas Univ. Bull. 1817, p. 28, pl. 5, figs. 2, 3.
1920. *Pecten texanus* Roemer. Adkins and Winton, Texas Univ. Bull. 1945, p. 71, pl. 12, fig. 2.
?1924. *Pecten texanus* Roemer. Twenhofel, Kansas Geol. Survey Bull. 9, p. 78.
1928. *Pecten (Neithea) texanus* Roemer. Adkins, Texas Univ. Bull. 2838, p. 127, pl. 17, figs. 2, 4.
1928. *Pecten (Neithea) texanus* var. *elongatus* Böse. Adkins, Texas Univ. Bull. 2838, p. 127.

Translation of Roemer's original description:

Shell rounded, triangular, with one valve strongly arched and the other almost flat. Left valve regularly strongly arched, its surface ornamented by 15 to 17 almost equal, smooth, flat-topped radiating ribs which are separated by smooth furrows scarcely half the breadth of the ribs. The upper valve is flat, covered with quite flat, unequal, radiating ribs with interspaces about equal in breadth to the ribs themselves.

The species was based on a single specimen, but by means of the description and figure it is easily identified with a very common and somewhat variable species of the Washita group. No specimens seen have exactly such sculpture on the flat valve as is described, and it is probable that the type was poorly preserved and misleading in that respect.

In the form most nearly resembling the type, 6 of the ribs on the convex right valve are slightly more prominent than the others and form obscure angulations on the ventral margin. There are 2 slightly smaller ribs in each space between the 6 principal ones, and all have flat or very broadly rounded tops. On the flat left valve the ribs are narrow, rounded, and at the ventral margin not more than half as broad as the interspaces. They alternate with the ribs on the other valve, and the pairs corresponding to the 6 principal ribs are slightly more prominent than the single ribs below them. Both valves are also covered with fine, closely arranged, concentric lines. The conspicuous angle formed at the beak by the outer side of the flat valve is about 110°, never less than 100°.

The ears are rather small, subequal, triangular, with the outer angle more or less rounded and somewhat greater than a right angle.

A rather small specimen has the following measurements: Height 41 mm., length 37 mm., convexity 13 mm., hinge line 15 mm. A large example measures 63 mm. in height, 52 mm. in length, and 21 mm. in convexity.

The simplest and most common departure from the typical form is caused by the relatively greater development of the 6 principal ribs, thus forming as many distinct angles on the ventral margin and

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giving the whole shell a more angular appearance. It is commonly associated with greater convexity. There is considerable variation in the relative length of the hinge line and the size of the ears. The variations in this respect do not seem to be strictly correlated with any of the other modifications, though as a rule the typical form has a longer hinge and larger ears. There seems to be perfect gradation from *Pecten texanus* to *P. subalpinus* (Böse), and the specific assignment of some specimens is very difficult.

This species has been compared with *Pecten quadricostatus* Sowerby[2] and *P. aequicostatus* Lamarck, from both of which it differs in the smaller number of subordinate ribs as well as in other respects. Another European species that still more closely resembles the angular variety of *P. texanus* is *Janira alpina* D'Orbigny (1847, p. 643, pl. 446, figs. 4–8), which has the same number and arrangement of ribs, but relatively larger ears, a longer hinge line, and broader and coarser ribs.

Pecten (Neithea) subalpinus Böse (1910, p. 96, pl. 15, figs. 5, 7–9) is smaller, more slender, and has relatively larger ears, and narrower, more elevated ribs.

Plesiotypes: U.S.N.M. 103230–34.

Locality and position: The species is common at almost all exposures of the Washita group throughout Texas. At Denison in Grayson County it is especially abundant in the Duck Creek limestone, Denton clay, Fort Worth limestone, and Grayson marl. In the Austin section in Travis County it has a similar range, occurring in the Georgetown, Del Rio, and Buda formations. It ranges through the entire Washita group at Kent in Culberson County, in the Quitman Mountains and the Sierra Blanca in Hudspeth County, and near El Paso. At El Paso it is found down to the base of the local Cretaceous section in beds that clearly belong to the Fredericksburg group. At Comanche Peak near Granbury in Hood County 3 imperfect specimens apparently belonging to the species were collected in the Comanche Peak formation. It is common along the northern edge of the Staked Plains near Mesa Tucumcari, N. Mex.

Pecten (Neithea) georgetownensis (Kniker)

Plate 37, figures 1, 2; plate 38, figure 3

1919. *Neithea georgetownensis* Kniker, Texas Univ. Bull. 1817, p. 31, pl. 6, figs. 1–3.
1920. *Pecten georgetownensis* (Kniker). Adkins and Winton, Texas Univ. Bull. 1945, p. 70, pl. 12, figs. 5, 6.
1920. *Pecten georgetownensis* (Kniker). Adkins, Texas Univ. Bull. 1856, p. 125.
1925. *Pecten georgetownensis* (Kniker). Winton, Texas Univ. Bull. 2544, p. 59, pl. 10, fig. 7.
1928. *Pecten (Neithea) georgetownensis* (Kniker). Adkins, Texas Univ. Bull. 2838, p. 127, pl. 17, fig. 7.

The species has a form similar to the more convex varieties of *Pecten subalpinus* (Böse) to which it is possibly closely related, as indicated by the sporadic occurrence of radial grooves on the latter. The 6 principal ribs of the convex right valve are invariably well differentiated, and in its simplest form each rib, both subordinate and principal, is marked by a narrow, longitudinal furrow. On some specimens, like that represented on plate 37, figures 1, 2, there are several pronounced furrows on each rib, coarse striation in the intermediate furrows, and similar sculpture on the flat valve. This minor sculpture should not be confused with the striation seen on weathered and exfoliated specimens of *P. subalpinus* or *P. texanus*.

Plesiotypes: U.S.N.M. 103235a-b.

Locality and position: Weno clay and Fort Worth limestone near Fort Worth in Tarrant County, and Georgetown limestone near Austin in Travis County, Tex.

Pecten (Neithea) wrighti (Shumard)

Plate 21, figures 6, 7

1860. *Janira wrightii* Shumard, Acad. Sci. St. Louis Trans., vol. 1, p. 607.
1893. *Vola wrightii* (Shumard). Cragin, Texas Geol. Survey 4th Ann. Rept., p. 217, pl. 32, figs. 2, 3.
1911. *Pecten wrighti* (Shumard). Whitney, Texas Univ. Bull. 184, p. 13, pl. 1, fig. 4.
1913. *Pecten wrighti* (Shumard). Whitney, Texas Acad. Sci. Trans., vol. 12, p. 13, pl. 1, fig. 4.
1919. *Neithea wrighti* (Shumard). Kniker, Texas Univ. Bull. 1817, p. 23, pl. 4, figs. 1–3.
1920. *Pecten wrighti* (Shumard). Adkins and Winton, Texas Univ. Bull. 1945, p. 69, pl. 11, figs. 8–10.
1925. *Pecten wrighti* (Shumard). Winton, Texas Univ. Bull. 2544, p. 53, pl. 10, fig. 6.
1928. *Pecten (Neithea) wrighti* (Shumard). Adkins, Texas Univ. Bull. 2838, p. 125, pl. 17, fig. 6.

Shell rather small, subtriangular in outline, inequilateral and inequivalve, the right valve moderately convex, and the left valve flat; anterior ear of the right valve relatively large, elongate pointed; posterior ear not seen but probably much smaller; each valve marked by 4 very large, subequal, angular ribs, and a fifth smaller posterior rib, each ending in a distinct digitation, and separated from each other by broader, concave interspaces; surface also marked by obscure radial sculpture in the form of a shallow groove on either side of the crest of each rib, 2 or 3 faint lines in the interspaces on the right valve, and very fine, closely arranged concentric lines parallel with the very sinuous ventral margin on both valves. The interior of the shell has numerous, strongly marked, fine radial striae which are

[2] This name is antedated by *Neithea gibbosa* (Pulteney), according to L. R. Cox, Cretaceous mollusca described by R. Pulteney in the second edition of Hutchin's History of Dorset: Malecological Soc. Proc., vol. 24, pt. 3, 1940.

fairly prominent on internal molds and form distinct crenulations on the margin of the shell.

A medium-sized specimen measures 33 mm. in height, 28 mm. in length, and about 12 mm. in convexity.

There is no closely related American species known, but the Cenomanian *Janira digitalis* Roemer and *J. cometa* D'Orbigny, as described by D'Orbigny (1847, pp. 640–642, pl. 445, figs. 15–19; pl. 446, figs. 1–3) are of the same general type both in form and sculpture.

Plesiotypes: U.S.N.M. 103236a-b.

Locality and position: Known mainly from the Fort Worth and Duck Creek limestones. Shumard's type was from Shoal Creek near Austin in Travis County, and the specimens here figured, U.S.N.M. 12245, were collected in the same neighborhood. A single small specimen in the Geological Survey collection is from the International & Great Northern Railroad cut in Austin. Cragin reports it from this locality, from Denton Creek in Denton County, from 3 miles above Roanoke in Williamson County, near Georgetown in Williams County, and from Devils Ridge in Hudspeth County. Adkins and Winton (1920, p. 69, pl. 11, figs. 8, 10) record it from the Main Street limestone near Fort Worth in Tarrant County, Tex.

Genus CTENOSTREON Bayle, 1878

Ctenostreon cumminsi Stanton, n. sp.

Plate 38, figures 1, 6

Shell rather large, subovate in outline, subequivalve, both valves moderately convex; ears moderately large, triangular (full form not preserved on the specimen studied); sculpture of both valves similar, consisting of 12 to 14 strong, subangular, or narrowly rounded ribs generally not so broad as the interspaces; surface also covered with fine growth lines which are the only markings on the ears. The ventral margin is simple, not broken by the ribs.

An average specimen measures 92 mm. in height, 82 mm. in length, and 35 mm. in convexity of the two valves; hinge-line about 47 mm.

This species approaches *Pecten roemeri* in size, but in other respects it is not comparable with any described Comanche species.

Types: Holotype, U.S.N.M. 103237; figured paratype, 103238.

Locality and position: Rather common in the Quitman formation of Taff in the Quitman Mountains, Hudspeth County, Tex.; on the old Indian trail about 3 miles from Hot Spring on the Rio Grande; and several miles farther north at localities 1 to 2 miles south of Quitman Pass. Two small specimens apparently belonging to the species were collected in Guadalupe Canyon in southeastern Arizona.

Genus CHONDRODONTA Stanton, 1901

Since the original description of *Chondrodonta* (Stanton, 1901, pp. 301–307, pls. 25, 26) was published, the genus has been discussed by Douvillé (1902, pp. 314–318, pl. 11), Choffat (1902, pp. 157–161), Hoernes (1902, pp. 667–684, pls. 1, 2), and Schubert (1903, pp. 265–276, pl. 13), who have studied European specimens.

Douvillé studied Portuguese specimens of *Chondrodonta joannae* and confirmed in them all the essential generic features described by me. The structure of the hinge and the arrangement of the chondrophores are especially well shown by figures of 6 parallel sections across the hinge area. Douvillé also finds that *Ostrea desori* Coquand, from the Cenomanian of Angoulême, France, belongs to *Chondrodonta,* and he gives an enlarged figure of the interior of the left valve of this species which shows the interlocking chondrophores characteristic of the genus. The figure also shows on the hinge area near the beak a rather large, longitudinally divided imprint which Douvillé interprets as an anterior muscle scar. He also finds evidence of a distinct pallial line and of a posterior adductor on an internal cast of another specimen, and concludes from all these facts that *Chondrodonta* is closely related to *Pinna.*

Choffat accepts Douvillé's classification, republishing his figures of cross sections of *Chondrodonta joannae,* and refers *Ostrea delgadoi* from the Bellasian of Portugal to the same genus.

Hoernes refers *Chondrodonta* to the Ostreidae in spite of the fact that he accepts Douvillé's evidence of the presence of an anterior adductor, arguing that as ontogeny teaches that all Monomyaria are derived from Dimyaria the presence of 2 adductor muscles is not sufficient to exclude a genus from the Ostreidae. He also cites Chenu as authority for the statement that the ostreid genus *Amphidonta* has 2 muscle impressions.

Schubert concludes from his study of a large number from Istria that *Chondrodonta* is very closely related to *Ostrea* and not even generically distinct. He finds evidence of only a single muscle impression, and sees no reason for associating the group with *Pinna* or other Heteromyaria. He states that some of the specimens studied by him show the typical hinge features ascribed to *Chondrodonta,* whereas in others, especially in thick-shelled, cross-ribbed individuals, the relations of the ligament are not essentially different from those seen in typical *Ostrea.* He also asserts, though he cites no specific examples, that in late Tertiary oysters one of the

ridges accompanying the ligamental furrow is often so developed that a cross section of the shell must be similar to that of *Chondrodonta*.

The large amount of material studied by me has given no evidence of transition in hinge characters between *Chondrodonta* and *Ostrea*, nor have I found illustrations of any species of *Ostrea* that show a hinge structure comparable with that of *Chondrodonta*. The somewhat distinct pallial impression, shown on plate 44, figure 3, and the differences in the hinge are sufficient to justify the separation of *Chondrodonta* from *Ostrea* and its classification under another family.

The only evidence for closely associating *Chondrodonta* with *Pinna* is the supposed anterior muscle scar on the specimen of *C. desori* figured by Douvillé. It seems to me that this imprint must have some other meaning, because, in the first place, a muscle in that position could not be effective. It would have to work in direct opposition to the internal ligament or resilium without the intervention of leverage of any kind, and there is no space for its development. Judging from *Ostrea* and other similar forms, that part of the shell which bears the supposed muscle scar is practically external, so far as the living tissues of the animal are concerned, though it might serve for the attachment of a part of the ligament. In *Hinnites* the ligament fills a deep, narrow groove suggestive of the structure of *Chondrodonta*, but it is also attached to the whole broad area on each side of the groove. In the second place, all the Texan specimens both of *C. munsoni* and *C. glabra* that have been carefully cleaned in the interior of the umbonal region to expose the whole area, fail to show any trace of such a muscular impression as Douvillé figures. Until more convincing evidence is produced the genus may well be left in the Pectinacea, including Pectinidae, Limidae, and Spondylidae, where it was first tentatively placed.

The geographic distribution of the genus is interesting. In America, it has not been reported outside of Texas, although it will doubtless be found in Mexico. In Europe, it occurs in Portugal, France, Italy, and the Adriatic provinces of Austria, always in rudistid limestone.

Chondrodonta glabra Stanton

Plate 39, figures 6, 8, 9; plate 40, figures 1, 2

1901. *Chondrodonta glabra* Stanton, U. S. Nat. Mus. Proc., vol. 24, p. 306, pl. 26, figs. 1–3.
1902. *Chondrodonta glabra* Stanton. Douvillé, Soc. géol. France Bull., 4e sér., t. 2, fasc. 3, p. 315, Paris.
1928. *Chondrodonta glabra* Stanton. Adkins, Texas Univ. Bull. 2838, p. 131.

The species is known only from the type locality, 1 mile east of Kerrville, in Kerr County, Tex. Its form and sculpture are well shown by the figures of the types presented herein.

Types: 2 cotypes, U.S.N.M. 30180a–b; plesiotype, 103239.

Chondrodonta munsoni (Hill)

Plate 41, figure 9; plate 42, figures 1, 2, 8, 9; plate 43, figures 1, 2, 4, 5; plate 44, figures 3–6

1893. *Ostrea munsoni* Hill, Biol. Soc. Washington Proc., vol. 7, p. 105, pl. 12.
1893. *Hippurites flabellifer* Cragin (part), Geol. Survey Texas 4th Ann. Rept., p. 190, pl. 40, fig. 1 (not pl. 38, fig. 3).
1901. *Chondrodonta munsoni* (Hill). Stanton, U. S. Nat. Mus. Proc., vol. 24, p. 303, pl. 25, figs. 1–5.
1928. *Chondrodonta munsoni* (Hill). Adkins, Texas Univ. Bull. 2838, p. 131.

Adkins (1933, p. 345) states that this species seems to be restricted to the upper part of the Edwards formation, and has been found at a number of localities in north-central and south-central Texas; but it also occurs in the Devils River limestone, ranging to a horizon near its top, and therefore well up in the Washita group.

Types: Three cotypes in the Hill collection at Johns Hopkins University; plesiotypes, U.S.N.M. 30181, 30182, 103240a-e.

Genus LIMA Bruguière, 1792

Lima pecosensis Stanton, n. sp.

Plate 37, figures 5, 7

Shell attaining a rather large size, elongate ovate, slightly oblique, moderately convex; ears comparatively large and conspicuous, the posterior about twice as large as the anterior; antero-dorsal margin nearly straight, formed by the abruptly depressed anterior area which is limited by a sharp edge; surface marked by 60 to 70, or more, closely arranged, rounded, radiating ribs, which are well marked on the posterior ear, somewhat less conspicuous on the anterior ear and area, and increase in size toward the antero-ventral margin. At irregular intervals on the tops of the ribs there are narrow, transverse, more or less crescentic constrictions which, when viewed in the proper light, give the entire surface a coarsely reticulated appearance. These have no direct connection with the growth lines, which are inconspicuous.

Length of larger type 64 mm., breadth 43 mm., hinge length 19 mm. The smaller figured specimen is somewhat more slender. The species is represented by 8 specimens in the Geological Survey collections.

In size, form, and general appearance this species resembles *Lima rauliniana* D'Orbigny, as figured by Pictet and Campiche (1870, p. 154, pl. 166, figs.

2a-c), from the lower part of the Gault of Switzerland.

Types: Holotype, U.S.N.M. 103241; figured paratype, 103242.

Locality and position: The type is from cliffs of Devils River limestone of Washita age, at Painted Caves on the Rio Grande near the mouth of Pecos River in Val Verde County, Tex. The other specimens are also from Val Verde County, from the high bridge across Pecos River, on the Galveston, Harrisburg, & San Antonio (Southern Pacific) Railroad.

Lima (Plagiostoma) semilaevis Cragin

Plate 37, figures 3, 4, 6

1893. *Lima semilaevis* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 194.
1895. *Lima semilaevis* Cragin, Am. Geologist, vol. 16, p. 370.
1928. *Lima semilaevis* Cragin. Adkins, Texas Univ. Bull. 2838, p. 133.

Shell rather large, ovate or subtrigonal in outline, slightly oblique, moderately convex; ears very unequal, the anterior small and not visible in direct side view of shell; beaks conspicuous, approximate; hinge line short, slightly oblique; anterior area abruptly depressed and concave, with a sharp edge; antero-dorsal margin nearly straight; posterior and ventral margins forming a nearly regular, broad curve; surface of the umbonal region marked by fine, subequal, radiating striae, separated by narrower, finely punctate grooves, and crossed by very fine lines and a few larger ridges of growth. On the middle portion of the shell the radiating striae extend only about 15 mm. from the beak; near the posterior and anterior margins they develop into conspicuous, broad ribs of irregular size, of which 2 or 3 near the edge of the depressed anterior tend to become spinose. This conspicuous radial sculpture extends over the anterior area.

One of Cragin's types measures 45 mm. in length and height, and about 11 mm. along the hinge. Another specimen in the National Museum collections measures 58 mm. in length and height, 15 mm. along the hinge, and 29 mm. in convexity of both valves.

This species resembles *Lima meyeri* Woods (1904, vol. 2, pt. 1, p. 15, pl. 4, figs. 2, 3, text fig. 4) from the Upper Greensand of England, but it is somewhat more convex, and differs in details of sculpture. The nearest relative in the American Cretaceous is *L. elpasensis*, which is distinguished by its more oblique and more compressed form, and by the different character of its more evenly distributed radiating sculpture.

Types: Cotypes in Texas State collection at Austin; plesiotype, U.S.N.M. 103243.

Locality and position: The types (2 specimens) are from the Denton clay at Browns Ferry on Red River, Cooke County, Tex. The only other example I have seen was collected from the Fort Worth limestone on Hog Creek near Waco, McLennan County, Tex.

Lima (Plagiostoma) elpasensis Stanton, n. sp.

Plate 43, figures 6, 7

Shell rather large, obliquely ovate in outline, compressed, resembling *Lima semilaevis* in general appearance, but more oblique and less convex; surface marked by many narrow, finely punctate, radiating grooves, which are deeper and more closely arranged near the anterior and posterior margins, but on the middle portion of the valve are irregularly spaced, and gradually disappear at about 30 mm. from the beak; growth lines not conspicuous.

The type measures 50 mm. in length, 48 mm. in height, and 17 mm. in convexity of both valves. The smaller figured specimen (see pl. 43, fig. 3), which is supposed to be a young individual of this species, is 13.5 mm. in length and 11 mm. in height.

This species closely resembles *Lima semilaevis*, but the greater obliquity, more compressed form, and differences in sculpture are believed to be of specific importance. The distribution of the radiating striae over a larger portion of the surface, and their more uniform character, especially the absence of the spinose ribs near the anterior margin, are considered important.

Holotype: U.S.N.M. 103249.

Locality and position: The type is from the Washita group, at about the position of the Duck Creek limestone in New Mexico, on the west side of the Rio Grande about 4 miles from El Paso, Tex. The smaller figured specimen, U.S.N.M. 103244, compared with this species is from the Comanche Peak limestone on Wolf Creek about 9 miles northeast of Kerrville in Kerr County, Tex.

Lima (Mantellum) blancensis Stanton, n. sp.

Plate 44, figures 1, 2

Shell small, broadly ovate, slightly oblique, convex; ears subequal; beaks convex and prominent; surface ornamented by about 25 or more rounded, minutely crenulate, radiating ribs which equal or slightly exceed in breadth the interspaces; lines of growth inconspicuous.

Height of type 19 mm., breadth 15 mm., convexity of both valves about 16 mm., hinge line 9 mm.

From *Lima wacoensis*, the only described Comanche species that suggests a comparison, this species differs in its much shorter and broader form, greater convexity, and all details of sculpture. *L.*

crenulicosta Roemer (1852, p. 63, pl. 8, figs. 8a-c) from the Austin limestone near New Braunfels, resembles *L. blancensis* more closely both in form and sculpture, but it differs in details, and comes from a much younger formation.

Lima bravoensis Böse (1910, p. 88, pl. 14, figs. 4–6) has few ribs, a less convex form, and occurs in older beds.

A very closely related form, which may be only a variety of this species, is represented by 2 imperfect specimens from the Quitman formation of Taff about 3 miles from Hot Springs on the Rio Grande in Hudspeth County, Tex. It differs chiefly in having more angular ribs.

Types: Holotype, U.S.N.M. 103245; unfigured paratypes, 103246-103248.

Locality and position: The type is from the Washita group between the north and south peaks of Sierra Blanca in Hudspeth County, Tex. There are also single specimens from the Washita group 4 miles west of El Paso, at San Felipe Spring near Del Rio in Val Verde County, and 2 miles north of Denison in Grayson County, Tex. Imperfect specimens doubtfully referred to this species are from the Pawpaw formation near Gainsville in Cooke County, Tex., and from the Mentor formation near Marquette, Kans.

Lima (Mantellum) wacoensis Roemer

Plate 41, figures 4–8, 10

1849. *Lima wacoensis* Roemer, Texas, p. 399, Bonn.
1852. *Lima wacoensis* Roemer, Die Kreidebildungen von Texas, p. 63, pl. 8, figs. 7a, 7b, Bonn.
1857. *Lima wacoensis* Roemer. Conrad, U. S. and Mex. Boundary Survey Rept., vol. 1, pt. 2, p. 151, pl. 5, figs. 4a, 4b.
1857. *Lima leonensis* Conrad, U. S. and Mex. Boundary Survey Rept., vol. 1, pt. 2, p. 151, pl. 5, figs. 3a–3c.
?1903. *Lima wacoensis* Roemer. Shattuck, U. S. Geol. Survey Bull. 205, p. 18, pl. 5, fig. 10.
1910. *Lima (Mantellum) wacoensis* Roemer. Böse, Inst. geol. México Bol. 25, p. 90, pl. 14, figs. 7–13.
1920. *Lima wacoensis* Roemer. Adkins and Winton, Texas Univ. Bull. 1945, p. 72, pl. 17, figs. 7–9.
1925. *Lima wacoensis* Roemer. Winton, Texas Univ. Bull. 2544, p. 49, pl. 9, fig. 4.
1928. *Lima wacoensis* Roemer. Adkins, Texas Univ. Bull. 2838, p. 132, pl. 18, fig. 4.
1928. *Lima leonensis* Conrad. Adkins, Texas Univ. Bull. 2838, p. 132.

Shell of moderate size, very oblique, elongate-subelliptical in outline, moderately convex; ears subequal, not very conspicuous; hinge very oblique to the major axis of the shell; beaks convex and very prominent; dorsal and ventral margins nearly straight and subparallel; anterior end regularly rounded; posterior end nearly straight above and broadly rounded into the ventral margin below; surface marked by about 20 (18 to 25 prominent, subangular, radiating ribs, by numerous, fine, radiating striae that cover the ribs and interspaces, and by inconspicuous growth lines. The striae are ordinarily very fine and inconspicuous unless magnified, and are not visible on molds or eroded specimens. In rare specimens they are rather prominent on parts of the ribs, and in other specimens equally rare they are entirely absent.

The ear and antero-dorsal slope show no radial sculpture, or at most very faint lines, whereas the posterior ear and the adjacent area behind the principal ribs bear rather conspicuous striae or small ribs that are finely tuberculate or denticulate. In some specimens this tuberculate character extends to several of the posterior ribs. The principal ribs are most prominent on the anterior half of the shell. They are generally less elevated and somewhat more widely separated on a more or less flattened or compressed area behind the middle. An average specimen (the type of *Lima leonensis*) measures 31 mm. in length, 22 mm. in greatest breadth or height, 15 mm. in convexity of both valves, and 13 mm. along the hinge line. Corresponding measurements of the other 2 specimens figured are 32, 19, 13, and 13 mm., and 35, 23, 16.5, and 12 mm., respectively. A few specimens are considerably larger.

The species was originally based on 2 specimens, only 1 of which retained a small part of the shell. Consequently the finer sculpture and the subangular character of the ribs were not observed. It is evident also that Roemer's figures are more or less restored and conventionalized. After making due allowance for these facts, the specimens here referred to *Lima wacoensis* agree very well with the original description and figures, the form and general appearance being identical. The bifurcation of some of the posterior ribs mentioned by Roemer, or the interpolation of short ribs, is seen in some specimens, though in the majority of specimens the ribs are all similar and simple.

Conrad had difficulty in identifying his specimens from western Texas with Roemer's figures, chiefly because his specimens are larger, and retain more of the shell, and hence show more angular ribs and the fine striae. He therefore described them as the new species *Lima leonensis*, asserting that it also differed from *L. wacoensis* in being inequivalved, but an examination of his figured type shows that this feature is accidental. His figures of *L. wacoensis* are not drawn from any specimen in the collection studied by him, but appears to be imperfect copies of Roemer's figures. Of 2 specimens labeled *L. wacoensis* by Conrad, one is the type of *L. leonensis*, and the other shows precisely the same features of form and sculpture.

The specimens from the Upper Cretaceous of southern Utah, referred by White (1877, p. 176, pl. 17, figs. 4a-c) to *Lima wacoensis*, belong to a distinct species which I have named *L. utahensis* (1893, p. 71, pl. 9, fig. 5), and the one from the Buda limestone described by Shattuck (1903, p. 18, pl. 5, fig. 10) is now somewhat doubtfully referred to the variety *quadrangularis*.

Plesiotypes: U.S.N.M. 9889a–b, 30218, 103250, 103251.

Locality and position: Roemer's types came from the "Waco camp on the Guadalupe above New Braunfels," where it was associated with species of the Washita group. The type of *Lima leonensis* is from Leon Springs near Fort Stockton, from lower Washita strata. Of the other two specimens here figured the smaller one is from the Comanche Peak limestone at Seven Knobs, 5 miles southeast of Glen Rose in Somervell County, and the other from Bluff Creek near Crawford in McLennan County, Tex., probably from the Washita group. The collections of the National Museum and of the Geological Survey show that the species ranges through practically all the Comanche series, but that the typical form is most common in the Fredericksburg group, especially in the Comanche Peak limestone in which it may be found at almost every exposure in Texas. In the Washita group it is much less common, the prevailing form there being the variety *quadrangularis*, though the typical variety also occurs sparingly in the neighborhood of Austin, near Kent in Culberson County, and elsewhere.

A few poorly preserved specimens that seem to be referable to this species have been collected from the Travis Peak formation in Travis County, and from the Glen Rose limestone in the neighborhood of Austin. The species also occurs in the Quitman formation of Taff in Hudspeth County. In all these occurrences in the Trinity group the sculpture of the posterior half of the shell is somewhat less conspicuous than in the typical variety, but the difference is too slight to warrant even a varietal name for the imperfect material in hand.

Lima wacoensis quadrangularis Stanton, n. var.

Plate 41, figures 1–3

This variety has the general aspect of the typical form of *Lima wacoensis*, but differs in the following respects.

The posterior end is more distinctly truncated, so that the outline is subquadrangular; the ribs are more numerous, ranging from 22 to 30 with an average of 25 or more, and they are more nearly equal and less angular; the radiating striae are less prominent and in many specimens almost disappear; the hinge line is generally somewhat shorter, and the shell itself attains a larger size. The anterior ear and antero-dorsal slope are destitute of radial sculpture, agreeing with the typical form in that respect; the posterior ear and adjacent parts of the shell bear a few simple lines or small ribs.

An average specimen measures 37 mm. in length, 25 mm. in greatest breadth, about 16 mm. in convexity of the 2 valves, and 11 mm. in hinge length. One of the largest specimens seen measures 56 mm. in length.

This variety is distinguished from *Lima mexicana* Böse (1910, p. 92, pl. 14, figs. 14, 15) as defined, by the presence of small ribs on the posterior ear, and by a slightly more convex shell, but it is possible that the study of additional specimens would show that the 2 forms are conspecific.

Types: Holotype, U.S.N.M. 103252; 2 figured paratypes, 103253a–b.

Locality and position: Of the figured specimens, the largest one is from the Washita group in the gap between the peaks of Sierra Blanca in Hudspeth County, and the others are from the Fort Worth limestone at Fort Worth. The variety is also represented in collections of Washita fossils from Denison, Crawford, Austin, El Paso, and Kent, Tex.

Genus PACHYMYA Sowerby, 1826

Pachymya austinensis Shumard

Plate 45, figure 1; plate 46, figure 1

1860. *Pachymya austinensis* Shumard, Acad. Sci. St. Louis Trans., vol. 1, p. 604.
1879. *Pachymya austinensis* Shumard, White, U. S. Geol. and Geog. Survey Terr., 11th Ann. Rept., p. 298, pl. 5, figs. 7a, 7b; pl. 8, figs. 1a, 1b.
?1903. *Pachymya austinensis* (?) Shumard. Shattuck, U. S. Geol. Survey Bull. 205, p. 26.
1920. *Pachymya* sp. Adkins and Winton, Texas Univ. Bull. 1945, p. 75, pl. 17, fig. 10.
1925. *Pachymya austinensis* Shumard. Winton, Texas Univ. Bull. 2544, p. 60, pl. 11, fig. 3.
1928. *Pachymya austinensis* Shumard. Adkins, Texas Univ. Bull. 2838, p. 150, pl. 15, fig. 3.

Shell large, equivalve, inequilateral, oblong, very convex, gaping at both ends; test very thick; beaks rather prominent, approximate, situated near the anterior end; cardinal margin nearly straight; anterior end regularly rounded; posterior end obliquely subtruncate; ventral margin gently convex in the anterior third, broadly excavated in the middle, and again gently convex in the posterior third; prominent subangular umbonal ridge extends obliquely downward and backward from the beak to the base of the posterior end and sharply separates the postero-dorsal slope from the rest of the shell; the portion in front of the umbonal ridge somewhat less distinctly separated into 2 areas by a broad constriction extending from the beak to the ventral

border; greatest convexity on the umbonal ridge a little behind the middle of the shell; surface marked mainly by irregular lines of growth, which are especially prominent on the umbonal ridge and posterior area; where the surface of the posterior area is slightly eroded, obscurely punctate radiating lines are also faintly indicated; ligament attached to prominent, rather short nymphae; hinge without teeth; adductor muscle impressions well-marked, oval, the posterior much the larger; parallel lines rather deeply impressed and well marked, somewhat irregular and scalloped above along the ventral portion, without a distinct posterior sinus but retreating greatly from that end of the shell, where it is very broad, irregular, and deeply impressed; the posterior end of the shell outside of the pallial line shows two broad, obscure depressions, probably indicating the position of the siphons.

Dimensions of figured specimen: Length 204 mm., height 84 mm.; convexity of the valves, anterior area 78 mm., on the umbonal ridge 132 mm.; thickness of test at the anterior muscle scar, 14 mm.

The posterior gape extends across the whole of the truncate end and has a maximum width of about 15 mm.; the anterior gape extends around the anterior third of the shell and has a maximum width of about 13 mm.

The above description and the figures here published are drawn from an excellent specimen showing both valves, in the Cragin collection at Colorado College at Colorado Springs, Colo. A plaster replica of this specimen is in the collections of the Geological Survey. This is the only example of the species known to me in which the shell is preserved; all previous descriptions and illustrations have been based on internal molds composed of impure limestone, which do not preserve the details of the interior, such as the pallial line, and do not clearly indicate that the shell gaped in front and behind.

There has been considerable discussion as to the classification of *Pachymya*, which was based on *P. gigas* Sowerby from the Lower Cretaceous of England. The internal features of the type have never been fully described, for lack of material; but it has been considered a closed shell. The general aspect of the exterior is very much that of *P. austinensis*, and it is for this reason only that the latter has been referred to *Pachymya*. Whether or not this reference is correct can be decided only when fuller knowledge of the type has been obtained.

The present species seems to be very closely allied to *Panope*, as is indicated especially by its edentulous hinge, thick gaping shell, and particularly the character of the pallial line. It differs from the ordinary Tertiary forms of *Panope* in the angularity and great convexity of the valves, and in the absence of a distinct pallial sinus, though the lack of a sinus seems to be due to the great depth of the valve; that is, if the posterior portion of the shell had the usual moderately convex form, the retreat of the pallial line from the margin to the extent seen in this shell would necessarily form a distinct sinus.

Plesiotype: U.S.N.M. 8043; plastotype, 103254.

Locality and position: Cragin's specimen figured here was collected 2 miles east of Gainesville in Cooke County, Tex. The species has likewise been found in the upper part of the Weno clay and lower part of the Main Street limestone of the Fort Worth region in Tarrant County, the Georgetown and Buda limestones of the Austin region in Travis County, the Grayson marl near Cleburne in Johnson County, and from Salado in Bell County, Tex.

GASTROPODA

Genus PLEUROTOMARIA J. de C. Sowerby, 182[illegible]

Pleurotomaria (Leptomaria) austinensis Shumard

Plate 48, figures 1, 7–10

1849. *Pleurotomaria* sp. ind. Roemer, Texas, p. 414, Bonn.
1852. *Pleurotomaria* sp. ind. Roemer, Die Kreidebildungen von Texas, p. 39, Bonn.
1861. *Pleurotomaria austinensis* Shumard, Boston Soc. Nat. History Proc., vol. 8, p. 198.
1893. *Pleurotomaria robusta* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 228.
1920. *Pleurotomaria austinensis* Shumard. Adkins and Winton, Texas Univ. Bull. 1945, p. 76, pl. 18, figs. 2, 3.
1928. *Pleurotomaria austinensis* Shumard. Adkins, Texas Univ. Bull. 2838, p. 172.

Original description:

Shell large, depressed conical, spire short, very rapidly expanding from apex; volutions five, convex; last one subangulate 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 at base, 2½ inches; spiral angle, 102°. Austin limestone near city of Austin.

The original type of the species has been lost, and it has never been figured; but even if it were accessible, it is doubtful whether the species could be accurately defined, since an internal mold cannot furnish good specific characters in this group. Cragin has named two species, *Pleurotomaria macilenta* and *P. robusta*, one of which he says "is certainly a synonym of Dr. Shumard's *P. austinensis*," but he

is unable to say which one should be identified with it. These two species are distinguished by differences in the form of the whorls, and in the apical angle of the spire (100° or more in one, and 90° or less in the other). In both these respects, however, some species of this genus are known to be variable, and nothing is to be gained by multiplying names for forms whose real specific characters are unknown. It may be that the forms named are really distinct, but I have provisionally treated *P. robusta* as a synonym of *P. austinensis,* and have retained the name *P. macilenta* for certain molds that have narrower and more numerous whorls and a lower spire. The types of *P. robusta* Cragin are figured here.

Another cause of doubt as to the identity of Shumard's species is the fact that he attributed it to the Upper Cretaceous Austin chalk, whereas all the specimens treated by Cragin, and those in the National Museum collections, are from the Fort Worth limestone. It is probable that the original reference to the Austin chalk was an error, though Roemer (1852, p. 39) twice reports a *Pleurotomaria.* He reports one from the ford at New Braunfels, which he compares with *P. perspectiva* (Sowerby) and which therefore resembles the form under consideration. The exposures at that locality are of Austin chalk. He reports the other from beds now known to be Lower Cretaceous on Guadalupe River near the Waco camp. The latter is probably *P. austinensis,* and the other may have been a specimen of the same species brought down by the river from the lower horizon.

The specimens in the Geological Survey collections here referred to *Pleurotomaria austinensis* vary considerably in the relative height of the spire, but they agree well in all other respects. Though they are mainly in the form of internal molds, the two specimens figured, representing the extremes of variation, retain small portions of the shell that show identical sculpture. On the spire this consists of numerous closely arranged fine spiral lines crossed by still finer growth lines, giving the surface a minutely reticulated appearance. The sculpture of the base of the shell is somewhat coarser, but of the same character. In molds the last volution is "subangulated below" as originally described, but the shell itself bore there a strong sharp carina, much more prominent than that formed by the band of the sinus. The band is very narrow, and it is on account of this feature, together with the general aspect, that the species is referred to the subgenus *Leptomaria.*

One of the figured specimens is 55 mm. high and 77 mm. broad; the umbilicus is 22 mm. wide. Corresponding measurements of the other specimen are 37, 79, and 19 mm.

Plesiotypes: U.S.N.M. 19146, 21829. The types of *P. robusta* Cragin are in the Texas Bureau of Economic Geology at Austin.

Locality and position: Georgetown limestone at Bull Creek near Austin; Fort Worth limestone 8 miles north of Fort Worth and half a mile east of Texas Christian University at Fort Worth; also from Bexar County, Tex. Reported to be abundant in upper Duck Creek and lower Fort Worth formations in north-central Texas and in northern trans-Pecos Texas.

Pleurotomaria (s.l.) increbescens Stanton, n. sp.

Plate 47, figures 9–11, 17, 18

Shell small, depressed conical, consists of about 4 whorls that increase in size very rapidly, the last whorl constituting the bulk of the shell; base broadly and deeply excavated, but the earlier whorls not visible in the umbilicus; periphery of the body whorl with 2 prominent revolving ridges separated by a somewhat broader groove, the upper ridge larger than the other and bearing on it 2 filiform lines, between which is the narrow band of the sinus. The larger ridge is accompanied by a narrow groove above, and the whole surface of the shell is marked by fine revolving lines crossed by almost equally prominent lines of growth that extend obliquely backward in passing down across the whorl, except where they are abruptly curved on the band of the sinus. The band and accompanying ridges are concealed on the whorls of the spire, which are moderately convex. Aperture obliquely ovate, with the regularity of outline interrupted by the peripheral ridges and groove.

The species is represented by 11 small specimens, all of which may be immature. The largest is about 5 mm. in height and 9 mm. in greatest breadth.

That these small shells cannot be the young of either of the other species of *Pleurotomaria* described from the Comanche series is evident from the great difference in the form of the whorls, though the sculpture is of the same character in all of them. *P. anomala* Pictet and Campiche (1863, p. 433, pl. 80, figs. 2a-d), from the Lower Cretaceous (Urgonian) of Switzerland, is probably the most closely related described species, as it agrees very closely in form. The sculpture of that species was not well known when it was described, and the sinus is represented as occurring between the two revolving ridges on the periphery.

Pleurotomaria texana (Hkins) (1940, p. 12, pl. 1, figs. 6a-e), from the Edwards limestone of Kerr County, Tex., may be specifically identical with *P. increbescens,* but appears to be less elevated and to have less prominent revolving ridges.

Types: Cotypes, U.S.N.M. 103091a-c; 8 unfigured paratypes, 103092.

Locality and position: Edwards limestone on Colorado River above the mouth of Bartons Creek near Austin in Travis County, Tex.

Pleurotomaria (Leptomaria) macilenta Cragin

Plate 47, figures 1–4

1893. *Pleurotomaria macilenta* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 228.
1928. *Pleurotomaria macilenta* Cragin. Adkins, Texas Univ. Bull. 2838, p. 172.

Original description:

Large; spiral angle one hundred degrees or more; whorls six, slender and compressed in such a manner as to be subhorizontally elongate-auriculate in cross-section, showing only faintly expressed peripheral and superior angulation in the cast; ornamentation of the outer face of the whorl consisting of revolving lines, that of the inferior face of the body whorl unknown.

Measurements: Height 36 mm., breadth 80 mm.

Occurrence: Rather common in the Fort Worth limestone. The specimens before me were collected in Travis, Williamson, Bell and Gillespie Counties by Messrs. Dumble, Wilcox, Taff, Drake, and Jenny.

The two specimens, U.S.N.M. 103093 and 18758, that are separated from *Pleurotomaria austinensis* Shumard and referred to this species are from the Fort Worth limestone on Bartons Creek near Austin, and at Mountain City in Hays County, Tex They are somewhat more depressed than even the shortest spiral forms referred to *P. austinensis*, and differ especially in having more numerous and narrower whorls that produce an entirely different apical view. The base of the body whorl is also somewhat more convex. Though these specimens are both molds, one of them shows traces of numerous fine spiral lines on the base as well as the rest of the shell. Their identification with *P. macilenta* is justified by comparison with a specimen, probably one of Cragin's types, in the Texas Bureau of Economic Geology at Austin.

Genus RIMULA Defrance, 1819

Rimula vaughani Stanton, n. sp.

Plate 52, figures 9, 12

Shell small, elevated, with the apex strongly recurved; aperture elliptical; perforation small, situated at the anterior end of a long groove that extends from the apex almost halfway to the anterior border of the shell; surface marked by about 22 strong radiating ribs, with broader flat interspaces covered with fine radiating lines. The broader spaces on the sides of the shell each bear 4 or 5 lines, while those in front and toward the posterior where the ribs are more crowded have only 2 or 3 lines each. The growth lines are very faintly marked.

The largest of the type specimens has the following dimensions: Height 5 mm., length of aperture 6 mm., breadth of aperture 5 mm. Corresponding measurements of the other figured specimen are 4.2, 5, and 3.5 mm.

The species is represented by 4 calcite pseudomorphs and by about 8 external molds. Owing to the fragile nature of the pseudomorphs it has not been possible to clean the interior of the shells perfectly, consequently it is necessary to rely entirely on external characters in assigning them to a genus. Except in the greater separation of the perforation from the apex, the species has the aspect of *Puncturella*. If it has an internal septum behind the perforation it should be assigned to that genus, but as no evidence of such a septum has been seen the writer prefers to refer it provisionally to *Rimula*.

The name is given in honor of Mr. T. Wayland Vaughan.

Types: Cotypes, U.S.N.M. 103106a-b; 2 unfigured paratypes, 103107.

Locality and position: Edwards limestone in high bluff on west side of Colorado River above the mouth of Bartons Creek near Austin in Travis County; and near Kickapoo Springs on the west fork of Nueces River in Edwards County, Tex.

Genus TURBO Linné, 1758

Turbo? belviderensis Stanton, n. sp.

Plate 49, figures 1, 2

Shell rather small, stout conical, narrowly umbilicated, consists of 5 convex whorls; apical angle about 70°; sutures slightly channeled; surface ornamented by prominent beaded spiral lines, of which 5 are visible on the spire and 10 on the base. Of the revolving lines visible on the spire, the middle one is the largest and the second one below the suture is the smallest, giving the whorl a shouldered appearance. The spiral lines are somewhat broader than the interspaces, especially on the convex base of the shell.

The spiral sculpture of the base continues in the umbilicus, but the ridges bordering and entering the umbilicus are somewhat larger than the others on the base. Aperture broadly ovate; inner lip rather thick, partly reflected over the umbilicus.

The type measures 16.5 mm. in height and 15.5 mm. in breadth.

The species has about the proportions of *Amberleya mudgeana* (Meek) (p. 57) which occurs in the same beds, but it is easily distinguishable by its sculptured and umbilicated base, and by the difference in the sculpture of its spire.

Holotype: U.S.N.M. 103126.

Locality and position: Kiowa shale near Belvidere, Kans.

Turbo? cookensis Stanton, n. sp.

Plate 49, figure 13

Shell of medium size, subglobose, consisting of 4 or 5 rapidly increasing, very convex whorls; spire moderately prominent; suture slightly channeled; surface marked by about 12 prominent, rounded revolving ridges that equal or slightly exceed the interspaces in width, 6 of the ridges being visible on the spire. The uppermost ridge and groove are considerably larger than the others, which are subequal, and these are all crossed by smaller ridges made up of bundles of fine growth lines, giving the surface a somewhat reticulated appearance. The aperture and basal portion of the shell are not known. The single specimen studied is an external mold.

The type, which lacks the basal portion, measures 16 mm. in height and 18 mm. in breadth. In a complete shell the height is probably slightly greater than the breadth.

This species is evidently related to *Turbo? gainesvillensis* Stanton, with which it is associated, but it may be readily distinguished by the more uniform convexity of its whorls, and by differences in sculpture, especially the absence of the fine spiral lines.

Holotype: U.S.N.M. 103127.

Locality and position: Pawpaw sandy member of the Denison formation, 4½ miles northeast of Gainesville in Cooke County, Tex.

Turbo? gainesvillensis Stanton, n. sp.

Plate 49, figures 7, 8

Shell of medium size, subglobose, consisting of about 4 rapidly increasing convex whorls that are subtruncate or obliquely shouldered above; last whorl abruptly contracted, produced into a short canal in front, and narrowly umbilicated; suture channeled; surface marked by about 12 prominent, simple, revolving ridges, by a variable number of fine lines in the interspaces which, except the broad upper one, are about equal to the ridges in width, and by fine lines of growth that show a tendency to form incipient costae and slight elevations, but not distinct granules or tubercules, where they intersect the spiral ridges. The upper two ridges are somewhat larger than the others. The broad interspace between them, forming the shoulder of the whorl, bears 7 fine lines at the outer lip, but this number is reduced to 5 or even 3 on the spire. The other interspaces bear from 1 to 3 lines, except the anterior 2 or 3 interspaces which have none. On the spire only 2 or, in some places, 3 of the ridges are visible. Aperture broad above, narrow and produced below, the inner lip forming a heavy oblique callus on the last whorl.

Height of holotype 26 mm., greatest breadth 25 mm.

This species is very closely related to *Turbo? newberryi* (Cragin), but has relatively finer sculpture, more numerous intermediate spiral lines, and larger ridges which are less distinctly granular or tuberculate. The spire is also relatively larger and more prominent, and the whole shell is considerably larger, judging by the few specimens available for comparison.

Types: Holotype, U.S.N.M. 103128; paratype, 103129.

Locality and position: Pawpaw sandy member of the Denison formation 4¼ miles northeast of Gainesville, Cooke County, Tex.

Turbo? gouldi Stanton, n. sp.

Plate 49, figure 9

Shell rather small, low turbinate; spire depressed; last whorl with 2 prominent carinae about 8 mm. apart on the periphery, with a broad flattened slope above the carinae and a convex slope below; suture deeply channeled; surface also marked by rather coarse revolving lines, of which there are 6 on the upper slope, 3 between the carinae, and a larger number below, with fine lines in some of the interspaces, the whole surface crossed by low, broad, inconspicuous costae. Aperture and base of shell unknown.

The type measures 11 mm. in height and 12 mm. in breadth. The height of the perfect shell would be probably 13 or 14 mm.

The species is represented by a single incomplete mold of the exterior. The generic reference must remain somewhat doubtful until more perfect material is obtained, but enough is known of the general form and the very well-preserved sculpture to make the specific identification easy.

Holotype: U.S.N.M. 103130.

Locality and position: Mentor formation 4½ miles southeast of Marquette, Kans.

Turbo? benbrookensis Stanton, n. sp.

Plate 49, figures 3, 4

Shell rather small, subglobose, narrowly umbilicated, consisting of about 4 convex whorls, the last relatively very large; surface of the mold with 5 strong carinae, only 3 of which are visible on the spire; the upper carina borders the channeled suture; the concave interspace between the upper carina and the second carina is slightly broader than the other interspaces; the lower third of the

body whorl beneath the last carina shows traces of several finer revolving lines; a specimen collected near Fort Worth shows 2 or 3 finer lines on each interspace between the carinae; aperture subovate, somewhat produced in front; inner lip with rather heavy callus.

Height 18 mm., greatest breadth 19 mm.

The species is represented by only 3 internal molds which of course do not show all the specific characters, but the features preserved are sufficiently striking to make the recognition certain.

Types: Holotype, U.S.N.M. 103131; 2 unfigured paratypes, 103132, 103133.

Locality and position: Comanche Peak limestone at Benbrook, 8 miles west of Fort Worth in Tarrant County; 4 miles south of Weatherford in Parker County; and 5 miles southeast of Glen Rose in Somervell County, Tex.

Turbo? newberryi (Cragin)

Plate 49, figures 5, 6

1894. *Margarita (Solariella) newberryi* Cragin, Am. Geologist, vol. 14, p. 10.

1924. *Margarita (Solarella) newberryi* Cragin. Twenhofel, Kansas Geol. Survey Bull. 9, p. 54.

Shell rather small, subglobose, umbilicated, consisting of about 4 rapidly increasing very convex whorls; last whorl abruptly contracted and slightly produced in front to form an incipient canal; surface sculpture consisting of about 10 strong, granular revolving ridges, with 1 or 2 fine lines on each of the rather narrow interspaces, crossed by somewhat conspicuous lines of growth; the uppermost ridge, bordering the channeled suture, more prominent than the others and separated from them by a broader and deeper furrow; only 2 of the ridges visible on the low spire. The full form of the aperture is not preserved in any of the specimens seen, but it is certainly somewhat produced in front and there is a narrow umbilicus.

Cragin's measurements of the type are: Height 13.5 mm., greatest breadth of 15 mm. Corresponding measurements of the other figured specimen are 16 mm. and 19 mm. The basal portion is lacking in each specimen; if this were restored it would add 2 or 3 mm. to the height.

The character of the sculpture and the form of the aperture and of the umbilicus seem to remove this species from the genera to which it was originally referred. It is congeneric with the other forms now described as *Turbo? benbrookensis* and *T.? weatherfordensis,* and all three seem to belong near *Turbo,* though the material available is too imperfect for positive generic reference.

Plesiotypes: U.S.N.M. 103134, 103135; Cragin's type is probably lost.

Locality and position: Champion shell bed at the base of the Kiowa shale near Belvidere, Kans., type locality; Purgatoire formation at Mesa Tucumcari, N. Mex.; and Washita group 1 mile south of Kent, Culberson County, Tex.

Turbo? revueltensis Stanton, n. sp.

Plate 49, figure 10

Shell of moderate size, consisting of about 5 volutions, not umbilicated; apical angle about 65°; body whorls large, with 2 moderately prominent, distant, granular carinae, the lower of which is just concealed on the spire, the whorl obliquely flattened above and between the carinae, rounded below, and bearing 3 granular revolving lines above the carinae, 2 (sometimes only 1) between them, and 8 or 9 finer lines on the base below the carinae; the uppermost revolving line almost as large as the carinae, giving the suture a channeled appearance; spire showing all the revolving sculpture above the lower carina; aperture subcircular, somewhat produced below; inner lip with a moderately heavy flattened callus; outer lip not preserved on the types.

The figured specimen measures 25 mm. in height and 22 mm. in greatest breadth. The 4 other less perfect specimens examined are all smaller, and 3 of them show only 1 revolving line between the carinae. Other features appear to be constant.

Types: Holotype, U.S.N.M. 103136; 4 unfigured paratypes, 103137.

Locality and position: Purgatoire formation on Monte Revuelto in the Llano Estacado, N. Mex., on the southern side of the point at the head of Canyon Bonito.

Turbo? weatherfordensis Stanton, n. sp.

Plate 49, figures 11, 12

Shell of medium size, turbinate, somewhat produced in front and umbilicated; consisting of about 4 convex whorls; spire much more prominent than in *Turbo newberryi* and *T. benbrookensis;* surface of the mold marked by 6 rather prominent revolving ridges separated by slightly broader shallow furrows, in each of which there seems to have been 1 or 2 finer revolving lines; lower portion of last whorl with 5 or 6 similar revolving lines that bear granules, as the other lines and ridges probably did also; aperture subovate, with the inner lip forming a moderately heavy callus; umbilicus distinct but not very broad.

Height 26 mm., greatest breadth 22 mm.

This species is evidently related to the associated *Turbo? benbrookensis* Stanton, from which it is distinguished by its much more elevated form and the more numerous and less prominent revolving

ridges. Represented by an internal mold retaining small portions of the shell.

Holotype: U.S.N.M. 103138.

Locality and position: Comanche Peak limestone 4 miles south of Weatherford, Parker County, Tex.

Genus AMBERLEYA Morris and Lycett, 1851

Amberleya mudgeana (Meek)

Plate 49, figures 14, 15

1871. *Turbo mudgeana* Meek, U. S. Geol. and Geog. Survey Terr. 4th Ann. Rept., p. 313.
1876. *Margarita mudgeana* (Meek), U. S. Geol. Survey Terr. Rept., vol. 9, p. 300, pl. 2, figs. 9a, 9b.
1894. *Margarita marcouana* Cragin, Am. Geologist, vol. 14, p. 9.
1924. *Margarita marcouana* Cragin. Twenhofel, Kansas Geol. Survey Bull. 9, p. 55, pl. 8, fig. 7.
1924. *Margarita mudgeana* (Meek). Twenhofel, Kansas Geol. Survey Bull. 9, p. 55, pl. 8, figs. 8, 9.
1940. *Amberleya mudgeana* (Meek). Stainbrook, Texas Univ. Bull. 3945, p. 706, pl. 33, figs. 1–3.

Meek's revised description:

Shell rather large, turbinate, about as high as wide; spire moderately prominent; volutions four and a half to five, increasing rather rapidly in size, convex, last one somewhat obliquely flattened around the middle of the outer side, at the base of which it is angular; suture more or less channeled; aperture circular; outer lip thin and oblique; columella arched and flattened below; axis imperforate; surface ornamented by strong, raised, oblique lines of growth, which are crossed by four equidistant rather sharp, revolving carinae, only three of which are seen on the volutions of the spire.

Height 0.66 inch, breadth about 0.64, divergence of slopes of the spire about 75°.

Meek further compares the species with *Turbo tricostatus* D'Orbigny, and speaks of the entire absence of an umbilicus, a feature in which it differs from living species of *Margarites*.

The species was based on a single specimen preserved as an internal mold, and a distinct impression of the exterior in the sandstone matrix. From the mold a gutta-percha cast was made that showed the features described, and served as the basis of the best published figure. It was collected by B. F. Mudge at a locality 12 miles southwest of Salina, Kans., in a ferruginous sandstone then referred to the Dakota formation but later named the Mentor beds and assigned by Cragin to the Comanche series.

The types of *Margarita marcouana* (Cragin) were obtained from the Kiowa shale and the Champion shell bed near Belvidere, Kans., where they are associated with a fauna closely related to that of the Mentor beds, several of the species being identical, though the beds at Belvidere are probably somewhat older. In the original description Cragin remarked that "The species is very closely related to *M. mudgeana* Meek, from which it is distinguished chiefly by the beaded characters of the revolving carinae," and he has since stated that the form probably belongs to Meek's species. This conclusion is probably correct, as additional material from the Belvidere region shows greater individual variation than the differences observed between the Belvidere specimens on the one hand and Meek's types on the other. In the type of *M. mudgeana* the carinae show only a very slight tendency to crenulation, hardly noticeable even with a lens, and the upper carinae is prominent, forming a distinct shoulder. In Cragin's types the carinae bear distinct granules or tubercles, and the upper carina bordering the suture is inconspicuous, but in all other features and in general aspect the form agrees with Meek's specimen, as comparison of the figures will show, remembering that the aperture is somewhat restored and unnaturally shortened in Meek's figure.

Two additional specimens collected by me near Belvidere show other variations in sculpture as seen in plate 49, figure 14, which represents a nearly complete example. In this example each of the interspaces separating the 3 principal carinae bears a fine line, and on the upper slope of the last whorl there are 2 granular lines in addition to the somewhat larger one that borders the suture.

Possibly the Belvidere form should be regarded as a variety, and in that case the name *marcouana* would be retained, but its relationship with *Amberleya mudgeana* is too close to permit specific separation.

A small, distorted specimen collected at Monte Revuelto, Llano Estacado, N. Mex., probably also belongs to this species, though in its distorted and imperfect preservation its form appears to be more elevated.

Types: Holotype, U.S.N.M. 7903; plesiotype, 77640. Cragin's types are probably lost.

Locality and position: Mentor formation 12 miles southwest of Salina, Kans.; Kiowa shale near Belvidere, Kans.; questionably from Monte Revuelto, N. Mex.; Kiamichi formation near Tahoka, Lynn County, Tex.

Genus TROCHUS Linné, 1758

Subgenus TECTUS Montfort, 1810

Trochus (Tectus) texanus Roemer

Plate 48, figures 2–6

1888. *Trochus texanus* Roemer, Palaeont. Abh., Band 4, Heft 4, p. 13 (293), pl. 1 (31), fig. 13.
Not 1894. *Trochus texanus* Roemer. Cragin, Am. Geologist, vol. 14, p. 11.
Not 1895. *Trochus texanus* Roemer. Cragin, Am. Geologist, vol. 16, p. 378.
Not 1895. *Trochus texanus* Roemer. Stanton, Am. Jour. Sci., 3d ser., vol. 50, p. 217.

Not 1924. *Trochus texanus* Roemer. Twenhofel, Kansas Geol. Survey Bull. 9, p. 57, pl. 9, fig. 4.
1928. *Trochus texanus* Roemer. Adkins, Texas Univ. Bull. 2838, p. 174.
Not 1940. *Trochus texanus* Roemer. Stainbrook, Texas Univ. Bull. 3945, p. 707, pl. 33, figs. 10, 11.

Shell of moderate size, conical, consisting of about 6 volutions obliquely flattened so that the sides of the spire are almost uniform slopes; base of shell very slightly convex, not umbilicated, and without other sculpture than fine lines of growth; aperture subtriangular, narrow, and obliquely elongated, broader than high; columella thickened and twisted to form a toothlike projection below; surface of the spire marked by fine rather prominent tuberculated revolving lines, the lower one slightly larger than the others; the last whorl, which is angulated below, shows a sixth finer line on the angle that is concealed on the earlier whorls; suture indicated only by a slightly wider spacing of the lines.

Roemer's type specimen, as figured, measures 14 mm. in height, 17 mm. in breadth at the base, and has an apical angle of about 62°. I have examined 9 specimens, all young shells excepting 1 imperfect individual, and they all have about the same proportions.

Cragin has reported this species from the Belvidere beds of Kansas, but judging from his descriptive note his specimen is most probably *Calliostoma cragini Stanton* (see p. 60), which is a much more elevated shell, with more convex sculptured base and a distinctly different form of aperture, though the sculpture of the spire is of the same general character in both.

It should be noted that Roemer's figure is slightly inaccurate, as he himself remarks, in that it does not show the toothlike fold at the base of the aperture. It also represents the scultpure as relatively coarser than on any of the specimens I have seen.

Plesiotypes: U.S.N.M. 22988, 103175.

Locality and position: Edwards limestone about 2 miles above the mouth of Bartons Creek (type locality) near Austin, Tex.; and on west side of Colorado River above the mouth of Bartons Creek.

Genus MONODONTA Lamarck, 1799

Monodonta (Osilinus?) minuta Stanton, n. sp.

Plate 49, figures 27–29

Shell thick, small, turbinate, consisting of about 5 convex whorls, the last constituting about half of the total bulk of the shell; apex blunt; aperture subquadrate, outer lip sharp, inner lip rather thick, flattened, and bearing below 2 small, tooth-like folds or projections; surface covered with minute revolving lines, commonly not well preserved.

One of the types is 4 mm. high and 5 mm. broad at the base. Another with the same breadth is 4½ mm. high. Species represented by 5 specimens.

It is possible that these, like several other forms found with them and preserved as calcite pseudomorphs, are all immature individuals, but they are certainly not the young of any of the larger species found in the same beds. The generic reference is not very satisfactory, because of the small size of the shell, its slender form, and the fact that its preservation as crystalline calcite gives no indication as to whether it was originally pearly or not. The form of the aperture, especially the tooth-like folds on the columella, and the spiral sculpture, afford the chief reasons for referring it provisionally to *Monodonta (Osilinus)*.

Types: Cotypes, U.S.N.M. 77641a–b; unfigured paratypes, 77642.

Locality and position: Edwards limestone on the west side of Colorado River above the mouth of Bartons Creek, near Austin, Travis County, Tex.

Monodonta bartonensis Stanton, n. sp.

Plate 49, figure 35

Shell of moderate size, conical, consisting of about 5 convex whorls; base strongly convex, not umbilicated, with about 12 fine tuberculated revolving lines; aperture subquadrate in outline, with a prominent toothlike projection of the columella just below the middle of the inner lip; surface of the spire marked by 5 rather narrow tuberculated revolving ridges and by inconspicuous revolving lines; the tubercles more or less distinctly arranged in transverse rows corresponding to the lines of growth; body whorl not angulated below; suture distinctly channeled.

The species is represented by 5 incomplete shells, the most perfect of which is 10 mm. in height and about 11 mm. in greatest breadth; apical angle about 60°. Other fragments represent considerably larger individuals.

It may be distinguished at once from *Trochus texanus* Roemer, with which it is associated, by its whorls, convex sculptured base, and very different form of aperture. The convexity of the whorls, difference in aperture, and greater apical angle will also serve to separate it from *Calliostoma cragini* Stanton. *Monodonta bartonensis* is almost identical in sculpture with *M. texana* Ikins (1940, p. 12, pl. 2, figs. 1a-b) but is a little less elevated and has a differently shaped aperture.

Types: Cotypes, U.S.N.M. 103124a-b; unfigured paratype, 103125.

Locality and position: Edwards limestone on west side of Colorado River above the mouth of Bartons Creek, near Austin, Travis County, Tex.

Genus MARGARITES Leach in Gray, 1847

Margarites? brownii (Cragin)

Plate 49, figures 20, 21

1895. *Margarita brownii* Cragin, Colorado Coll. Studies, 5th Ann. Pub., p. 61.

Shell rather large, moderately thick, depressed conical, consisting of about 5 rapidly increasing convex whorls slightly flattened above and sharply rounded on the periphery; umbilicus moderately broad, partly covered by the reflected inner lip, marked within by prominent plications parallel with the growth lines and by a spiral furrow that almost interrupts the plications just within the umbilical margin; the plications are largest at the lower ends below the furrow, where they give the edge of the umbilicus a crenulated appearance; remainder of surface of the shell is smooth; aperture subcircular, slightly deflected; outer lip with an acute edge, behind which a thickened, external callus 3 or 4 mm. broad gives this portion of the body whorl a tumid appearance, except on the base where the collar is flattened for a short distance; inner lip considerably reflected, forming a callus where attached to the preceding whorl above, and partly covering the umbilicus below; edge of callus thin and nearly straight, though ordinarily a little more produced in the upper attached portion, forming a wide, bluntly rounded angle with the flattened base of the peristome.

The species is represented by 26 specimens in the Geological Survey collections. The largest specimen measures 10 mm. in height and 15 mm. in greatest breadth. Corresponding measurements of the type are given by Cragin as 10.5 mm. and 14.0 mm.

It is obvious that this species is not a typical *Margarites*, the most important differences being the thickened peristome and the sculpture of the umbilicus, but I am unable to refer it to any other genus with which it agrees more closely. Unfortunately, it is not possible to determine whether the shell was pearly.

Plesiotype: U. S. N. M. 77635.

Locality and position: Edwards limestone on west side of Colorado River above the mouth of Bartons Creek, near Austin, Travis County, Tex. The original type is from the same formation and vicinity.

Margarites bartonensis Stanton, n. sp.

Plate 49, figures 24–26, 30–32

Shell small, turbinate, consisting of about 5 convex whorls; aperture subcircular, somewhat produced below; umbilicus rather narrow; body whorl subangular on the periphery, where it bears a rather prominent revolving line above which 3 somewhat smaller lines are visible on the spires; base of the shell is also marked by 2 or 3 lines.

Height of largest specimen 7 mm., greatest breadth 7 mm.

Represented by 5 imperfect specimens preserved as calcite pseudomorphs that do not show whether the shell was originally pearly. Only 2 of the shells are well enough preserved to show the spiral lines, and they agree, though the sculpture may vary as it commonly does in this genus.

Types: Cotypes, U.S.N.M. 77636a-b; 2 unfigured paratypes, 77637.

Locality and position: Edwards limestone on west bank of Colorado River above the mouth of Bartons Creek, near Austin, Travis County, Tex.

Margarites bartonensis vaughani Stanton, n. var.

Plate 49, figures 33, 34

Like *Margarites bartonensis* Stanton, n. sp., in sculpture and general aspect, but with a wider apical angle and broader umbilicus. It has almost exactly the same form and proportions as young examples of *Margarites? brownii* (Cragin), but it is distinguished from them by the presence of spiral sculpture, and the absence of crenulations on the umbilicus. Represented by 7 specimens; associated with the typical form of the species.

Types: Holotype, U.S.N.M. 77638; 6 unfigured paratypes, 77639.

Locality and position: Edwards limestone above the mouth of Bartons Creek, near Austin, Travis County, Tex.

Genus SOLARIELLA Wood, 1842

Solariella serrata Stanton, n. sp.

Plate 49, figures 36–38

Shell small, depressed turbinate, with about 5 rapidly increasing shouldered whorls; body whorl bicarinated, the upper carina serrated with distant prominent conspicuous tubercles, and the lower carina with similar but smaller tubercles; on the spire the slightly channeled suture is a little in advance of the upper carina, and this, with the obliquely flattened upper surface, gives the whorls their shouldered appearance; in addition to the carinae the surface is marked by a beaded spiral line just below the suture, the rounded base bears 3 similar beaded lines and a row of larger crenulations on the edge of the rather broad umbilicus, within which other beaded lines are visible; aperture almost circular, with the regularity of the outline broken by the peripheral keels.

Height of the figured type 4 mm., greatest breadth

6 mm. The 3 other specimens in the type lot are somewhat smaller.

Fossil species apparently closely related to this beautiful little form have usually been described as *Solarium*. For example, *Solarium kirsteni* Geinitz (1874, p. 255, pl. 56, figs. 8a-c), from the Cenomanian of Germany, is a closely similar form. Several other similar species from the Lower Cretaceous have been assigned to *Solariella* by various authors and are certainly very different from the typical recent species of *Solarium*. Whether *Solariella serrata* had the pearly interior characteristic of *Solariella* cannot now be determined.

Types: Holotype, U.S.N.M. 103112; 3 unfigured paratypes, 103113.

Locality and position: Edwards limestone on west side of Colorado River above the mouth of Bartons Creek, near Austin, Travis County, Tex.

Genus CALLIOSTOMA Swainson, 1840

Calliostoma cragini Stanton, n. sp.

Plate 49, figures 22, 23

?1894. *Trochus texanus* Roemer. Cragin, Am. Geologist, vol. 14, p. 11.

1895. *Trochus texanus* Roemer. Stanton, Am. Jour. Sci., 3d ser., vol. 50, p. 217.

?1924. *Trochus texanus* Roemer. Twenhofel, Kansas Geol. Survey Bull. 9, p. 57, pl. 9, fig. 4.

Not 1928. *Trochus texanus* Roemer. Adkins, Texas Univ. Bull. 2838, p. 174.

1940. *Trochus texanus* Roemer. Stainbrook, Texas Univ. Bull. 3945, p. 707, pl. 33, figs. 10, 11.

Shell small, conical, with about 5 volutions that give the spire almost uniform slopes; base of the shell strongy convex, not umbilicated, with tuberculated revolving sculpture like that of the spire but slightly finer; aperture subtriangular, higher than broad; surface of the spire marked by 5 prominent, tuberculated revolving ridges, the lower and upper ones slightly larger than the others, and also by numerous fine revolving lines visible only under a lens; body whorl subangulated below, with an additional revolving ridge on the angle, which is commonly concealed on earlier whorls, and with about 7 smaller revolving lines on the base; suture slightly channeled.

The type specimen measures about 11 mm. in height and 9 mm. in greatest breadth; apical angle about 45°. Species by 6 specimens, which are associated with *Oxytropidorceras acutocarinatum* (Shumard) and *Gryphaea roemeri* Marcou.

The types were referred by me to *Trochus texanus* in a report to R. T. Hill, which was published by him. On casual examination this species might be mistaken for *T. texanus* Roemer, though the differences in form of aperture, the absence of the tooth-like fold on the columella, and the strongly sculptured base, show that they are really not very closely related. *Monodonta bartonensis* Starton is also somewhat similar in general aspect, but is distinguished by its convex whorls, finer sculpture, and subquadrate aperture.

Types: Holotype, U.S.N.M. 77594; unfigured paratype, 77595.

Locality and position: Kiowa shale in no. 11 of Hill's section at Black Hill, Comanche County, Kans.; 1 mile south of Belvidere, Kans.; on West Bear Creek 11 miles northwest of Ashland, Kans.; and from Kiamichi formation near Tahoka, Lynn County, Tex.

Subgenus EUTROCHUS Adams, 1864

Calliostoma (Eutrochus) serratum Stanton, n. sp.

Plate 49, figures 16–19

Shell of moderate size, conical, consisting of 7 or 8 rapidly increasing whorls acutely angulated on the periphery and flattened above so that the slopes of the spire are uniform except where broken near the sutures; peripheral angulation coarsely serrate on the adult whorls, the sharp serrated carina thus formed on the middle of the last whorl extending up on 2 or 3 whorls of the spire, where it appears just above the suture, to which it gives a channeled appearance; surface of spire marked by 6 or 7 rather coarse granulose spiral lines, the slightly broader interspaces usually each bearing a much finer line, and the whole surface of the well-preserved specimens covered with minute spiral lines visible only under a lens; surface of the last whorl or two also marked by rather prominent, short undulations extending upward from the serrations of the carina; the convex base marked by 12 or 13 coarse, granulose spiral lines in addition to the minute lines, the same sculpture extending into the umbilicus, which is rather narrow and partly arched over by the columella; aperture subquadrate, with a very obscure tooth-like projection near the base of the columella.

The larger of the type specimens measures 18 mm. in height and 16 mm. in greatest breadth. In the smallest figured specimen the height and breadth each measure 13 mm. The species is also represented by the apical portions of 4 other shells. All are silicified.

The reference of this form to *Eutrochus* may be questioned. It differs somewhat from modern representatives of the subgenus, especially in the character of the umbilicus which in them is bordered by a more or less distinct ridge and is smooth within. The differences do not seem great enough, however, to warrant the reference of the species to any

other group. It seems to be congeneric with *Trochus geinitzianus* Reuss (Stoliczka, 1868, p. 365), of the Bohemian and Indian Cretaceous, which is usually referred to *Eutrochus*.

Types: Cotypes, U.S.N.M. 77596a-b; 4 unfigured paratypes, 77597.

Locality and position: Limestone of Fredericksburg age in the eastern foothills of Quitman Mountains near their southern end, about 16 miles south of the town of Sierra Blanca, Hudspeth County, Tex.

Genus TEINOSTOMA H. and A. Adams, 1853

Teinostoma? austinense Stanton, n. sp.

Plate 56, figures 13, 14

Shell small, depressed, suborbicular, consisting of 4 or 5 rapidly increasing, convex whorls; umbilical region slightly concave, but covered by a thin callus, not perforated; aperture subcircular, entire, with simple, sharp outer lip; surface smooth.

Height of figured type about 4 mm., greatest breadth or diameter of the shell 6 mm.

This simple little shell, preserved in calcite, like its associates, is represented by only 2 specimens. Its general form and lack of an umbilicus seem to justify its reference to *Teinostoma*, though it lacks the expanded aperture and the conspicuous basal callus that is so common in that genus. It also resembles in some respects certain forms referred to *Photinula* and to *Vitrinella*.

Types: Holotype, U.S.N.M. 103115; unfigured paratype, 103116.

Locality and position: Edwards limestone on west side of Colorado River above the mouth of Bartons Creek, near Austin, Travis County, Tex.

Genus NERITA Linné, 1758

Nerita? apparata (Cragin)

Plate 47, figures 14, 15

1893. *Neritina apparata* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 227, pl. 46, fig. 14.
1928. *Neritina apparata* Cragin. Adkins, Univ. Texas Bull. 2838, p. 174.

Shell of moderate size, rather thin for this genus, obliquely subovate, consisting of 3½ or 4 very rapidly increasing whorls; spire low but distinct, with impressed suture; aperture semilunar; outer lip sharp, slightly thickened within but not denticulate; inner lip very slightly convex, with 6 or 7 moderately large denticles, those in the middle strongest; columella with a broad, thick, slightly convex callus; sculpture on the upper surface of the whorls consisting of sharply elevated, rather distinct oblique transverse plications, each more or less completely divided into 3 elongated tubercles; the lower portion (a little more than half) of the last whorl with 6 or 7 granular spiral lines about equal in width to the interspaces; the whole surface also marked by fine growth lines.

Height about 13 mm., greatest breadth 16 mm. Species represented by 4 specimens in the material examined.

The type is evidently an imperfect specimen, and the species is scarcely recognizable from the published figure; but the description of the peculiar sculpture leaves no room for doubt that Cragin had the same species here described and figured from better material. Our larger specimen was cleared with acid by the collector, and the sculpture was thus almost destroyed, but enough remains to show that it was identical in character with that of the smaller specimen figured.

The character of the aperture and the general aspect of the shell allies *Nerita apparata* with *Nerita* rather than with *Neritina*, to which it was originally referred. A considerable number of Cretaceous Neritidae from Europe and India, with somewhat similar sculpture, have been described, but the resemblance is not sufficiently close to require detailed comparison. *Nerita? marcouana* (Cragin) (below) is a related species of somewhat smaller size, and more simple, less conspicuous sculpture.

Plesiotypes: U.S.N.M. 22987, 103083.

Locality and position: Edwards limestone at Big Springs (type locality) in Howard County; on west side of Colorado River above mouth of Bartons Creek, near Austin, Travis County; and Comanche Peak limestone 7 miles west of Austin, Travis County, Tex.

Nerita? marcouana (Cragin)

Plate 47, figures 5–8

1895. *Neritoma marcouana* Cragin, Colorado Coll. Studies, 5th Ann. Pub., p. 62.
1924. *Nerita? semipleura* Twenhofel, Kansas Geol. Survey Bull. 9, p. 56, pl. 7, fig. 2.
1924. *Neritoma marcouana* Cragin. Twenhofel, Kansas Geol. Survey Bull. 9, p. 56.
1940. *Nerita? semipleura* Twenhofel. Stainbrook, Texas Univ. Bull 3945, p. 708, pl. 33, fig. 19.

Shell small, moderately thick, subglobose, broader than high, consisting of 3 or 3½ rapidly increasing, convex whorls; spire low, not very conspicuous, with impressed suture; aperture semilunar; outer lip sharp, very slightly thickened, and smooth within; inner lip with a moderately heavy callus, nearly straight, and bearing 6 or 7 denticles, the middle ones largest and the anterior 1 or 2 very small; sculpture on the upper half of the last whorl, and less conspicuously on part of the spire, consisting

of rather conspicuous oblique wrinkles or costellae that start as narrow ridges at the suture and gradually increase in width to the middle of the whorl, where they decrease in size abruptly; lower half of last whorl with about 10 inconspicuous revolving lines; the whole surface covered with fine lines of growth that tend to give the revolving striae a granular appearance. There are also very faint traces of revolving sculpture crossing the costellae.

One of the original types loaned to me by Professor Cragin for study measured 9 mm. in height and 11 mm. in greatest breadth. Compared with 4 other specimens in the Geological Survey collection, this seems to be about the average size. Corresponding measurements of the largest specimen seen are 12 mm. and 13 mm.

This description of the sculpture is drawn mainly from the small specimen represented on plate 47, figures 6, 7, which has the surface unusually well preserved. Specimens that are more weathered have less conspicuous sculpture, and the revolving striae are so little noticeable that they are not mentioned in the original description.

This species is evidently closely related to *Nerita apparata* (Cragin), which is easily distinguished, however, by its much more conspicuous and coarser spiral sculpture, and especially by the fact that the costellae on the upper half of the whorl are thus each broken up into 3 tubercles.

When the species was first described it was supposed that the inner lip was smooth, but a careful cleaning of the aperture showed the denticles well developed. The presence of these denticles, and the lack of a distinct sinus on the outer lip, show that the species cannot be retained in *Neritoma*.

Types: Holotype, U.S.N.M. 32674; plesiotype, 103084.

Locality and position: Kiowa shale near Belvidere, Kans.; Mentor formation about 5 miles west of Smolan, Saline County, Kans.; Kiamichi formation near Tahoka, Lynn County, Tex.

Nerita? pecosensis Stanton, n. sp.

Plate 47, figure 16

Shell of medium size, rather thick, obliquely subovate, consisting of about 3 very rapidly increasing convex whorls; aperture semilunar; outer lip somewhat thickened within; inner lip with a heavy flat callus, nearly straight, probably denticulate; surface marked by numerous rather narrow, sharp costae parallel with the fine growth lines and separated by spaces about twice their width. Last whorl crossed entirely by about 25 costae.

The type measures 16 mm. in height and 19 mm. in greatest breadth.

In form and general aspect this species closely resembles *Nerita apparata* (Cragin), from which it is distinguished by its simple costae passing entirely across the last whorl, and its lack of spiral sculpture. The last whorl is also proportionally somewhat larger.

Holotype: U.S.N.M. 103085.

Locality and position: A single specimen from the "Rio Grande, Pecos County [probably Brewster], Texas," where it is associated with *Nerinea riograndensis* Stanton and *Trochactaeon cumminsi* Stanton, in the Devils River limestone of Washita age.

Genus NERITINA Lamarck, 1816

Neritina? elpasensis Stanton, n. sp.

Plate 47, figures 12, 13

Shell small, rather thick, obliquely subovate, consisting of about 3 rapidly increasing whorls; spire minute, only very slightly elevated above the body whorl; suture impressed; aperture semilunar; outer lip sharp, not thickened; inner lip with 5 or 6 small denticles; columellar callus broad, thick, and very convex; surface smooth and polished, marked only by fine somewhat irregular lines of growth.

Height of a small specimen about 9 mm., greatest breadth of 10 mm. Corresponding dimensions of another less perfect specimen are almost twice as great. Species represented by about 20 specimens.

This species does not differ greatly from some of the simple forms in the Upper Cretaceous, such as *Neritina incompta* White (1879, p. 308, pl. 7, figs. 6a-c), but the details of outline, and the greater development of callus and of denticles on the inner lip of *N. elpasensis*, make it easily distinguishable from them. Possibly this is the species mentioned by Hill (1888, p. 129; 1893, p. 37) as occurring in the Trinity beds of Arkansas and Texas.

Types: Holotype, U.S.N.M. 103086; 8 unfigured paratypes, 103087, 103088.

Locality and position: Lowest beds exposed in railroad cut on bank of Rio Grande about 4 miles west of El Paso, Tex.; "Cajoncito" on the Rio Grande west of Quitman Mountains; southeast end of Finlay Mountains; eastern foothills of Quitmar Mountains about 16 miles south of town of Sierra Blanca, Hudspeth County; Comanche Peak formation in the neighborhood of Austin, Travis County, Tex. In all occurrences the species is associated with *Exogyra texana* and other species of Fredericksburg age.

Genus PILEOLUS Cookson in Sowerby, 1873

Pileolus septangularis Stanton, n. sp.

Plate 55, figures 4–9

Shell small, depressed patelliform, with the apex slightly curved backward; outline when perfect more

or less distinctly septangular, the anterior angle opposite the outer lip of the aperture generally most prominent, the other broad and somewhat rounded; surface marked by fine lines of growth, and by moderately prominent radiating ribs ranging in number from 24 to 29 with an average of about 28; those ribs that terminate in the peripheral angle are commonly somewhat larger than the others; some of the smaller intermediate ribs, especially on the posterior end, do not reach the apex; base flattened or slightly concave in a narrow zone around the thin margin of the shell, but the larger part behind the aperture covered with a very convex oval callus deposit; aperture narrow and slitlike, with the outer margin gently convex and the inner nearly straight or very slightly concave; outer lip bordered by a narrow elevated rim; inner lip generally showing 6 to 8 minute crenulations on the margin.

An average specimen has the following dimensions: Length at right angles to the aperture 7 mm., breadth parallel with the aperture 6 mm., height from apex through thickest part of basal callus 3.5 mm. Some of the smaller specimens are relatively somewhat higher. The largest specimen seen, an imperfect one, is a little more than 10 mm. long and 5 mm. high. Species represented by 9 specimens.

In Europe the genus *Pileolus* ranges from Middle Jurassic to the Eocene, though the typical forms do not pass above the Middle Cretaceous.

The Texan species described here is a typical *Pileolus*, in many respects resembling several Jurassic species and not very different from *P. urgonensis* Pictet and Campiche (1863, p. 412, pl. 76, fig. 7), from the Lower Cretaceous (Urgonian) of Switzerland.

Pileolus whitneyi Ikins (1940, p. 13, pl. 2, figs. 3a-c), from the Edwards limestone in Kerr County, Tex., is distinguished from *P. septangularis* by its more rounded outline, and its more numerous, less prominent radiating ribs.

Types: Cotypes, U.S.N.M. 103089a-c; 6 unfigured paratypes, 103090.

Locality and position: Edwards limestone on west side of Colorado River above mouth of Bartons Creek, near Austin, Travis County, Tex.

Genus PSEUDOMELANIA Pictet and Campiche, 1862

Pseudomelania? pupoides (Cragin)

Plate 55, figures 28, 30, 31

1893. *Rostellites pupoides* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 228.

Shell of medium size, subcylindrical or pupoid, consisting of 6 or 7 whorls that are convex in internal molds, but probably much less convex when the shell is preserved; first 3 or 4 whorls increasing rapidly in size, so that the apex of the spire is obtuse; last whorl narrowly rounded and very slightly produced in front; aperture elongate ovate or auriform, rounded in front and subangular behind; outer lip slightly expanded and somewhat thickened within, as indicated by the broad suubmarginal furrow of the last whorl, preserved on the mold, and in a few specimens on one or more of the earlier whorls also; surface unkown.

An average specimen that has lost a few millimeters from each end measures 45 mm. in height and 16 mm. in greatest breadth. One of the largest fragmentary examples is 20 mm. in breadth.

The material on which this species was based consists entirely of internal molds, none of which shows the sculpture, the character of the initial whorls, or all the features of the aperture. If it were not for the very slender elongate form it might be justifiable to refer it to *Tylostoma*, because of the internal thickening of the outer lip and the general form of the aperture. The reference to *Pseudomelania* is provisional and due more to the general form and aspect than to any particular generic feature.

Cragin's original comparison with the Upper Cretaceous *Rostellites texana* must have been made only on the basis of Conrad's imperfect description and figure in the U. S. and Mexican Boundary Survey Report. *R. texana* has nothing in common with the present species.

Types: Cotypes in the Texas State collections at Austin, Tex.; plesiotype, U.S.N.M. 103095.

Locality and position: Cragin's types are from the Glen Rose limestone in Travis County; on the Colorado River near Sandy Creek and Santa Monica Springs; and on the Blanco River above Blanco City, Tex. Two of the specimens now figured belong to Cragin's original type lot from the Blanco locality. The other figured specimen is from the Glen Rose limestone in Travis County, and is in the Geological Survey collections.

Genus EPITONIUM Bolten, 1798

Epitonium? austinense Stanton, n. sp.

Plate 63, figure 21

Shell small, consisting of a few very convex somewhat rapidly increasing whorls; apical angle about 15°; sides of the whorls regularly convex, marked on the spire by 7 or 8 revolving threadlike lines crossed by strong costae, of which there are 12 on the last whorl; base of last whorl rounded and bearing 4 additional revolving lines.

The type, incomplete both at apex and aperture, consists of 4 whorls, and measures 8 mm. in height and 5 mm. in greatest breadth. With the apex restored the height would be about 11 mm. Species represented by 2 specimens.

The reference of this species to the genus *Epitonium* is based on the general form, and on the character of the sculpture. As the shell is broken near the aperture its full form cannot be determined, but it has the appearance of having been slightly produced or subcanaliculate in advance.

None of the described American Cretaceous species is sufficiently similar to require detailed comparison. In general aspect the shell resembles *Rissoa texana* (p. 71), and it may be more closely related to it than its present reference would indicate. It is easily distinguished, however, by its more slender form, and more distant costae which extend relatively farther toward the front on the last whorl.

Types: Holotype, U.S.N.M. 103110; unfigured paratype, 103111.

Locality and position: Edwards limestone on the Colorado River above the mouth of Bartons Creek, near Austin, Travis County, Tex.

Genus SOLARIUM Lamarck, 1799 ?

Solarium? planorbis Roemer

Plate 55, figures 23–26

1888. *Solarium planorbis* Roemer, Palaeont. Abh., Band 4, p. 293, pl. 31, figs. 14a–14c.

?1895. *Solarium chickasaense* Cragin, Colorado Coll. Studies, 5th Ann. Pub., p. 63.

1928. *Solarium? planorbis* Roemer. Adkins, Texas Univ. Bull. 2838, p. 175.

?1940. *Solarium pseudoplanorbis* Ikins, Bull. Am. Paleontology no. 96, p. 13, pl. 2, figs. 4a–4c.

Translation of original description:

Shell discoidal, consisting of 4 or 5 slightly involute whorls, plane or even somewhat depressed above, quite plane and umbilicated below; umbilicus coarsely crenulate, not very wide in comparison with other species of the genus; whorls beneath the crenulations within the umbilicus excavated in a deep furrow; surface smooth above and below, with only a few faint growth lines visible here and there; test of the shell thick.

It cannot be doubted that the species belongs to the genus *Solarium*. The characteristically crenulated edge of the umbilicus, and the recession of the shell beneath the crenulated umbilical border to form a deep furrow scarcely visible from without, are characteristic features that thoroughly agree with those of typical species of *Solarium*. It is true that the lack of surface sculpture is somewhat unusual, but not without parallel. *Solarium dupinianum* D'Orbigny is likewise smooth, though distinguished by its very broad non-crenulate umbilicus and by its small size. The considerable thickness of the test, especially in comparison with the Tertiary and recent species is noteworthy.

The generic position of this fossil is uncertain. It does not appear to fit any part of the genus "*Solarium*" (*Architectonica* of present usage), nor any described genus of the Architectonicidae. The specimens available, however, do not seem to justify the institution of a new genus, and the old name is retained provisionally.

A specimen (see pl. 55, figs. 23, 25, 26) in the U. S. National Museum, from the same vicinity and formation as Roemer's types, is 17 mm. in diameter, somewhat smaller than Roemer's figure. The periphery of the shell is regularly rounded, and the aperture is almost circular, the inner wall of the whorl very thick so that the receding whorl does not encroach on the cavity; in this respect this shell differs from Roemer's figure (1888, pl. 31, fig. 14c) which is doubtless inaccurate in the apertural region, and this inaccuracy led Cragin to describe *Solarium chickasaense* as a distinct species, based chiefly on the difference in form of aperture as compared with Roemer's figure. Cragin also described *S. chickasaense* as marked by "growth lines which are crossed by a series of sub-remote revolving striae." The Texan specimens of *S.? planorbis* apparently have no revolving sculpture, though the specimen here figured has been cleaned with acid which may have removed the finer lines, and it is probable that all the differences noted are due to differences in preservation. Some of the Texan specimens show small crenulations, or short transverse ribs, near the suture on the upper surface of the shell.

The immature forms of *S.? planorbis* Roemer (see pl. 55, fig. 24) have a very low spire and are apparently identical in appearance with the small specimen described by Ikins (1940, p. 13, pl. 2, figs. 4a-c) as *Solarium pseudoplanorbis*.

Plesiotypes: U.S.N.M. 22989, 103114.

Locality and position: Roemer states that he had 6 specimens from a locality on Bartons Creek, 2 miles above its mouth, near Austin, which he supposed to be in the Upper Cretaceous Austin limestone but which is now known to be in the Edwards limestone. The Geological Survey collections contain 11 small specimens from a place near the type locality. A single silicified specimen was obtained from the foothills of the Quitman Mountains, near their southern end about 16 miles south of the town of Sierra Blanca in Hudspeth County, Tex., where it is associated with a fauna of Fredericksburg age. Three internal molds from the lower part of the Washita group near Kent in Culberson County are doubtfully referred to the species. The type of *S. chickasaense* was found "in the Comanche Peak limestone on a south branch of Little Hickory Creek, a few miles north and a little west of Marietta, Indian Territory" [Oklahoma].

Genus NATICA Scopoli, 1777

Natica? conradi (Hill)

Plate 52, figure 11

Not 1857. *Buccinopsis parryi* Conrad, U. S. and Mexican Boundary Survey Rept., vol. 1, pt. 2, p. 158, pl. 13, figs. 4a, 4b.

1888. *Buccinopsis? conradi* Hill, Arkansas Geol. Survey Ann. Rept., vol. 2, p. 130, pl. 3, figs. 2, 2a.
1893. *Buccinopsis? parryi* Conrad. Hill, Biol. Soc. Washington Proc., vol. 8, p. 33, pl. 6, fig. 1.
1893. *Buccinatrix conradi* (Hill). Cragin, Texas Geol. Survey 4th Ann. Rept., p. 220.

Mold of shell rather large, consisting of 6 or 7 rapidly increasing whorls; spire elevated, constituting half or more than half the height of the shell; umbilicus of the mold relatively narrow but deep; suture channeled; whorls distinctly shouldered, showing a rather broad plane surface on the top, almost at right angles with the side, which, on the body whorl, is flattened and somewhat constricted in its upper third and rounded below; surface unknown. The constricted flattened band on the body whorl of one specimen shows obscure undulations which might indicate sculpture, but as other specimens do not show them they are probably accidental. Aperture slightly oblique and apparently elongate subovate when complete.

The best preserved specimen, the one figured in the third paper cited, with the apex of the spire lacking measures 73 mm. in height, 55 mm. in greatest breadth, height of aperture 36 mm., breadth of aperture about 21 mm. The original specimen from Arkansas, to which the specific name *conradi* was given, has about the same size and proportions but lacks more of the spire. A third specimen in the Hill collection from Glen Rose, Tex., is considerably larger.

As to the generic reference it is not probable that the species belongs to *Natica* in the restricted sense, thought it is certainly a naticoid shell. The specimens now available do not preserve the generic characters, and I think it is convenient and often the better plan to use such generic names in their old general and indefinite sense rather than to attempt closer reference or create new names.

A somewhat similar species is *Leviathania leviathan,* Pictet and Campiche (1863, p. 562, pl. 89, figs. 1a-c, 2; Choffat, 1886, p. 18, pl. 1, figs. 1a-b, and pl. 3, figs. 1–3), from the Lower Cretaceous (Valanginian) of Switzerland and Portugal, but it is a much more robust, larger form with a broader apical angle and without an umbilicus. The briefest comparison of *Natica? conradi* with the type specimens of *Buccinopsis parryi* Conrad shows that the form now under consideration is not at all related to that species, which is very strongly sculptured and has a prominent anterior canal.

Hill's figure (1888) represents *Natica? conradi* as having the aperture produced in front to form a broad canal or beak, but this figure is misleading, the produced portion being nothing more than a bit of the matrix that has accidentally been trimmed so that it seems to be continuous with and to form a part of the cast of the shell. It should be noted in passing that *Buccinopsis parryi* is the type of Conrad's genus and hence must belong to it, though by a misplaced quotation mark Conrad is made to say in Hill's description that it is not a true *Buccinopsis.*

Types: Probably lost.

Locality and position: De Queen formation at Gypsum bluff on the Little Missouri River, Pike County, Ark. (type locality), and from Glen Rose, Tex.

Genus LUNATIA Gray, 1847

Lunatia? cragini Stanton, n. sp.

Plate 52, figures 1–3

Shell rather small, elongate ovate, consisting of about 6 rapidly increasing convex whorls; apical angle about 65°; spire elevated, but forming less than half the height of the shell; umbilicus small, partly covered by the relatively thin callus of the inner lip; aperture elongate-ovate, broadly rounded in front and acute behind; suture deeply impressed; surface covered with rather prominent lines of growth.

The best preserved type has the following dimensions: Height 24 mm., maximum breadth 18 mm., height of aperture 15 mm., greatest breadth of aperture 9 mm. The other figured type is slightly larger, and because of accidental distortion appears to be somewhat more slender. This species is represented by 5 specimens.

The species has no close relatives in the Comanche series, with the possible exception of *Natica acutispira* Shumard (1860, p. 597), which is described as having a lower spire and greater apical angle. In general form and proportions it resembles the young shells of *Viviparus? cossatotensis* Hill (1888, p. 130, pl. 3, figs. 4, 4a, 5, 5a), and it was probably this species that Cragin (1895a, pp. 373, 379) listed as *Natica? cossatotensis* Hill from the Kiowa shale of southern Kansas. The presence of an umbilicus, and the smaller size and more slender form, distinguish it from Hill's species. Several Upper Cretaceous species of *Lunatia* differ from this only in slight details.

Cotypes: U.S.N.M. 77633a-b.

Locality and position: Kiowa shale three-fourths of a mile south of railroad station at Belvidere, Kiowa County, Kans. (type locality); and at Black Hill, about 6 miles southeast of Belvidere.

Lunatia? praegrandis (Roemer)

Plate 51, figures 1, 2

1849. *Natica praegrandis* Roemer, Texas, p. 410, Bonn.
1852. *Natica praegrandis* Roemer, Die Kreidebildungen von Texas, p. 44, Bonn.

1852. *Globiconcha planata* Roemer (part), Die Kreidebildungen von Texas, p. 42, pl. 4, figs. 6a, 6b, Bonn.
1869. *Lunatia pedernalis* Gabb (not Roemer), California Geol. Survey, Paleontology, vol. 2, p. 259, pl. 35, fig. 3.
1877. *Prisconatica pedernalis* Gabb (not Roemer), Acad. Nat. Sci. Philadelphia Jour., 2d ser., vol. 8, p. 278.
Cf. 1877. *Prisconatica ovoidea* Gabb, Acad. Nat. Sci. Philadelphia Jour., 2d ser., vol. 8, p. 278.
Cf. 1891. *Natica (Lunatia) omecatli* Felix, Palaeontographica, Band 37, p. 169, pl. 25, figs. 1, 1a.
1928. *Tylostoma? praegrande* (Roemer). Adkins, Texas Univ. Bull. 2838, p. 178.

Shell large, obliquely ovate in outline, consisting of 4 or 5 very rapidly increasing whorls; test relatively thin; suture in some specimens slightly channeled; spire 1/3 to 1/4 the total height of the shell; whorls very convex and regularly rounded; surface marked only by fine lines of growth; aperture auriform, outer lip simple, acute, inner lip straight with a moderately thick callus which is slightly reflected over the narrow but distinct umbilicus.

Height of figured specimen 130 mm., greatest breadth 105 mm., height of aperture 103 mm., greatest breadth of aperture 53 mm.

Specimens of the species are abundant, but are almost invariably in the form of internal molds, many of which are distorted by pressure, though a few retain enough of the shell to show the essential features.

The species has often been confused with *Lunatia? pedernalis* (Roemer, see pl. 50, figs. 1, 2), which, however, as stated by Roemer, has whorls flattened on the side and with angular shoulder above, whereas *L.? praegrandis* has the whorls regularly convex without an angular shoulder. *Lunatia? praegrandis* was not figured by Roemer, but his comparison of it with *Natica gigas* Brown (*N. macrostoma* A. Roemer) (1836, p. 157, pl. 10, fig. 11) makes it clear that the name was applied to a form like that represented on plate 51, figures 1, 2, which has proved to be more common in the Glen Rose formation than *Lunatia? pedernalis.*

The form described as *Globiconcha planata* Roemer (1852, p. 42, pl. 4, figs. 6a-b) is duplicated by a few of the smaller specimens in the Geological Survey collections, but they seem to me only examples of *Lunatia? praegrandis,* or in part *L. pedernalis,* much shortened by accidental distortion. It is believed, therefore, that *Globiconcha planata* is a synonym.

The form from Arivechi, Sonora, Mex., described and figured by Gabb as *Lunatia pedernalis* (Roemer) appears to belong to *L.? praegrandis,* although later collections from the same locality have shown that the real *L.? pedernalis* is present in the fauna.

Among related species *Natica (Lunatia) omecatli* Felix, from the Neocomian of Tehaucan, Puebla, is very similar to some of the Texan specimens, and though perhaps it is a little shorter and more globose it will possibly prove to be identical. Gabb's *Prisconatica ovoidea,* from Peru, is also a closely related if not identical species, and his *P. ampla,* described in the same paper, is not greatly different. *Tylostoma princeps* White (1881, p. 140, pl. 2, figs. 1, 2) from Zapotitlan, Puebla, is somewhat similar in form, but it is much longer, and it is not umbilicated, besides showing rather obscurely the internal varices characteristic of *Tylostoma.*

From the Lower Cretaceous of Portugal, Choffat (1886, p. 22, pl. 1, figs. 4a-b) has described several large species of *Natica* more or less closely related to the Texan species. One of them especially, *N. similimus,* somewhat resembles figures 1 and 2 on plate 51.

Plesiotype: U.S.N.M. 7131.

Locality and position: Very abundant in the Glen Rose limestone on the Paluxy River in the neighborhood of Glen Rose, Somervell County; Anderson Bend on the Colorado River 20 miles west of Austin, Travis County; between Bee Creek and Pedernales River, near Corwin road to Bee Caves, Travis County; near Driftwood, and on Bear Creek, Hays County; and 3½ miles west of Kerrville, Kerr County, Tex. It also occurs in the Comanche Peak and Walnut formations 9 miles northeast of Kerrville; 9 miles west of Austin; and in the neighborhood of Kickapoo Springs on the west fork of Nueces River in Edwards County, Tex.

Some specimens in the U. S. National Museum are labeled "Bell County," "Lampasas Valley," and "Coryell County." The species likewise has been collected near El Paso, Tex., in the Apache Mountains of Arizona, and near Arivechi, Sonora, Mexico, in beds of Fredericksburg age.

Lunatia? pedernalis (Roemer)

Plate 50, figures 1, 2

1849. *Natica pedernalis* Roemer, Texas, p. 410, Bonn.
1852. *Natica pedernalis* Roemer, Die Kreidebildungen von Texas, p. 43, Bonn.
1852. *Globiconcha planata* Roemer (part), Die Kreidebildungen von Texas, p. 42, Bonn.
Not 1869. *Lunatia pedernalis* Roemer. Gabb, California Geol. Survey, Paleontology, vol. 2, p. 259, pl. 35, fig. 3.
Not 1877. *Prisconatica pedernalis* (Roemer). Gabb, Acad. Nat. Sci. Philadelphia Jour., 2d ser., vol. 8, p. 278.
Not 1893. *Tylostoma pedernalis* (Roemer) Hill, Biol. Soc. Washington Proc., vol. 8, p. 33, pl. 6, fig. 2.
Not 1901. *Lunatia (Tylostoma) pedernalis* (Roemer) Hill, U. S. Geol. Survey 21st Ann. Rept., pt. 7, pl. 25, fig. 1.
Not 1904. *Lunatia pedernalis* (Roemer) Stanton, U. S. Geol. Survey Prof. Paper 21, p. 70, pl. 16, fig. 3.

1910. *Natica pedernalis* Roemer. Böse, Inst. geol. México Bol. 25, p. 142, pl. 30, fig. 9.

1928. *Natica? pedernalis* Roemer. Adkins, Texas Univ. Bull. 2838, p. 176.

Not 1928. *Lunatia pedernalis* (Hill) Vanderpool, Jour. Paleontology, vol. 2, p. 99, 1 fig. on pl. 12.

Shell large, obliquely ovate in outine, consisting of 4 or 5 rapidly increasing whorls; test thin; suture apparently slightly channeled; spire about one-fourth the total height of the shell; whorls flattened on the side and shouldered above; surface marked by fine growth lines; aperture auriform, fairly wide below, outer lip simple, inner lip nearly straight with a callus reflected over a small but distinct umbilicus.

Height of figured specimen 120 mm., greatest breadth 113 mm., height of aperture 98 mm., greatest breadth of aperture 55 mm.

This species is distinguished from *Lunatia? praegrandis* (Roemer) by its shouldered and flattened whorls, its less elongate form, its slightly larger umbilicus, and its somewhat broader aperture. Neither of these species is very similar to *Tylostoma pedernalis* Hill (not Roemer), which is common in the lower Glen Rose formation of central texas and in beds of upper Aptian age in Mexico.

Natica pedernalis was first assigned to the genus *Lunatia* by Gabb, who, however, misidentified the species. This generic reference seems to me correct, the only exceptional feature that the species possesses being its very large size. Subsequently, however, Gabb (1877, p. 278) made it the type of his new genus *Prisconatica* which was intended to include a number of Mesozoic naticoid species "characterized by being almost always of large size, including several of the largest known species of the family; by their thin shells, generally elevated spire, increasing rapidly in their axial length rather than obliquely; with very small, or entirely obsolete, umbilicus, and in having the columellar lip always thinly encrusted." The present species, cited as the type, is distinctly umbilicated, and agrees in essential characters with forms usually referred to *Lunatia*. Adkins (1939, p. 1670) has recently listed this species under *Amauropsis*.

Plesiotype: U.S.N.M. 77634.

Locality and position: Glen Rose limestone at many localities in central and western Texas. From Comanche Peak limestone at Wolf Creek about 9 miles northeast of Kerrville on road to Fredericksburg, Kerr County; in the vicinity of Kickapoo Springs on the west fork of the Nueces River, Edwards County; and 9 miles west of Austin, Travis County, Tex. Also in beds of Fredericksburg age near Arivechi, Sonora, Mex.

Genus GYRODES Conrad, 1860

Gyrodes biangulata (Shumard)

Plate 49, figures 39, 40

1860. *Neritopsis biangulatus* Shumard, Acad. Sci. St. Louis Trans., vol. 1, p. 598.

Not 1893. *Neritopsis biangulatus* Shumard. Cragin, Texas Geol. Survey 4th Ann. Rept., p. 227.

Original description:

Shell depressed, width greater than the height; spire short, obtuse at apex (in cast), forming about one-fifth of the total height of the shell; volutions three and a half, angulated above, upper surface narrow, flat, declining very gradually from angle of periphery to suture; last volution very large, transverse diameter greater than the height, periphery convex, angulated below but less sharply than above; surface of cast exhibiting obscure, coarse striae, which are preserved only on the side of the body volution, where they pass obliquely downwards and backwards from the superior to the inferior angle.

Height, 1.10; width, 1.42.

The few examples of this species we have seen are casts, and occur with *Inoceramus problematicus* [probably *I. comancheanus* Cragin] and *Hamites fremonti* near the base of the Upper Cretaceous limestone.

Locality: Alexander's Bend, Grayson County, about 20 miles west of Preston, Texas, in the neighborhood of Olivia.

Shumard's species has not hitherto been figured, and the types have not been preserved. From the description alone the inference would hardly be justified that the form described as a *Neritopsis* really belongs to *Gyrodes*, but there is strong circumstantial evidence that this is true. The locality given is in an area in which the Cretaceous beds exposed belong to the Washita group of the Comanche series. *Idiohamites fremonti* (Marcou) is one of the common fossils of the Duck Creek formation, and *Inoceramus comancheanus*, which is usually associated with it, might easily be mistaken for *I. problematicus*.

It is almost certain, therefore, that the original *Neritopsis biangulatus* came from the Duck Creek formation. The specimen here figured was in the collection of F. W. Cragin at Colorado College and was identified with Shumard's species by him. It was collected from the Duck Creek formation near Marietta, Love County, Okla. This is the same formation as at the type locality and only a few miles distant from it. This rather large mold is certainly a *Gyrodes* closely resembling some of the Upper Cretaceous forms such as *G. conradi* Meek. It consists of 3½ rapidly increasing whorls regularly convex on the sides, with a narrow, flat shoulder bordering the suture above and narrowly rounded into the rather broad umbilicus below. The aperture is almost semicircular. The internal mold shows distinct traces of the oblique growth lines, which probably formed the only sculpture. The dimensions of

the specimen are: Height 42 mm., breadth 50 mm., height of aperture 35 mm., breadth of aperture 26 mm., breadth of umbilicus 10 mm.

A comparison of this description and figure with the original description shows no essential inconsistency except that Shumard makes no mention of an umbilicus, but it is probable that in his specimens this feature was concealed by the matrix.

A smaller, somewhat distorted specimen, U.S. N.M. 77632, probably belonging to this species was collected in the Forth Worth limestone near Denison and is in the Geological Survey collections.

The fossils mentioned under this name by Cragin came from the Eagle Ford shale and probably belong to another species, most likely *Gyrodes conradi* Meek (1876, p. 310, figs. 33–36), which occurs in the equivalent Benton group of the Rocky Mountain and Upper Missouri regions. *Gyrodes pattoni* Stainbrook (1940, pl. 33, fig. 14) has a more depressed spire.

Types: Both Shumard's and Cragin's types are probably lost.

Locality and position: Duck Creek formation at Alexanders Bend about 20 miles west of Preston, Grayson County, Tex.; and near Marietta, Love County, Okla. Fort Worth limestone near Denison, Grayson County, Tex.

Genus TYLOSTOMA Sharpe, 1849

Tylostoma elevatum (Shumard)

Plate 53, figures 1–5

1853. *Globiconcha? elevata* Shumard, in R. B. Marcy, U. S. 32d Cong., 2d sess., S. Doc. 54, p. 208, pl. 4, fig. 4.
1861. *Globiconcha curta* Gabb, Acad. Nat. Sci. Philadelphia Proc., p. 319.
cf. 1888. *Natica (Amauropsis) avellana* Roemer, Palaeont. Abh., Band 4, p. 292.
1892. *Globiconcha (Tylostoma) curta* Gabb. Whitfield, U. S. Geol. Survey Mon. 18, p. 160, pl. 19, figs. 26, 27.
?1924. *Tylostoma elevata* (Shumard). Twenhofel, Kansas Geol. Survey Bull. 9, p. 59, pl. 16, fig. 5; pl. 22, fig. 3.
1928. *Tylostoma elevatum* (Shumard). Adkins, Texas Univ. Bull. 2838, p. 178.

Shell of medium to large size, consisting of about 7 rapidly increasing, convex whorls; apical angle about 65°; suture rather deeply impressed; spire acute, elevated, but constituting considerably less than half the length of the shell; surface marked only by lines of growth and the two varices characteristic of the genus; varices varying in size on different individuals, on many fairly strong and leaving deep grooves on internal molds; aperture oblique, auriform, closely resembling the aperture of *Tylostoma tumidum* Shumard; inner lip with a rather heavy callus which is nearly straight above and slightly excavated below over the narrow umbilical chink.

The most perfect specimen seen (see pl. 53, fig. 4) is from the vicinity of Austin, Tex. It measures 42 mm. in height, 32 mm. in maximum breadth, and the aperture is 28 mm. in height and 13 mm. in greatest breadth. Some much larger specimens, one of which is 70 mm. in height, have about the same proportions and are provisionally referred to this species.

As in the closely related species *Tylostoma tumidum* Shumard, with which *T. elevatum* is associated, there will always be room for doubt as to the identity of Shumard's *Globiconcha elevata*. I have applied the name to a form from the same region and formation as the original type that corresponds closely with the figure and description, though Shumard's statement that the body whorl is shorter than the spire is misleading and probably due to the imperfection of the type. Gabb's *G. curta* is almost certainly based on a young example of the same species. *Natica* (*Amauropsis*) *avellana* Roemer in the original figure has almost exactly the form of this species, and although he did not notice nor represent the varices I suspect that it is really a young *T. elevata*.

Tylostoma naticoide, Pictet and Campiche (1862, p. 353, pl. 73, figs. 6, 7), from the Valanginian (lowest Cretaceous) of Switzerland, is a similar species. Some of the larger specimens have a close resemblance to the figures of *T. torrubrae* Sharpe (1849, p. 378, pl. 9, fig. 1).

Plesiotypes: U.S.N.M. 103168, 103161–63.

Locality and position: The type was found with *Tylostoma tumidum* at "Cross Timbers, Texas," in limestone that doubtless belongs to the Fredericksburg group. Other specimens are from the Comanche Peak limestone of north-central and central Texas at Seven Knobs, Somervell County; Chalk Mountain, Erath County; Comanche Peak near Austin, and Mount Barker west of Austin, Travis County; and 6 miles west of Fort Worth and Benbrook, Tarrant County, Tex. Also from the Goodland limestone 10 miles northwest of Denison in Grayson County; from the Fredericksburg group near El Paso; and from the Washita group in the vicinity of Kent, Culberson County, Tex., where it is associated with the large, more slender form that I have described as *T. kentense*. *T. elevatum* also occurs in beds of Fredericksburg and Washita ages at several localities in the foothills of the Quitman Mountains between Quitman Canyon and the Rio Grande, in Hudspeth County, Tex.

Tylostoma? formosum (Cragin)

Plate 52, figures 6, 8

1893. *Cylindrites formosus* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 223, pl. 42, fig. 4.

1928. *Cylindrites formosus* Cragin. Adkins, Texas Univ. Bull. 2838, p. 195.

Shell small, subovate, consisting of about 5 moderately convex whorls, the last of which constitutes the greater part of the bulk; spire short, obtuse, suture slightly impressed; surface smooth; aperture elongate, very narrow and acute above, broader and rounded below; inner lip forming a moderately heavy callus, which is straight above, slightly excavated below, where it almost covers the narrow umbilical chink, and twisted at the base to join the outer lip, which appears to be slightly thickened within, though the margin is acute.

Height 20 mm., greatest breadth 14 mm., height of aperture 14 mm.

The description and figure are taken from the type specimen in the Texas State collections. Cragin's original description and figure represents the species as having a "columella bearing two prominent tooth-like folds nearly parallel to the axis of the shell," but on cleaning the matrix from the aperture more thoroughly it was found that one of the "folds" is only the twisted lower end of the inner lip, and the other is accidental and does not belong to the shell. The cleaning of the aperture also revealed a narrow umbilical chink, and a rather heavy callus formed by the inner lip.

The type does not show the distinct varices characteristic of *Tylostoma*, but the other features of the shell, and especially the aperture, are very similar to those of the species of *Tylostoma* here described. The specific characteristics that distinguish this form are its very short obtuse or convex spire, and its very long and narrow aperture.

Holotype: Texas State collections.

Locality and position: The type was collected "from the top of the *Exogyra texana* bed on the Texas and Pacific Railway two and a half miles east of Benbrook, Tarrant County," Tex. Imperfect molds referred to this species have been obtained from equivalent beds at Benbrook in Tarrant County; near Austin; and 7 miles west of Austin.

Tylostoma kentense Stanton, n. sp.

Plate 52, figures 4, 5, 10

Shell large, rather slender, consisting of 7 or 8 slightly convex whorls; apical angle about 45°; suture inconspicuous on shell, channeled on molds but not so prominent as in *Tylostoma tumidum* Shumard; last whorl constituting about half the height of the shell; surface smooth; internal varices indicated by grooves on the mold that are commonly small and inconspicuous; aperture somewhat oblique, rather narrow auriform, acute above, broader and rounded below; inner lip with a moderately heavy callus.

The smaller of the figured types has the following measurements: Height 77 mm., to which should be added about 9 mm. lost from apex, breadth 50 mm., height of aperture 43 mm., breadth of aperture 20 mm. Corresponding dimensions of the larger specimen (the largest one seen) are 97 mm., to which about 16 mm. should be added to restore apex, 61 mm., 56 mm., and 21 mm.; in this specimen the aperture is accidentally narrowed by breaking and weathering. Species represented by many specimens.

This species is evidently closely related to *Tylostoma tumidum* Shumard (p. 70), from which it differs in its larger size, more slender form, less convex whorls, and differently shaped aperture, which is not so oblique and is relatively broader above. *T. regina* (Cragin) (below) is also fairly similar in general form, and as large, or larger, but is not so slender, has more convex whorls, and also differs in the form of the aperture.

Types: Holotype, U.S.N.M. 103157; 1 figured paratype, 103156; 9 unfigured paratypes, 103158–60.

Locality and position: Washita group at various localities in the neighborhood of Kent, Culberson County, Tex.

Tylostoma regina (Cragin)

Plate 54, figures 1–4

Not 1842. *Natica praelonga* Deshayes, Soc. géol. France Mém., t. 5, p. 13, pl. 16, fig. 8.
1849. *Natica* sp. ind.? Roemer, Texas, p. 411, Bonn.
1852. *Natica* sp. ind. Roemer, Die Kreidebildungen von Texas, p. 44, Bonn.
1853. *Natica praelonga* Deshayes. Giebel, Naturwiss. Ver. Halle Jahresber. 1852, p. 365.
1893. *Buccinatrix regina* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 220, pl. 43.
1928. *Natica* sp. Adkins, Texas Univ. Bull. 2838, p. 176.

Shell large, elongate, consisting of 6 or 7 rather rapidly increasing whorls; apical angle varying from 50° to 60°; spire elevated, about equal to the last whorl in height; sutures of the internal mold deeply channeled; whorls regularly rounded, rather convex; umbilicus narrow in well-preserved molds, probably closed in perfect shells; aperture elongate subovate, somewhat produced in front, and prolonged backward on the penultimate whorl; outer lip slightly expanded and reflected. Well-preserved molds usually show 2 irregular opposite rows of depressions formed by the internal varices.

A medium-sized specimen in the Geological Survey collections from the Paluxy River 5 miles above Glen Rose has the following measurements: Height 98 mm., maximum breadth 64 mm., height of aperture 52 mm., greatest breadth of aperture 27 mm.

The measurements and figure of the type indicate a much larger and stouter specimen. One from El Paso is also somewhat stouter.

This species was first described from a single large specimen, preserved, like all the others studied since, as an internal mold. Because of the absence of internal varices Cragin was not able to refer it to *Tylostoma,* and as it did not seem to agree perfectly with any other described genus the new generic name *Buccinatrix* was proposed for it. The 25 or more specimens here examined agree too closely with Cragin's figure and description to warrant their reference to another species, yet most of them clearly show the internal varices and other characteristic features of *Tylostoma,* and in other specimens the absence of the varices may be explained as due to accidents of preservation. On comparing these specimens with the figures and descriptions of *Natica praelonga* published by Leymerie (1842, p. 13, pl. 16, fig. 8), D'Orbigny (1843, p. 152, pl. 172, fig. 1; 1842a, p. 78; 1847, pl. 18, fig. 1), Pictet and Campiche (1862, p. 369), it is at once seen that they resemble each other closely in general form. Pictet remarks that in European collections large specimens of *Tylostoma fallax* are frequently labeled *N. praelonga.* For these reasons it seems to me most probable that the fossils identified or compared with *N. praelonga* by Roemer and Giebel really belong to *T. regina.*

The most closely related Texan form is *Tylostoma tumidum* Shumard, from which *T. regina* may be distinguished by its larger size, its generally more slender form, and by differences in the form of the aperture.

Plesiotypes: U.S.N.M. 103164, 103165; Cragin's type is probably lost.

Locality and position: The type was obtained in the Glen Rose limestone of Gillespie County, Tex. Other specimens have been obtained also from the Glen Rose limestone at Glen Rose, Somervell County; Bluff Dale, Erath County; Johnsons Branch of Bear Creek, Hays County; Anderson Bend on the Colorado River about 20 miles west of Austin; 9 miles west of Austin; Colorado River below mouth of Cow Creek, Travis County; Spanish Creek, Burnet County; also from beds about the same height, or possibly somewhat higher, at El Paso, Tex.

Tylostoma tumidum (Shumard)

Plate 53, figures 6–9

1853. *Globiconcha (Tylostoma) tumida* Shumard, in R. B. Marcy, U. S. 32d Cong., 2d sess., S. Doc. 54, p. 208, pl. 5, fig. 3.

1859. *Phasianella perovata* Shumard, Acad. Sci. St. Louis Trans., vol. 1, p. 597.

?1895. *Tylostoma tumida* Shumard. Cragin, Am. Geologist, vol. 16, p. 379.

1928. *Phasianella perovata* Shumard. Adkins, Texas Univ. Bull. 2838, p. 173.

1928. *Tylostoma tumidum* Shumard. Adkins, Texas Univ. Bull. 2838, p. 178.

Shell rather large, robust, consisting of about 7 moderately convex whorls; apical angle about 55°; suture slightly impressed on the shell, deeply channeled on internal molds; last whorl constituting half or a little more than half the height of the shell; surface smooth but bearing inconspicuous lines of growth; 2 opposite longitudinal varices varying greatly in size, on some molds represented by deep distinct constrictions, and on others indicated only by faint depressions; aperture oblique, auriform, very narrow and acute above, and broadly rounded below.

An average specimen has the following measurements: Height 67 mm., maximum breadth 44 mm., height of aperture 37 mm., greatest breadth of aperture 18 mm. Species abundantly represented.

Shumard described 2 associated and closely related species under the names *Globiconcha (Tylostoma) tumida* and *G. elevata.* The types, which were badly preserved internal molds, have been lost, so that it is necessary to identify the species from the brief descriptions and the figures. On studying these in connection with large numbers of specimens from the same formation in Texas it is evident that both are *Tylostoma* and that *T. tumidum* is somewhat the more slender and has less convex and relatively higher whorls. These differences are possibly too slight for characterizing distinct species, but as the names have already been given, it is thought best to retain them, especially because better preserved specimens might show other differences of specific importance.

Phasianella perovata Shumard has never been figured, but the description corresponds more closely with this species than with any other form that has since been found in the bed from which it was obtained.

Among European species the nearest representative is *Tylostoma fallax,* Pictet and Campiche (1862, p. 351, pl. 73, figs. 3, 4), from the Valanginian of Switzerland.

Plesiotypes: U.S.N.M. 103166a-b, 103167.

Locality and position: Shumard's types were obtained "at Cross Timbers, Texas, in Cretaceous limestone." The exact locality referred to is not known, but it was in northern Texas, and the limestone was probably the Goodland limestone of the Fredericksburg group. The species as here defined has been obtained from the Comanche Peak limestone at Seven Knobs, Somervell County; Chalk

Mountain, Erath County; Benbrook, Tarrant County; Comanche Peak, Travis County; and elsewhere in north-central Texas. Also from the Comanche Peak or an essentially equivalent formation in Bell County and Comanche County; Owl Creek, Coryell County; Liberty Hill, Williamson County; Blocker Creek, 20 miles southwest of Gainesville, Cooke County; and 9 miles northwest of Kerrville, Kerr County, Tex.

Genus VIVIPARUS Montfort, 1810

Viviparus? cossatotensis Hill

1888. *Vivipara cossatotensis* Hill, Arkansas Geol. Survey 2d Ann. Rept., vol. 2, p. 130, pl. 3, figs. 4, 4a, 5, 5a.
1889. *Natica cossatotensis* (Hill). Marcou, Am. Geologist, vol 4, pp. 359, 362.
1889. *Vivipara? cossatotensis* Hill, Texas Geol. Survey Bull. 4, pp. 18, 40, 47.
1890. *Natica cossatotensis* (Hill). Marcou, Am. Geologist, vol. 5, p. 317.
1893. *Vivipara (Natica?) cossatotensis* Hill, Biol. Soc. Washington Proc., vol. 8, p. 32.
1928. *Natica? cossatotensis* (Hill). Adkins, Texas Univ. Bull 2838, p. 176.

Shell of medium size, consisting of 5 or 6 rapidly increasing, convex whorls; spire elevated, forming about half the height of the shell; apical angle about 55°; suture impressed; aperture broadly ovate, somewhat produced obliquely in front; peristome continous; no umbilicus; surface features unknown.

The largest of the types has the following measurements: Height 43 mm., greatest breadth 31 mm., height of aperture 23 mm., breadth of aperture 18 mm.

This description is drawn from the 3 specimens on which the species was originally based, 2 of which were figured. They are in the form of ferruginous internal molds retaining portions of the shell, or replacements of it, around the aperture. With such imperfect material it is impossible to determine generic affinities with certainty. It may be that these are naticoid shells, as has been suggested, but they are so similar in all the preserved features to certain species of *Viviparus,* such as *V. raynoldsianus* Meek and Hayden (1876, p. 584, pl. 44, figs. 7a-b), from the Laramie formation, that it seems best to leave them in the genus to which they were first assigned. This implies fresh-water deposits, or at least the presence of fresh water in streams or lagoons nearby. All the other Lower Cretaceous fossils from Arkansas are marine forms, but none of them was found immediately associated with this species, and the bed in which it was found, if really of Lower Cretaceous age, may be a local estuarine deposit.

Types: Probably lost.

Locality and position: "From a well in the yellow Trinity sands near Chapel Hill, Sevier County, Arkansas."

Genus RISSOA Fréminville, 1814

Rissoa? texana Stanton, n. sp.

Plate 55, figures 20, 21

Shell rather large for the genus, slender, consisting of about 11 convex whorls; apical angle 30°; surface of the spire marked by about 10 threadlike revolving lines of variable size, crossed by broad, rounded costae, of which there are 13 or 14 on each whorl and which appear only on the upper portion of the last whorl, fading out before reaching the middle, below which the surface is covered by numerous revolving lines that are finer than those on the spire; aperture broadly ovate, slightly produced in an incipient canal in front, and obtusely subangulated behind; peristome continuous, the inner lip moderately thick, the outer lip with a heavy external varix on which the revolving lines pass without interruption.

The figured type, which is the largest specimen seen, measures 13 mm. in height and 7 mm. in greatest breadth, height of aperture 5 mm. and length of aperture 4 mm. Represented by 9 specimens.

This is the first species from the American Cretaceous that has been referred to *Rissoa,* and no nearly related forms have been described, unless the species described in this paper under the name *Epitonium? austinense* Stanton should prove to be congeneric. The sculpture, the general aspect of the shell, and the form of the aperture of *R. texana* makes its reference to the Rissoidae reasonably certain, though if the aperture were a little more canaliculate in front it might be referred to *Rissoina* rather than to *Rissoa.* Stoliczka (1868, p. 278, pl. 20, figs. 19, 19a-b) describes a somewhat similar species, *Rissoa tropica,* from the Cretaceous of India.

Types: Holotype, U.S.N.M. 103108; unfigured paratypes, 103109.

Locality and position: Eastern foothills of the Quitman Mountains, about 16 miles south of the town of Sierra Blanca, Hudspeth County, Tex., associated with a fauna of Fredericksburg age.

Genus TURRITELLA Lamarck, 1799

Turritella belviderei Cragin

Plate 56, figures 8–10

1890. *Turritella marnochii* var. *belviderei* Cragin, Washburn Coll. Lab. Nat. History Bull., vol. 2, p. 75 *(nomen nudum).*
1897. *Turritella belviderei* Cragin, Science, new ser., vol. 6, p. 134.

1924. *Turritella seriatim-granulata* var. *belviderii* Cragin. Twenhofel, Kansas Geol. Survey Bull. 9, p. 58, pl. 8, figs. 1, 2.

1940. *Turritella belviderii* Cragin. Stainbrook, Texas Univ. Bull. 3945, p. 710, pl. 33, figs. 15, 16.

Shell of medium size, having about the form and proportions of *Turritella seriatim-granulata* Roemer; whorls 12 or more, gently convex; suture slightly channeled or at least distinct; apical angle about 15°; sculpture consisting generally of 6 strong, more or less granular spiral ridges that are mostly broader than the interspaces, the upper one generally distinctly more prominent than the others; base of body whorl with about 6 narrower lines; a few specimens show 7, more rarely 5, spiral lines on the sides.

None of the specimens examined is sufficiently complete to give the height accurately, but apparently the average specimens measure 55 to 60 mm. in height and 15 to 16 mm. in greatest breadth.

In its coarse sculpture and general aspect this form is most like *Turritella seriatim-granulata* Roemer from Mesa Tucumcari, but the constantly larger number of ribs and their closer arrangement easily distinguish it. These differences are slight, but their constancy and the geographic isolation of the 2 forms seem to me sufficient grounds for recognizing them as distinct species. *T. washitensis* Ellisor (1918, p. 9, pl. 1, figs. 5, 6) has somewhat finer ribbing.

The name adopted for the species by Cragin (1897, p. 134) was subsequently abandoned by him, the forms from this region being assigned to *Turritella seriatim-granulata* var. *marnochi* and var. *kansasensis* and *T. ventrivoluta* Cragin. The collections from southern Kansas here examined contain more than 100 specimens, all belonging to the species just described. *T. kansasensis* (Meek) (1876, p. 333, pl. 2, figs. 7a-b) is a smaller species with indistinct sculpture, based on specimens from the "Dakota" beds near Salina, Kans., to which Cragin subsequently gave the name Mentor beds. I have not seen any examples from older beds, and they seem to me entirely distinct from *T. seriatim-granulata* Roemer, as well as from *T. belviderei.*

Plesiotypes: U.S.N.M. 103139a-c.

Locality and position: Abundant in the Kiowa shale and equivalent beds, including the Champion shell bed, in Kansas, particularly from Black Hill, Comanche County; a single specimen from the Weno formation(?), 8 miles north of Fort Worth; and from the Kiamichi formation near Tahoka, Lynn County, Tex.

Turritella irrorata Conrad

Plate 55, figures 12, 14

1855. *Turritella irrorata* Conrad, Acad. Nat. Sci. Philadelphia Proc. for 1854, p. 268.

1857. *Turritella planilateris* Conrad, U. S. and Mex. Boundary Survey Rept., vol. 1, pt. 2, p. 158, pl. 14, figs. 1a, 1b.

1893. *Turritella seriatim-granulata* var. *planilateris* Conrad. Cragin, Texas Geol. Survey 4th Ann. Rept., p. 232.

Not 1918. *Turritella planilateris* Conrad. Ellisor, Texas Univ. Bull. 1840, p. 18, pl. 4, fig. 7.

1928. *Turritella irrorata* Conrad. Adkins, Texas Univ. Bull. 2838, p. 182.

Shell rather small, slender, consisting of numerous whorls with flattened and somewhat concave sides; sculpture beginning at the top of the whorl consists of 4 subequal beaded ribs alternating with finer simple lines, then a larger beaded rib that forms a rather distinct carination, followed by 2 smaller lines, the lower of which borders the linear and scarcely visible suture; base of body whorl somewhat flattened and marked by spiral lines.

This description is drawn from the specimen, U.S. N.M. 9845, labeled type of *Turritella planilateris,* which is evidently also the specimen described under the earlier name *T. irrorata* in the preliminary "Descriptions of one Tertiary and eight new Cretaceous fossils from Texas, in the collection of Major Emory." In this earlier paper, after a brief and unsatisfactory description, Conrad remarks that "This shell differs from *T. seriatim-granulata* Roemer, in having much finer lines and tubercles, and in having a smooth line between each of the beaded ones. It is associated with *Nodosaria occidentalis,* the very small *Venus quinquecostata,* and the little *Corbula occidentalis.* It is imbedded in a highly fossiliferous, ferruginous, indurated clay, which appears to have been obtained from the same bed with *Cardium Texanum.*" The locality is given as "between El Paso and Frontera?."

Two years later *Turritella planilateris* was described and figured in the U. S. and Mexican Boundary Survey Report, and the type is preserved in the U. S. National Museum. The description does not agree with the figure, and neither agrees in detail with the specimen, but there is no doubt as to the authenticity of the type. No statement is made as to locality, but it is stated that "It is accompanied by *Lima leonensis,* a small Natica, and a small *Astarte,* which has about five broad concentric prominent ribs, and triangular in form. It may be named *Astarte crassilira.*" The author had apparently entirely forgotten his earlier description. No reference is made to *Nodosaria texana* (mentioned as *N. occidentalis* before), which is on the same rock fragment with the type, and the *"Venus quinquecostata"* has now become *"Astarte crassilira."* The lithologic character also agrees with the earlier description. These incidental statements, taken with Conrad's well-known careless habits of

work, make it reasonably certain that both his descriptions were drawn from this one specimen, and the earlier name is therefore retained.

The revised description given above does not exactly fit any other specimen seen except the type. A slightly smaller example, U.S.N.M. 103140, collected by Vaughan and Stanton from the Del Rio formation near El Paso (the original locality?), has the same concave form of the whorls, but the sculpture is somewhat finer, and the stronger carination near the base of the whorl is not developed (pl. 55, figs. 13, 22). Two specimens, U.S.N.M. 8347, from Denison have flattened whorls with sculpture more like that of the type, except that the beaded ribs are more nearly uniform over the whole surface. Both these specimens are referred to *Turritella irrorata* with some doubt.

The stratigraphic position of the type and of the other El Paso specimens is certainly in the Grayson (Del Rio) clay. Those from Denison are probably from equivalent beds in the upper part of the Washita group.

Turritella kerrvillensis Stanton, n. sp.

Plate 56, figure 16

Shell small, very slender, consisting of 15 or more whorls; apical angle 4° or 5°; suture distinctly channeled; sides of the whorls flat or very gently convex; surface marked by 3 comparatively strong spiral ridges, of which the middle one is the smallest, intersected on each whorl by about 15 to 17 equally strong costae arranged in continuous lines across successive whorls and bearing rather coarse granules at the intersections with the spiral ridges. The largest specimen seen shows a fourth spiral line just above the suture and has a decided tendency to depart from the regular spiral, the last whorl and a half being separated so that they are not in contact with the preceding whorls.

The figured type, which lacks several of the apical whorls and is imperfect at the base, consists of 10 whorls, and is 10 mm. in height, and 2 mm. in maximum breadth. Another specimen more nearly complete at the apex consists of 11½ whorls, and is 8 mm. in height and 1.5 mm. in greatest breadth. The partly uncoiled example mentioned is 3 mm. broad at the base. Species represented by 4 silicified specimens.

The only Texan species whose form and size suggest a comparison is *Turritella delriensis* Stanton, but it is at once distinguished by its lack of vertical costae as well as by other differences in sculpture. *T. marnochi* White (p. 74) has the same style of sculpture, but its larger size and much stouter form easily distinguish it. A number of European species, such as *T. angulata* D'Orbigny (1842, p. 35, pl. 151, figs. 4–6) and *T. costata* Sowerby (1829, p. 126, pl. 565, fig. 4), are similar in form and sculpture, though distinguished by minor details. Another species with somewhat similar surface features, though larger and with a different form of aperture, I have described under the name *Cerithium trituberculatum*.

Turritella pecosensis Stanton is a more closely related form, and the distinguishing features are pointed out under its description.

Types: Holotype, U.S.N.M. 103141; 3 unfigured paratypes, 103142.

Locality and position: Edwards limestone, 6 miles northeast of Kerrville, Kerr County, Tex.

Turritella leonensis Conrad

Plate 55, figures 1–3, 10, 11

1857. *Turritella leonensis* Conrad, U. S. and Mex. Boundary Survey Rept., vol. 1, pt. 2, p. 165, pl. 21, figs. 7a, 7b.
1895. *Turritella denisonensis* Cragin, Colorado Coll. Studies Ann. Pub 5, p. 65.
1903. *Turritella budaensis* Shattuck, U. S. Geol. Survey Bull. 205, p. 31, pl. 19, figs. 4–6.
1918. *Turritella budaensis* Shattuck. Ellisor, Texas Univ. Bull. 1840, p. 10, pl. 2, figs. 4–6.
Not 1928. *Turritella leonensis* Conrad. Adkins, Texas Univ. Bull. 2838, p. 182.

The original description, based on a single specimen from Leon Springs, Tex., follows:

> Volutions sub-angular, each with three distant, large, crenulated, revolving ribs, and an intermediate crenulated line; spire rapidly tapering to the apex; body volution large, rounded at base, which has four or five revolving ribs.
>
> A limestone cast; traces of shell show oblique longitudinal folds or ribs.

It is not evident what was meant by "oblique longitudinal folds or ribs" unless reference is made to the elongated granules or tubercles on the spiral ribs; 4 of these instead of 3, appear on each whorl, as the upper one bordering the suture was not counted. The specimen shows 4 whorls, and a restoration of the apex would probably make the total number about 12. Traces of intermediate lines appear on each of the interspaces, but the fine sculpture is not retained. Apical angle about 24°.

About 25 better-preserved specimens, U.S.N.M. 19158, from the Buda limestone near Austin, seem to agree with the type in all essential features, though they are all considerably smaller. The whorls of the spire are very convex, subangular below the middle, the most prominent portion bearing the third and largest of the 4 granular ribs; upper and middle interspaces nearly twice as broad as the ribs, the lower interspaces narrower, each bearing 1 or 2 more or less distinct filiform lines besides numerous microscopic lines; sutures deeply channeled.

An average specimen with the apex restored is 51 mm. in height and 18 mm. in greatest breadth.

Turritella denisonensis Cragin (1895b, p. 65) from the Main Street limestone at Denison is a synonym of *T. leonensis*, as I have been able to confirm by an examination of the types of *T. denisonensis*. The specimens from Denison are mostly in the form of large internal molds about the size of the type of *T. leonensis* and of the same general proportions, though a few are a little more slender. A few of the specimens retain enough of the sculpture to show essential agreement with that of *T. leonensis* and are best referred to that species.

Turritella budaensis Shattuck is likewise a synonym of *T. leonensis* Conrad, as is obvious from examination of the types and of other better-preserved material in the U. S. National Museum.

Types: Holotype, U.S.N.M. 9834; 2 figured plesiotypes, 19158a-b.

Locality and position: Washita group at Leon Springs (type locality), 9 miles west of Fort Stockton; Buda limestone near Austin and at Manchaca in Travis County, and Round Rock in Williamson County; Main Street limestone at Denison in Grayson County; upper Washita at Kent in Culberson County, and in the gap between the main peaks of the Sierra Blanca, Hudspeth County, Tex.

Turritella delriensis Stanton, n. sp.

Plate 56, figure 15

Shell small, very slender, consisting of 12 to 15 subangular whorls, most prominent below; suture deeply channeled; sculpture consisting of 3 relatively large, somewhat granular, spiral ribs and a variable number of finer lines.

A small specimen lacking the apex and consisting of 10 whorls is 13 mm. in height and 2.7 mm. in greatest breadth. Another specimen is 14 mm. in height and 3 mm. in breadth. The largest examples seen are not more than 22 mm. in height. Represented by many specimens.

The form of the whorls is somewhat like that of *Turritella leonensis* Conrad, but the smaller size and the much narrower apical angle, which is even less than in *T. seriatim-granulata* Roemer, at once distinguish it. The number of ribs is fewer than in any of the other Comanche species of *Turritella*.

Types: Holotype, U.S.N.M. 103143; unfigured paratypes, 103144.

Locality and position: Denton formation 2 to 3 miles west of Denison in Grayson County; Washita group near Fort Worth in Tarrant County, and near Del Rio in Val Verde County, Tex.

Turritella marnochi White

Plate 56, figure 12

1879. *Turritella marnochi* White, U. S. Geol. and Geog. Survey Terr. 11th Ann. Rept., p. 314, pl. 7, fig. 5a (not 5b).

Not 1928. *Turritella marnochi* White. Adkins, Texas Univ. Bull. 2838, p. 183.

The original description was based on 3 specimens, U.S.N.M. 8055, collected by G. W. Marnoch near Helotes, Bexar County, Tex. The exact formation in which they were found is not known, but it was a limestone, doubtless in the Fredericksburg group. Two of these specimens are referable to *Turritella seriatim-granulata* Roemer, one of them not differing in any respect from specimens of that species collected in the Goodland limestone of northern Texas; and the other, represented by fig. 5b of the original publication, differing only in the somewhat deeper channeling of the sutures and in the doubling of the lower lines of granules.

The remaining specimen of the type lot has very different sculpture, and must remain the type of *Turritella marnochi* as now restricted. Besides the type specimen, only one other is available in the U. S. National Museum collection.

Shell of medium size, consisting of probably 9 or 10 whorls (only 3 preserved) which are gently convex, with a shallow constriction between the first 2 spiral ribs below the channeled suture; whorls of the spire with 5 equidistant granular ribs, the upper one most prominent, separated by broader flat interspaces; lower part of body whorl with 4 similar ribs, and the whole surface covered with closely arranged filiform spiral lines; the granules on the spiral ribs also arranged in transverse series and connected by distinct ridges that pass directly across the whorls without the sinuous curves seen in the growth lines of most species of *Turritella;* aperture somewhat produced below.

This species may be distinguished at once from *Turritella seriatim-granulata* Roemer by its pronounced transverse sculpture, more produced aperture, and fewer, stronger, and more distant spiral ribs on the base of the last whorl. The fine spiral lines are also much coarser, easily visible without a magnifier.

Holotype: U.S.N.M. 8055.

Locality and position: Limestone of probable Fredericksburg age near Helotes, Bexar County; limestone of definite Fredericksburg age on Bluff Creek near Waco, McLennan County, Tex.

Turritella pecosensis Stanton, n. sp.

Plate 56, figures 1, 2

Shell rather small, very slender, consisting of

numerous whorls; apical angle about 5°; suture impressed, not very distinct on the earlier whorls but becoming more or less channeled in the adult stages; sides of the early whorls flat, but later becoming gently convex with the greatest convexity in the lower third; surface marked by 4 equidistant granular spiral ridges, the granules arranged in more or less perfectly continuous vertical rows, of which there are about 13 to 15 on the shell. On the last 3 or 4 whorls of adult shells the sculpture becomes almost obsolete.

One of the larger specimens, which lacks the upper portion, consists of 13 whorls, and measures 51 mm. in height, 8 mm. in breadth at the base and 3 mm. at the top. The height when complete was probably at least 75 mm. A much smaller specimen, also incomplete at the apex, consists of 15 whorls, and measures 22 mm. in height and 2.5 mm. in greatest breadth. Species represented by about 32 specimens.

The nearest relative of this species in the Comanche fauna is *Turritella kerrvillensis* Stanton, a smaller form with relatively stronger sculpture, more deeply channeled suture, and with only 3 revolving tuberculated ridges instead of 4.

Types: Cotypes, U.S.N.M. 103145a-b; unfigured paratypes, 103146, 103147.

Locality and position: Devils River limestone, of Washita age, at the high bridge across Pecos River on the Galveston, Harrisburg & San Antonio Railway (Southern Pacific), 3 miles east of Shumla; and at Painted Caves on the Rio Grande just below the mouth of Pecos River, Val Verde County, Tex.

Turritella seriatim-granulata Roemer

Plate 56, figures 7, 11, 17–24

1849. *Turritella seriatim-granulata* Roemer, Texas, p. 413.
1852. *Turritella seriatim-granulata* Roemer, Die Kreidebildungen von Texas, p. 39, pl. 4, figs. 12a, 12b.
Not 1864. *Turritella seriatim-granulata* Roemer. Gabb, California Geol. Survey, Paleontology, vol. 1, p. 132, pl. 20, fig. 88.
1869. *Turritella seriatim-granulata* Roemer. Gabb, California Geol. Survey, Paleontology, vol. 2, p. 263.
1879. *Turritella marnochi* White (part), U. S. Geol. and Geog. Survey Terr. 11th Ann. Rept., p. 314, pl. 7, fig. 5b (not 5a).
1893. *Turritella seriatim-granulata* Roemer. Cragin, Texas Geol. Survey 4th Ann. Rept., p. 231.
1910. *Turritella vibrayeana* D'Orbigny. Böse, Inst. geol. México. Bol. 25, p. 145, pl. 30, fig. 10; pl. 31, fig. 6.
1928. *Turritella seriatim-granulata* Roemer. Adkins, Texas Univ. Bull. 2838, p. 183.
1940. *Turritella macropleura* Stainbrook, Texas Univ. Bull. 3945, p. 712, pl. 33, figs. 17, 20–21.

Roemer's revised description is as follows:

Testa turrita, parum elongata; anfractibus subplanis, granulato-striatis; seriebus granulorum 5 subaequalibus; seriebus medianis linea elevata tenui divisis.

His German descriptive notes may be somewhat freely translated as follows:

Shell turrited, tapering rather rapidly, the numerous (about 10) whorls flattened on the side, ornamented with 5 spiral rows of large subequal tubercles; the middle rows separated by a fine elevated line. This species mostly resembles *Turritella uchauxiana* D'Orbigny (Paléontologie française, terrain crétacé, t. 2, pl. 151, figs. 21–23), though the French species has only four granulated spiral ribs on each whorl, whereas the Texan species has five.

Occurrence: There is only a single example from Fredericksburg, which left the impression of its outer surface on the beak of a lower valve of [*Exogyra*] *texana* that had originally been attached to it.

Of the 2 figures drawn from a gutta-percha mold, one shows the entire form of the shell of natural size, and the other a single whorl enlarged; the enlarged portion shows 5 spiral granular lines as described, but in the other figure only 4 are represented. The apical angle is represented as about 12°.

The type was apparently a young shell, and I have not seen a specimen from Texas that agrees with it in all respects, i.e., in having 5 rows of coarse granules visible on the spire; but on an *Exogyra texana* from near Fredericksburg there is an impression of 2 whorls of a small specimen having the appearance of the original figure and, like the figure, with only 4 rows of granules. This form is also abundantly represented by well-preserved specimens from Mesa Tucumcari, N. Mex., and is probably not worthy of even varietal separation from *Turritella seriatim-granulata*. Commonly 2 or more (in most specimens the upper 2) of the interspaces show the simple intermediate line, and the whole surface when well preserved is covered with microscopic spiral lines and sinuous lines of growth. The base of the whorl bears 4 to 6 coarse granular lines, and occasionally a tendency to deflection from the regular spiral causes one of these to be visible on the last whorl or two of the spire. The average apical angle of these specimens from Tucumcari is about 15°. They attain a much larger size than Roemer's type and when complete consist of 12 to 15 whorls. An average specimen with the apex restored is about 70 mm. in height and 18 mm. in greatest breadth. This is apparently the form that Stainbrook (1940, p. 712, pl. 33, figs. 17, 20, 21) has named *T. macropleura*.

The same form, differing only in having the rows of granules somewhat narrower, and the sutures separating the earlier whorls perhaps not so distinct, is abundant in the Goodland limestone between Denison and Preston, Tex.

Some other variations should be noted. On specimens from both regions the upper row of granules is nearly always more prominent than the others, especially on the adult whorls, and on one of the Goodland limestone specimens it is double. Among

the collections from Tucumcari are a few small specimens, mostly more slender, that have finer sculpture than is general, and 5 granular lines, the extra line apparently formed by the greater development of the middle intermediate line.

Several more or less closely related American Cretaceous species have somewhat similar sculpture characterized by spiral rows of granules or tubercles. These include *Turritella leonensis* Conrad, *T. irrorata* Conrad, *T. planilateralis* Conrad, *T. seriatim-granulata* Gabb (not Roemer), *T. marnochi* White, *T. marnochi var. belviderei* Cragin, *T. whitei* Stanton, *T. seriatim-granulata* varieties *ventrivoluta* and *flagellata* Cragin, *T. denisonensis* Cragin.

Turritella leonensis, with its synonym *T. denisonensis*, is at once distinguished from the others named, by its large apical angle, the convexity and angularity of its whorls, and its larger size. The variety *ventrivoluta* probably also belongs here.

Turritella irrorata, synonym *T. planilateralis*, has the sides of whorls concave, and its number of spiral ribs is greater.

The Californian species from the Chico group referred by Gabb to *Turritella seriatim-granulata* has more angular whorls, more deeply channeled sutures, and the details of the sculpture are all different. The Mexican species from the Potrero formation near Arivechi, Sonora, briefly mentioned by Gabb, appears to be within the form range of this species. Two specimens of the original lot are shown here on plate 56, figures 17, 18, 23, 24.

Part of the specimens described as *Turritella marnochi* are referred to *T. seriatim-granulata*. One of those in the type lot, but not figured, is certainly like those from the Goodland limestone, and it probably came from that formation. The specimen represented by White's figure 5b also essentially agrees with the Goodland form, the only differences being that the lower line of granules is doubled, and the suture is more deeply channeled on account of a tendency to depart from the closely coiled spiral. The other figured specimen, which must be regarded as the type of *T. marnochi*, is at once distinguished by its well-marked transverse ribs.

Turritella marnochi var. *belviderei* Cragin (p. 71), a common form from southern Kansas, differs from *T. seriatim-granulata* in its constantly more numerous and more closely arranged granular spiral ridges.

Turritella charpentieri, Pictet and Renevier (1854, p. 29, pl. 3, figs. 3a-b), from the lower Aptian of Ste. Croix, is another closely similar species.

The Upper Cretaceous *Turritella whitei* Stanton (1893, p. 130, pl. 28, figs. 12–16) is a smaller species, with more convex whorls and finer sculpture.

Turritella seriatim-granulata var. *flagellata* Cragin (1893, p. 232) has not been identified. The variety *gainesvillensis* (below), has more convex whorls and obsolescent sculpture.

Plesiotypes: U.S.N.M. 103149a-b, 103150a-b; gutta-percha mold of holotype, 103148.

Locality and position: The type was found in either the Walnut or Comanche Peak formation near Fredericksburg, Tex. In Goodland limestone 10 or 12 miles northwest of Denison in Grayson County, and at other places in that neighborhood; and near Gainesville, Cooke County. In the Purgatoire formation at Mesa Tucumcari, N. Mex., and near Helotes, Bexar County, Tex. Probably in the Comanche Peak formation 7 miles southwest of Chispa, Jeff Davis County, and at Chalk Mountain 12 miles southwest of Glen Rose, Somervell County. In the Comanche Peak formation at Benbrook near Fort Worth in Tarrant County, and at Seven Knobs 5 miles southeast of Glen Rose in Somervell County, and at Comanche Peak. In the Edwards formation on Shoal Creek near Austin in Travis County. In the Kiamichi shale near Tahoka in Lynn County, Tex.

Turritella seriatim-granulata gainesvillensis Stanton, n. var.

Plate 56, figures 4–6

This variety has about the size and proportions of the typical forms from the Goodland limestone of northern Texas, and from the Purgatoire formation of Mesa Tucumcari, N. Mex., adult examples having from 13 to 15 whorls. The sculpture is much less conspicuous, however, and consists of 5 principal narrow spiral lines, which on the last 2 or 3 whorls become more or less distinctly granular; intermediate lines of smaller size; sinuous lines of growth, and numerous microscopic lines are also present. Sides of the whorls gently convex and the sutures distinctly channeled even in the earlier stages of growth; these features, and the less-pronounced sculpture, are the distinguishing characteristics of the variety, which in some specimens seems almost deserving of specific rank. The species somewhat resembles *Turritella graysonensis* Adkins (1920, p. 140, pl. 10, fig. 43) but comparison of the type specimens shows that *T. graysonensis* has a greater apical angle, and differs in details of sculpture. Species abundant.

Types: Holotype, U.S.N.M. 103151; paratypes, 103152, 103154; unfigured paratypes, 103153, 103155.

Locality and position: Pawpaw formation near Denison, Grayson County; and 4½ miles northeast of Gainesville, Cooke County, Tex.

Turritella ventrivoluta Cragin

Plate 56, figure 3

1893. *Turritella seriatim-granulata* var. *ventrivoluta* Cragin, Texas Geol. Survey 4th Ann. Rept., pt. 2, p. 232.
1920. *Turritella worthensis* Adkins, Texas Univ. Bull. 1856, p. 142, pl. 10, fig. 42.
1928. *Turritella ventrivoluta* Cragin. Adkins, Texas Univ. Bull. 2838, p. 184.

Shell of medium size, rather stout, consisting of numerous very convex whorls; apical angle about 25°; suture deeply channeled; surface marked by 6 or 7 prominent beaded spiral lines, with 3 or 4 of the broader interspaces each bearing a finer line, some of which occasionally almost equal the principal ones; the whole surface also covered by minute spiral striae visible under a lens.

The figure represents one of two specimens in the Texas State collection labeled "varietal types." It is a fragment consisting of 5 whorls, and measures 37 mm. in height and 18 mm. in greatest breadth.

This form was named with a very brief characterization as a variety of *Turritella seriatim-granulata* Roemer. Its very ventricose whorls and numerous granular spiral lines seem to me to separate it completely from that species, and from all others in the Comanche series. Its closest relationship is with *T. leonensis* Conrad (p. 73), and probably it should be regarded as only a variety of that species, though they are easily distinguished by differences in details of sculpture. A comparison of type specimens has shown that *T. worthensis* Adkins is a synonym of *T. ventrivoluta*.

Cotypes: Texas State collection.

Locality and position: The types were found loose on the surface, on the Texas and Pacific Railway 3½ miles east of Fort Worth, Tarrant County, Tex. A specimen in the Geological Survey collection is from the upper part of the Washita group 2 or 3 miles north of Fort Worth; and another specimen in the U. S. National Museum was found associated with *Turritella leonensis* Conrad in the Buda limestone near Austin, Travis County, Tex. It is probable that all the specimens came from about the same stratigraphical position.

Genus CASSIOPE Coquand, 1865

Cassiope branneri (Hill)

Plate 57, figures 1–6

1888. *Pleurocera strombiformis* (Schlotheim) Hill, Arkansas Geol. Survey Ann. Rept., vol. 2, p. 129, pl. 2, figs. 1–12.
1893. *Vicarya branneri* Hill (part), Biol. Soc. Washington Proc., vol. 8, p. 34, pl. 5, figs. 1–4 (not figs. 5, 6).
1901. *Glauconia branneri* (Hill), U. S. Geol. Survey 21st Ann. Rept., pt. 7, pl. 21, fig. 5 (not fig. 4).
1906. *Glauconia branneri* (Hill). Veatch, U. S. Geol. Survey Prof. Paper 46, pl. 4, figs. 2, 2a.
1928. *Glauconia branneri* (Hill). Adkins, Texas Univ. Bull. 2838, p. 185.
1928. *Glauconia branneri* (Hill). Vanderpool, Jour. Paleontology, vol. 2, p. 99, 3 figs. on pl. 12.
1929. *Glauconia branneri* (Hill). Dane, Arkansas Geol. Survey Bull. 1, p. 14, pl. 4, figs. 6–11.

Shell of medium size, turreted, not umbilicated, consisting of 12 or more rapidly increasing whorls; apical angle about 20°; suture narrowly channeled, especially on the upper whorls which are subangular below, and marked on their regularly sloping sides with 3 or 4 simple spiral lines; adult whorls with 2 prominent spiral rows of coarse tubercles bordering the suture above and below, and separated by a concave interspace a little broader than the rows of tubercles. The interspaces commonly show about 3 fine spiral lines, and the body whorl bears an additional somewhat smaller row of tubercles. Aperture as shown by the lines of growth is deeply sinuous between the principal rows of tubercles.

A nearly complete small specimen measures 40 mm. in height and 16 mm. in greatest breadth. Corresponding measurements of a large specimen with the apex restored are 66 and 24 mm.

The name *Vicarya branneri* was originally intended to include all the forms of *Cassiope* that are so common in the Trinity group of Arkansas and Texas, though only 2 of them were figured. It is true that the species is highly variable, but examination of the large collections seems to justify the recognition of 3 distinct species which, although associated in the same bed, are easily separable by means of differences in sculpture, and which do not seem to intergrade. *Cassiope branneri* is restricted to the form from Arkansas and Texas first described by Hill under the name *Pleurocera strombiformis*. This typical variety occurs in abundance on the Paluxy River near Glen Rose, and 18 miles southwest of Granbury, Texas. Local variations occur a few miles south and southwest of Weatherford. These are small individuals in which the tubercles are slightly or not at all developed, and the whorls are bicarinate, or unicarinate by the suppression of the upper carina, thus resembling the apical whorls of the typical variety.

The 3 species of this genus in the Trinity group are represented by closely similar, if not identical, forms in the Lower Cretaceous of Europe. Our specimens, however, do not agree in all details with any of the published figures, and it is therefore thought best not to refer them to the European species, though their close relationship is recognized. *Cassiope lujania* (Verneuil) (1853, p. 102, pl. 3, fig. 17; Coquand, 1866, p. 60, pl. 4, figs. 1, 2), from the Aptian or upper Neocomian of Spain, and *C. strombiformis* (Schlotheim) (Dunker, 1846, p. 50, pl. 10, figs. 18a, b; Verneuil and Lorière, 1868, p. 7,

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pl. 1, figs. 4–4f), from the Wealden of north Germany and the Neocomian of Spain, are the closest allies of *C. branneri* (Hill).

Plesiotypes: U.S.N.M. 77626, 77627a–b, 77628a–b. Original types are probably lost.

Locality and position: Glen Rose limestone at Paluxy River near Glen Rose, Somervell County; 7 miles south of Glen Rose; 8 miles southwest of Weatherford, Parker County; and 18 miles southwest of Decatur, Wise County, Tex. Dierks limestone in sec. 3, T. 8 S., R. 27 W., Howard County; sec. 9, T. 8 S., R. 25 W., and sec. 14, T. 8 S., R 26 W., Pike County, Ark. DeQueen limestone half a mile east of DeQueen; and 1½ miles southwest of Steel Ford on Cossatot River, Sevier County, Ark.

Cassiope burnsi Stanton, n. sp.

Plate 57, figures 9, 10

Shell of moderate size, averaging a little larger than *Cassiope branneri* which it resembles in general form and proportions; generally with a small umbilicus; suture in a deep channel; whorls of the spire with 2 prominent spiral ridges, in some specimens distinctly tuberculated, in others almost simple; the lower ridge borders the suture; the upper ridge is but little above the middle of the whorl, the flat space between it and the suture above being broader than the space between the 2 ridges; body whorl with 2 or 3 additional strong spiral lines on the base; lines of growth distinct, deeply sinuous where they cross the upper spiral ridge.

An average specimen is 56 mm. in height and 23 mm. in greatest breadth. Species rather abundant.

The arrangement and less nodose character of the spiral ridges at once distinguish *Cassiope burnsi* from *C. branneri*. In *C. burnsi* the 2 ridges belonging to the same whorl are close together, and are separated widely from those of the preceding and succeeding whorls, whereas in *C. branneri* both ridges border the linear suture, are almost in contact with ridges of adjacent whorls, and are separated by a broad interspace in the middle of the whorl.

In sculpture this species is similar to *Cassiope picteti* (Coquand) (1866, p. 63, pl. 4, figs. 6, 7), which Verneuil and Lorière (1868, p. 7, pl. 1, figs. 4–4f) regard as a synonym of *C. strombiformis* (Schlotheim).

Cotypes: U.S.N.M. 77629a-b.

Locality and position: Glen Rose limestone on the Paluxy River near Glen Rose, Somervell County; and 18 miles southwest of Decatur, Wise County, Tex.

Cassiope hyatti Stanton, n. sp.

Plate 57, figures 12, 13, 19

Shell large, robust, consisting of about 8 rapidly increasing whorls; apical angle varying from 30° to 35°, and not constant in different stages of growth of a single individual; columella perforated, but the umbilicus apparently closed in some individuals and open in others; first 3 or 4 whorls of the spire distinctly bicarinate, the succeeding whorls smooth and flattened, with inconspicuous sutures; body whorl generally tending to depart from the regular spiral and thus become constricted above, in some specimens becoming subangular below and bearing 2 or more spiral lines on the base; outer lip deeply sinuous in the middle, as shown by the lines of growth; inner lip thick, reflected, forming a callus on the body whorl.

The best preserved of the types measures 66 mm. in height and 30 mm. in greatest breadth. The species is represented by 10 imperfect specimens.

This species is closely related to *Turritella helvetica*, Pictet and Renevier (1854, p. 28, pl. 3, figs. 2a-c), from the Aptian of Ste. Croix, and perhaps still more closely to *T. renauxiana* D'Orbigny (1842, p. 41, pl. 152, figs. 1–4) from the Upper Cretaceous, Turonian and Senonian, of France. Another related species, *Cassiope paluxiensis* Stanton, occurs in the Glen Rose formation of Texas. It is a more slender form, and is generally more distinctly sculptured on the later whorls.

Cotypes: U.S.N.M. 77630a-c.

Locality and position: Purgatoire formation at Mesa Tucumcari and at Monte Revuelto, N. Mex.

Cassiope paluxiensis Stanton, n. sp.

Plate 57, figures 17, 18

1893. *Vicarya branneri* Hill (part), Biol. Soc. Washington Proc., vol. 8, p. 34, pl. 5, figs. 5, 6 (not figs. 1–4).
1901. *Glauconia branneri* (Hill), U. S. Geol. Survey 21st Ann. Rept., pt. 7, pl. 21, fig. 4 (not fig. 5).

Shell large, robust, consisting of 10 or 12 rapidly increasing whorls; apical angle about 25°; a small umbilicus commonly present; suture inconspicuous on most of the shell, channeled on the body whorl and near the apex; first 3 or 4 whorls subangular and bearing 2 or more strong spiral lines; the succeeding 4 or 5 whorls with flattened or very gently convex sides, either smooth or bearing 1 or 2 faint spiral ridges; body whorl tending to depart from a regular spiral and bearing 2, or less commonly 3, rather prominent rounded spiral ridges separated by concave interspaces; lines of growth deeply sinuous but rather faint; outer lip with a deep sinus at the extremity of the upper spiral ridge and a more shallow emargination near the somewhat produced base.

A medium-sized specimen (the figured type) is 70 mm. in height and 26 mm. in breadth. Species well represented; associated with *Cassiope branneri* and *C. burnsi*.

Cassiope paluxiensis differs from *C. branneri* and *C. burnsi,* with which it is associated, in its larger size, greater apical angle, and the complete absence of nodose sculpture. It is more slender than *C. hyatti,* and has more distinct and differently arranged spiral sculpture on the adult whorls. Its relationship is apparently much closer with *C. helvetica,* Pictet and Renevier (1854, p. 28, pl. 3, figs. 2a, 2c), from the Aptian of Switzerland and Spain, but there are some minor differences in sculpture that are thought to justify a provisional name at least until authentic specimens can be compared.

Holotype: U.S.N.M. 77631.

Locality and position: Glen Rose limestone on the Paluxy River near Glen Rose, Somervell County; and 18 miles southwest of Decatur, Wise County, Tex.

Cassiope zebra (Gabb)

Plate 57, figures 7, 8

1869. *Cemnitzia zebra* Gabb, California Geol. Survey, Paleontology, vol. 2, p. 260, pl. 35, fig. 5.

Shell rather large, robust, consisting of 8 or 10 whorls, not umbilicated; apical angle about 25°; whorls of the spire flattened or very slightly convex; suture impressed; last whorl subangular in the middle, flattened above the angulation and convex below it; surface smooth, with faintly marked, deeply sinuous lines of growth and with distinct bands of color parallel with the growth lines. These color bands are generally almost a millimeter in width, and the intervals between them are about as wide. The apical whorls are not preserved on any of the specimens, but the smallest whorl seen does not show any development of the spiral sculpture shown by the earlier whorls of the related species. The outer lip was evidently deeply sinuous, and the inner lip formed a heavy callus.

The original figure represents a specimen with 5 whorls and lacking the apical portion; it is 61 mm. in height and 22 mm. in greatest breadth. Another specimen consisting of only the last 3 whorls has a maximum breadth of 27 mm.

This description is drawn from 3 specimens labeled by Gabb and preserved in the Academy of Natural Sciences, Philadelphia. They are doubtless part of the original type lot, though the figured specimen is missing. The color bands are distinctly visible, and on these 3 specimens they appear to be parallel with the lines of growth. Gabb speaks of them as "more or less sinuous, broken, irregular bands of color, longitudinally disposed, and sometimes entire, sometimes zigzag, branching, anastomosing and running out." His figure also shows some of these irregularities, but I suspect that they are restorations on parts of the shell where the color bands could not be distinctly seen.

Cassiope zebra is evidently closely related to *C. paluxiensis* and *C. hyatti.* It differs from both in the apparent absence of spiral sculpture on the apical whorls, and the smoother, more regular character of the last whorl. Some specimens of *C. hyatti,* however, have the same form of last whorl, but they can be distinguished by their greater apical angle and consequent more robust form. *Cassiope paluxiensis* has almost exactly the same proportions as *C. zebra,* but its stronger sculpture and more irregular spire clearly distinguish it. *Cassiope zebra* is the only one of these related species in which the original color pattern has been preserved.

Locality and position: Potrero formation of Fredericksburg age in the Sierra de las Conchas, near Arivechi, Sonora, Mexico.

Genus TRICHOTROPIS Broderip and Sowerby, 1829

Trichotropis shumardi Cragin

Plate 52, figure 7

1893. *Trichotropis shumardi* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 229, pl. 42, fig. 13.
1920. *Trichotropis shumardi,* Cragin. Adkins and Winton, Texas Univ. Bull. 1945, p. 76, pl. 18, figs. 4, 5.
1928. *Trichotropis? shumardi* Cragin. Adkins, Texas Univ. Bull. 2838, p. 189, pl. 2, fig. 7.

Original description:

Cast rather large for the genus, turbinated, consisting of about three and a half whorls; spire moderately well elevated, rather loosely coiled; body-whorl and part of first spire-whorl carinated, the carina very prominent at the aperture and becoming gradually less conspicuous above, vanishing in the cast about the middle of the first spire-whorl; aperture large, subtriangular, the outer labial margin, like the upper part of the body-whorl, forming a nearly straight slope from the upper border to the summit of the carina, the lower margin convex with a small concavity just below the carina; columella inferiorly compressed; umbilicus of moderate breadth; surface of cast showing, in one example, traces of obliquely transverse and rather remote raised lines of ornamentation.

Measurements: Largest cast, height 43; maximum breadth of body-whorl 41; height of aperture 22; breadth of same 22; breadth of umbilicus 4.7 mm.

Occurrence: In limestone strata of the *Exogyra texana* beds at, and a mile and a half east of, Benbrook; collected by Messrs. Taff and McLaughlin.

The obviously thin and umbilicated shell, the strongly carinated body-whorl, the traces of cross-barred ornamentation, and other preserved characters of this fossil, seem to clearly indicate the genus *Trichotropis.*

The figured specimen, U.S.N.M. 32695, is an unusually large one from Professor Cragin's collection. It is labeled "seven and a half miles west of Fort Worth, Texas, on Weatherford—Fort Worth Telephone road," a locality that must be within 1 or 2 miles of the type locality. This specimen is 58 mm. in height and 47 mm. in greatest breadth. It agrees very well with the quoted description,

except that the last whorl on its outer portion shows a second smaller carina below the principal one.

Genus NERINEA Defrance, 1825

Nerinea? acus Roemer?

Plate 59, figure 3

1849. *Nerinea acus* Roemer, Texas, p. 412.
1852. *Nerinea acus* Roemer, Die Kreidebildungen von Texas, p. 42, pl. 4, figs. 10a, 10b.
1925. *Nerinella? acus* (Roemer). Dietrich, Fossilium catalogus, pt. 31, p. 139.
1928. *Nerinea acus* Roemer. Adkins, Texas Univ. Bull. 2838, p. 186.

Shell small, very slender, subcylindrical, consisting of numerous whorls; apical angle about 4°; sides of the whorls flat on the upper part of the spire, more convex below the point where the shell shows a tendency toward uncoiling; surface marked by relatively rather prominent spiral lines, of which 4 to 6 are visible on upper part of spire, the number visible increasing below the point where the coiling is more lax, until 9 or 10 may be seen on the last whorl; spiral lines differing and more or less regularly alternating in size, the one near the lower margins of the whorls being ordinarily the largest; suture inconspicuous, the boundaries of whorls scarcely recognizable, especially on the upper part of the spire.

A specimen consisting of about 15 whorls, and lacking the apex, measures 18 mm. in height and 2 mm. in greatest breadth. The type is a fragment consisting of 10 whorls of a larger specimen, measuring 29 mm. in height and 4 mm. in greatest breadth.

The original material on which this specimen was based consists of 2 impressions on the beaks of *Exogyra texana*, left by the shells to which the ostreids were originally attached. There are before me 5 similar impressions in limestone which show among themselves some variation in sculpture and some departure from the details as figured by Roemer, and yet their general aspect is so similar that I think they must all be referred to one species. As the internal structure and the form of the aperture have not been preserved, the reference to the genus *Nerinea* is only provisional and is based principally on the very slender form of the shell. The sculpture is rather more like that of *Turritella*.

Plesiotype: U.S.N.M. 77643.

Locality and position: The types were collected at Fredericksburg, Gillespie County, Tex., probably from the Comanche Peak limestone. The additional specimens here studied are from the Edwards limestone near Kickapoo Springs on the west fork of Nueces River, Edwards County, Tex.

Nerinea aquilina Stanton, n. sp.

Plate 58, figures 1, 5, 8, 9

Shell large, very slender, consisting of numerous whorls which are deeply and almost regularly concave, the maximum constriction being opposite the strong fold on the outer lip a little below the middle of the whorl; suture distinctly impressed on the middle of the broad, rounded ridge formed by the junction of the elevated portions of adjacent whorls; slit-band rather broad, bordered by a faint impressed line; surface almost smooth, marked only by fine sinuous lines of growth, and on well-preserved specimens by still more minute revolving lines, especially on the lower part of the whorl just above the suture; interior with a strong fold on the columella, the inner lip,[3] and the outer lip, respectively, the fold on the outer lip being the most prominent.

Internal molds have almost the same form as the shell, except that the sides of the whorl are more deeply excavated, the bottom of the excavation is much narrower, more angular, and situated lower, and the whorls are separated by a broad groove.

The 12 specimens collected are too fragmentary to furnish measurements of a complete specimen. The largest fragments have a maximum breadth of 39 mm. Specimens of about the same breadth seen on weathered surfaces of limestone in the field were more than a foot in length. A fragment consisting of about 4½ whorls is 101 mm. in length, 31 mm. in breadth at the base and 29 mm. at the top.

One of the largest specimens shows an abnormal contraction of the upper part of the penultimate whorl, so that the base of the preceding whorl projects several millimeters beyond it as a prominent carina. This was probably caused by some accident during the life of the animal, as the last whorl regains the normal form.

The nearest relative of this species in the Texan fauna is *N. incisa* Giebel (p. 84, pl. 58, figs. 6, 7, 10, 11) which has about the same size and general aspect, and is especially difficult to separate when internal molds are compared. The whorls of *N. aquilina*, however, are relatively somewhat higher, their sides are more deeply concave and not so nearly equally divided by the fold on the outer lip, and the surface sculpture is much less conspicuous, the revolving lines, when present, not being visible without the aid of a lens. The shell itself appears also to have been thicker, with a broader columella and heavier folds, and does not bear a second columellar fold, as is developed in *N. incisa*. However, it may be that some of the large molds men-

[3] In locating the folds of *Nerinea* I have adopted Zittel's custom of referring those that appear in section on the upper wall of the chamber to the inner lip in distinction from the columella proper.

tioned by Giebel as belonging to his species really belong to *N. aquilina*.

Nerinea hicoriensis Cragin (p. 83) also resembles *N. aquilina* in size and surface sculpture, and the internal structure is very similar, but the marked difference in the form of the whorl at once distinguishes them.

Nerinea chloris Coquand (1866, p. 67, pl. 21, fig. 1), from the Aptian of Spain, has the same general aspect, but the whorls are relatively shorter, and the internal folds have a different arrangement.

Types: Cotypes, U.S.N.M. 77644a-d; 8 unfigured paratypes, 77645.

Locality and position: Type locality about 13 miles southeast of the town of Sierra Blanca, Hudspeth County, Tex., a little south of the old stage road, and at the end of a prominent limestone ridge trending northwest from Eagle Mountain. The position is apparently low in the Trinity group. Imperfect specimens belonging to this or a closely related species have been collected in the Edwards limestone at the Santa Fe quarry about 3 miles northwest of Belton, Bell County, Tex.

Nerinea austinensis Roemer

1888. *Nerinea austinensis* Roemer, Palaeont. Abh., Band 4, p. 17 (295), pl. 1 (31), fig. 8.

1925. *Nerinea austinensis* Roemer. Dietrich, Fossilium catalogus, pt. 31, p. 117.

1928. *Nerinea austinensis* Roemer. Adkins, Texas Univ. Bull. 2838, p. 186.

Translation of the original description follows:

The turreted shell only moderately long acicular; apical angle about 20° but frequently not uniform throughout the length of the shell; the numerous whorls very slightly concave, scarcely elevated at the sutures, so that the whole surface of the shell is almost a single slender conical surface; but sometimes the surface of the whorls is distinctly concave, and the sutures then project as keels on which a fine impressed line marks the boundaries between adjacent whorls. A short distance below the keel and parallel with this line there is another fine impressed line, but not always plainly visible. Above the boundary between the whorls there is often on the keel an indication of a row of fine tubercles or granules. In the narrow mouth of the shell are seen 2 very prominent folds on the columella projecting as sharp cutting lamellae. Sometimes between the 2 a third much smaller and lower fold is observed. On the inner surface of the outer wall of the shell a strong fold somewhat curved downward is always present.

Among the known Cretaceous species of the genus, *Nerinea requieniana* D'Orbigny may be most closely compared with our species, but the shell is less elongated, and the surface of the whorls is still less excavated, indeed somewhat convex.

Occurrence: A large number of more or less perfectly preserved examples are present [in a collection made by Mr. Geo. Stolley from the Edwards limestone on Bartons Creek, near Austin, Tex.].

In the collections from Texas that have been studied by me I have seen no specimens that could be assigned to this species. In form and general appearance *Nerinea incisa* Giebel must have been very similar, but the presence of spiral sculpture and the difference in form and arrangement of the internal folds will serve to distinguish it. The shells that I have referred to *N. texana* Roemer have perhaps still closer relations with this species, but their much more slender form will at once separate them.

Nerinea colligata Stanton, n. sp.

Plate 59, figures 1, 2

Shell of medium size, slender, subcylindrical; apical angle 8° or 9°; sides of the whorls flat or very slightly concave, with a very narrow elevated slit band just below the inconspicuous suture; surface also showing faint growth lines and traces of 7 or 8 obscure revolving lines, of which one near the middle of the whorl is most prominent; interior with a rather prominent stout fold near the middle of the outer lip, a similar slight, smaller fold on the columella, and a much smaller fold on the inner lip near the junction with the columella. In molds the flat side of the whorl is divided by a relatively deep furrow into 2 subequal parts, of which the upper is slightly broader than the lower.

The material is too imperfect to furnish even approximate dimensions of the whole shell. Four whorls of one of the figured types measure 22 mm. in height, 9 mm. in breadth at base and 7 mm. at top. The largest fragment in the collection has a maximum breadth of 14 mm.

In general form and internal structure this species resembles *Nerinea hicoriensis Cragin* (p. 83), from which *N. colligata* Stanton is distinguished by its straight sides and smaller internal folds. In both species there is a narrow ridge near the suture, but in *N. hicoriensis* the ridge is relatively much more prominent above the suture, whereas in *N. colligata* it is formed only below the suture. Internal molds generally show nearly as much difference as the shells themselves, and I am therefore inclined to believe that the mold figured by Cragin (1893, pl. 42, fig. 7) under the name of *N. hicoriensis* really belongs to *N. colligata*.

Types: Cotypes, U.S.N.M. 77646a-b; 3 unfigured paratypes, 77647.

Locality and position: The types were obtained on Spanish Oak Creek, Burnet County, about 39 miles northwest of Austin, Tex., in the lower part of the Trinity group, where they were associated with *N. hicoriensis* and other Trinity fossils. Spanish Oak Creek of the Burnet topographic map is apparently the same as Hickory Creek of early geologic reports on this area.

Nerinea (Nerinella) cultrispira Roemer

1888. *Nerinea cultrispira* Roemer, Palaeont. Abh., Band 4, p. 295, pl. 31, fig. 9.
1925. *Nerinella cultrispira* Roemer. Dietrich, Fossilium catalogus, pt. 31, p. 140.
1928. *Nerinea cultrispira* Roemer. Adkins, Texas Univ. Bull. 2838, p. 186.

Translation of original description:

The most striking feature of this species is the strong, projecting, sharp-edged carina in which the margins of the whorls rise at the sutures of the long, slender, turreted shell. The real edge of the carina always belongs to the lower of the 2 whorls that are in contact at the suture. It forms a quite thin upturned translucent lamella which extends below the lower marginal carina of the preceding whorl. On close examination one sees the boundary between the 2 whorls as an impressed line on the upper surface of the cutting lamella. Between the upper and lower marginal cutting ridges the whorls are moderately concave and in the lower part of the shell completely smooth. In the upper part of the shell the whorls show in the middle a fine raised spiral line, and sometimes several such spiral lines are present.

The irregularly rhomboid aperture of the shell shows no folds either on the columella or on the outer lip. It may be doubted therefore whether the species belongs to the genus *Nerinea*, in spite of the fact that the general habit of the shell is in complete accord with that of typical species of *Nerinea*. In younger examples, however, a distinct sharp spiral fold is recognized on the columella, and in one such example an indistinct spiral fold was noticed on the outer lip. But in every specimen the feeble development of the internal folds is one of the most characteristic features of the species.

Occurrence: A number of larger and smaller examples of the species are present [from the Edwards limestone on Bartons Creek, near Austin, Tex.].

This species has not been found in the collections of the Geological Survey and the U. S. National Museum, from the locality and formation that yielded the types. The form I have described as *Nerinea geminata* var. *glabra* somewhat resembles the apical portion of Roemer's figure, but it lacks the sharp projecting carina, and has well-developed internal folds, 3 on the columella and 1 on the outer lip.

Nerinea (Nerinella?) decipiens Stanton, n. sp.

Plate 60, figures 1–3

Shell small, slender, consisting of 15 to 20 whorls; apical angle about 10°; suture hardly perceptible; sides of the whorls nearly flat, with a deep, narrow constricted band just below the middle; surface with 2 relatively coarse, granular, revolving ridges above the constriction, a similar one below it, and 1, or less commonly 2, finer granular lines on the constricted band. The effect of this sculpture is to give the deceptive appearance of flat or slightly convex whorls marked by 3 subequal spiral ridges and separated by distinctly channeled sutures. Interior with 1 small fold on the outer lip, and none on the columella or inner lip.

An average specimen consisting of 14 whorls, but lacking several from the apex, measures 15 mm. in height and 4 mm. in greatest breadth.

In external features this species resembles *Nerinea pseudoconvexa* Stanton to such at extent that it was not separated until several longitudinal sections had been made, showing conclusively the entire absence of folds on the columella. The very small fold on the outer lip, together with the general form, are the only reasons for assigning it to the Nerineidae.

The slit band has not been seen, but in small species of *Nerinea* it may not be recognizable, especially where, as in the present species, the growth lines are not discernible. According to the original description of the subgenus *Nerinella* as given by Sharpe, such forms as this with a simple columella and a single internal fold on the outer lip are referable to it.

Types: Holotype, U.S.N.M. 77648; figured paratype, 77649; 8 unfigured paratypes, 77650, 77651.

Locality and position: Upper part of the Devils River limestone of Washita age, at the high bridge across Pecos River on the Galveston, Harrisburg, & San Antonio Railway (Southern Pacific), 3 miles east of Shumla; and at Painted Caves on the Rio Grande just below the mouth of Pecos River, Val Verde County, Tex. The position is less than 100 feet below the base of the Del Rio shale.

Nerinea geminata Stanton, n. sp.

Plate 61, figures 2, 4

Shell small, slender, consisting of about 15 or 16 whorls; apical angle about 10°; sides of the whorls more or less flattened in the middle, with a narrow, elevated, granular ridge bordering the distinct suture above and below; last whorl subcarinate below, and produced into the rather prominent, deflected anterior canal; surface of the whorls also marked by 2 relatively coarse granular spiral lines in addition to the marginal ridges, the interspaces between these 4 being unequal; interior with 3 folds on the columella, of which the middle one is small and the others are longer and curved upward, and a single stouter fold below the middle of the outer lip.

An average specimen consisting of 16 whorls measures 27 mm. in height and 5 mm. in greatest breadth.

This description applies only to the more abundant variety of the forms I have grouped under a single species and is represented by about 80 specimens. Two varieties are named and described below to include shells with an extreme variation in surface sculpture, but agreeing in other respects.

The close relationship of this form with *Nerinea pseudoconvexa* Stanton is noted in the description of that species. The most distinctive feature is in the elevated portion of the shell bordering the suture, which in *N. pseudoconvexa* forms a single broadly convex ridge on which the suture is with difficulty discernible, whereas in *N. geminata* the ridge is narrower and double, being divided by the rather distinct suture.

Types: Holotype, U.S.N.M. 77652; figured paratypes, 77653; unfigured paratypes, 22984, 77654, 77655.

Locality and position: Edwards limestone on Bartons Creek near Austin, Travis County; and 6 miles northeast of Kerrville (type locality), in Kerr County; Comanche Peak limestone on west fork of Nueces River, 1 mile below Kickapoo Springs, Edwards County; limestone of Fredericksburg age on the east side of Quitman Mountains near their southern end, about 16 miles south of the town of Sierra Blanca, Hudspeth County, Tex.

Nerinea geminata glabra Stanton, n. var.

Plate 61, figures 3, 5

Shell with the general form and proportions of the typical variety of the species, but distinguished by the almost complete absence of surface sculpture. The ridges bordering the suture are plain and somewhat narrower than in the other varieties, and the flat sides of the whorls are marked by very faint spiral lines, as in the adult whorls of the variety *parvilineata;* or, as in the figured specimen, these lines nearly disappear and are only faintly visible on the upper part of the spire when examined with a lens.

The best-preserved specimen of this variety consists of 20 whorls, and measures 29 mm. in height and 5 mm. in greatest breadth. Species represented by 11 silicified specimens.

This species has considerable resemblance to the apical portion of *Nerinea cultrispira* Roemer (1888, p. 17 (295), pl. 1 (31), fig. 9), as figured, but it lacks entirely the sharp carina bordering the suture, which is the distinguishing character of that species.

Types: Holotype, U.S.N.M. 77656; figured paratype, 77657; unfigured paratypes, 77658.

Locality and position: Edwards limestone 6 miles northeast of Kerrville, Kerr County, Tex. A few imperfectly preserved specimens that are similar to and possibly identical with this variety were collected from the Glen Rose limestone exposed in the bed of the Paluxy River at Glen Rose, Somervell County, Tex. Associated with these specimens at Glen Rose are others that are doubtfully referred to *Nerinea pseudoconvexa* Stanton.

Nerinea geminata parvilineata Stanton, n. var.

Plate 62, figures 5, 6

Shell with the same general form and proportions as the typical variety of the species, but with the flattened portion of the whorl marked by finer and more numerous (3 to 5) granular lines. The sculpture is more prominent on the earlier whorls, where it resembles that of the typical variety. In some examples the last whorls become almost smooth, as in the variety *glabra.* The variety *parvilineata* is therefore intermediate between the other two. Represented by about 25 specimens.

Types: Cotypes, U.S.N.M. 77659a-b; unfigured paratypes, 77660, 77661.

Locality and position: Edwards limestone 6 miles northeast of Kerrville, Kerr County; on the Colorado River above the mouth of Bartons Creek, near Austin; and Bartons Creek, about 3 to 4 miles above its mouth, near Austin, Travis County, Tex.

Nerinea hicoriensis Cragin

Plate 58, figures 2–4

1893. *Nerinea hicoriensis* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 225, pl. 42, fig. 6 (not fig. 7).

1925. *Nerinea hicoriensis* Cragin. Dietrich, Fossilium catalogus, pt. 31, p. 115.

1928. *Nerinea hicoriensis* Cragin. Adkins, Texas Univ. Bull. 2838, p. 186.

Shell large, slender, consisting of numerous concave whorls; apical angle 8° or 9°; whorls gently concave in the middle, rather abruptly elevated both above and below so as to form a narrow, subangular ridge which bears the very inconspicuous suture below its middle; last whorl strongly subcarinate below, produced into a well-marked anterior canal; surface smooth, or nearly so, the lines of growth and other minute sculpture, if present, not preserved on any specimens studied; interior with 1 strong fold each on the outer lip, inner lip, and columella, having almost exactly the same form and arrangement as in *Nerinea schottii* Conrad (p. 90).

The largest specimen seen, a fragment consisting of 5 whorls, measures 113 mm. in height, 30 mm. in breadth at the base and 26 mm. at the top. If the spire were restored with the same proportions the total height would be about 238 mm.

The specimens here figured and described certainly belong to the species represented by Cragin's figure 6. Probably the original of his figure 7 belongs to *Nerinea colligata* Stanton, a species with flat whorls that has since been found associated with *N. hicoriensis.* The only other Texan species with which *N. hicoriensis* is likely to be confused is *N. incisa* Giebel (p. 84), which has relatively shorter and more deeply concave whorls, appar-

ently a thinner shell and more slender internal folds, and distinct spiral surface sculpture.

In size and general aspect *Nerinea hicoriensis* Cragin resembles several European forms, such as *N. archimedi* D'Orbigny (1842, p. 78, pl. 158, figs. 3, 4) and *N. gigantea* D'Hombre-Firmas (D'Orbigny, 1842, p. 77, pl. 158, figs. 1, 2 from the Neocomian, and *N. aunisiana* D'Orbigny (1843, p. 86, pl. 160, figs. 8, 9) from the Cenomanian. The last has a more sharply angular sutural ridge, while the others have much more distinct sutures, besides differing in other minor details.

It is probable that the Texan fossils referred by Giebel (1853, p. 363) to *N. archimedi* belong to *N. hicoriensis*, and possibly a part of those referred to *N. incisa* also belong to *N. hicoriensis*.

Plesiotypes: U.S.N.M. 77662a-c.

Locality and position: Cragin makes this statement concerning the occurrence of the types: "Dinosaur sands on Hickory Creek, Travis County; collected by Messrs. Taff and Drake, who obtained several incomplete specimens from No. 4 of their Hickory Creek section." The "Dinosaur sands" were later named the Travis Peak formation, and No. 4 of Taff's section is 70 feet above the base of the formation and just below the zone of *Dufrenoya justinae* (Hill).

It is evident from Taff's description (Geol. Survey of Texas, 3d Ann. Rept., 1891) that the Hickory Creek from which his section was named is in Burnet County, not far west of the Travis County line, and that it was called Panther Creek on the geologic map accompanying Taff's paper. Both these names are apparently replaced by the name Spanish Oak Creek on the Burnet geologic and topographic map (U. S. Geol. Survey Geol. Atlas, folio 183, Llano-Burnet, Tex., 1912). The specimens here described and figured are from the equivalent beds in the Travis Peak formation on Cow Creek, about 2 miles below Travis Peak Post Office, and only about 6 miles from the type locality.

Nerinea incisa Giebel

Plate 58, figures 6, 7, 10, 11

1849. *Nerinea* sp. ind. Roemer, Texas, p. 412.

1852. *Nerinea* sp. ind. Roemer, Die Kreidebildungen von Texas, p. 41, pl. 4, fig. 8.

1853. *Nerinea incisa* Giebel, Naturwiss. Ver. Halle, Jahresber. 1852, p. 364.

Not 1862. *Nerinea incisa* Etallon, Soc. émulation dépt. Doubs Mém., 3e sér., t. 6, p. 36 (88).

1925. *Nerinea incisa* Giebel. Dietrich, Fossilium catalogus, pt. 31, p. 130.

1928. *Nerinea incisa* Giebel. Adkins, Texas Univ. Bull. 2838, p. 186.

Shell large, slender, consisting of numerous whorls; apical angle not more than 8° or 9°; sides of the whorls in the mold deeply concave, divided by a narrow furrow just below the middle into two nearly equal portions that form even slopes to the inconspicuous suture above and below, though the narrow lower portion is somewhat the more prominent; surface apparently marked with 6 or 7 narrow spiral lines; interior with 1 relatively small slender fold on the inner lip, outer lip, and columella, respectively, and in some specimens with a second much smaller fold on the columella.

A fragment consisting of 3½ volutions measures 57 mm. in height and 29 mm. in greatest breadth. The specimen figured by Roemer is somewhat more slender.

It has not been possible to obtain sufficient material to characterize this species more fully. Roemer gave a brief description and a figure of a fragment, as above cited, but he did not give a specific name. He compared it with *Nerinea gosae* A. Roemer (1836, p. 143, pl. 11, fig. 27) and with *N. espaillaciana* D'Orbigny (*N. bisulcata* D'Archiae) (D'Orbigny, 1843, p. 99, pl. 164, fig. 2).

Afterward, in describing a collection of Texas Cretaceous fossils, Giebel named the species *Nerinea incisa*, giving a reference to Roemer's figure. He stated that he had a specimen a foot long with 10 whorls, a shorter one with 6 whorls, and some still smaller ones with 2 or 3 whorls, all from Cibolo, Tex. Judging from his description it is possible that the largest specimen may have belonged to another species, perhaps *N. hicoriensis* Cragin; but even if this should prove to be true he refers to Roemer's description and figure in such a way that the specimen on which they were based must be taken as the type of the species. The specimen from the Rio Grande near the crossing of the 103d meridian, represented by figures 10 and 11 on plate 58, clearly belongs to the typical form of the species. Other specimens from the Comanche Peak limestone at Seven Knobs, near Glen Rose, agree so well in general aspect and form of whorls that they are believed to belong to the same species, although they show a second small fold or the columella and retain traces of 6 or 7 spiral lines on the surface.

Molds of *Nerinea hicoriensis* Cragin are likely to be confused with *N. incisa*, which differs, however, in its more angular and more deeply concave whorls, thinner shell, more slender internal folds, and in the surface. Some small specimens that seem to be referable to *N. incisa* approach rather closely in appearance to *N. texana Roemer* (1852, p. 41, pl. 4, fig. 7), another imperfectly known species described originally from an internal mold. The whorls of *N. texana* are not so distinctly concave as

the whorls of *N. incisa* and are divided in the internal mold into a broad, flat portion above and a much narrower subcarinate portion below.

The most closely related European species seems to be *Nerinea blancheti,* Pictet and Campiche (1862, p. 230, pl. 66, figs. 1–4), from the Lower Cretaceous of Switzerland.

Plesiotypes: U.S.N.M. 77663a–b; 77664.

Locality and position: Roemer's type was collected on the upper course of Pedernales River, probably in the Comanche Peak limestone. The collections examined contain specimens from presumably the same formation 5 miles southeast of Glen Rose, Somervell County; Boundary Mountain, 21 miles west of Austin, Travis County; bed of west fork of Nueces River, 1 mile below Kickapoo Springs, Edwards County; and from Bexar County, Tex. One of the specimens here figured was collected by J. M. Hamilton, of Marathon, Tex., somewhere in the Big Bend country south of Marathon, but its stratigraphic position is unknown. One fragment, doubtfully referred to the species, is from the Glen Rose limestone at Andersons Bend on the Colorado River, in Travis County, Tex.; and several small fragmentary molds have been found in the same formation in that region.

Nerinea kentensis Stanton, n. sp.

Plate 62, figures 18, 19

Shell moderately large and fairly stout, consisting of numerous rapidly increasing whorls with slightly concave sides; apical angle 18° to 20°; suture broadly and deeply channeled on the internal mold but apparently inconspicuous on the shell itself; sides of the whorls in the mold narrowly rounded or subangular above, broadly rounded and much more prominent below, with a broad, shallow concave slope between; external form of the whorls essentially the same, except that the sutures are not channeled; surface not well preserved but evidently without conspicuous sculpture; interior with only 2 prominent folds, one of which is on the inner lip and the other on the columella.

One of the types, an internal mold lacking a considerable amount of the apex, consists of 5 whorls, and measures 72 mm. in height and 32 mm. in greatest breadth. With the apex restored the height would be about 106 mm., and the number of whorls probably 12 or 15. Another fragmentary mold is 38 mm. broad.

This species is distinguished from all others in the Comanche fauna by its general proportions, the form of the whorls, and the absence of a fold on the outer lip. The internal structure is similar to that of *Nerinea titania* Felix (1891, p. 169, pl. 25, fig. 3; pl. 26, fig. 3) and *N. euphyes* Felix (1891, p. 170, pl. 26, fig. 11), from the Neocomian of Tehuacan in the State of Puebla, Mexico, but other specific features do not agree with either of these species.

Cotypes: U.S.N.M. 77665a-b,

Locality and position: From San Martine water tank on the Texas & Pacific Railway in Peeves County, 8 miles east of Kent, Culberson County, Tex., where it is associated with *Nerinea sammartinensis* in the Buda limestone which is the uppermost bed of the local Comanche section.

Nerinea kerrvillensis Stanton, n. sp.

Plate 62, figures 7, 8

Shell small, moderately stout, consisting of 10 or 12 whorls; angle of divergence of the spire 20° to 25° at the apex, but rapidy diminishing with the growth of the shell until in the adult it is not more than 15°; sides of the whorls nearly flat, with a relatively broad, shallow groove, just below the middle, about equal in breadth to the part of the whorl below it and slightly narrower than the part above; surface also bearing about 5 obscure granular lines on the more elevated parts, in addition to the fine lines of growth, but on some specimens the surface markings are almost lacking; suture impressed, moderately conspicuous; interior with a well-marked fold near the middle of the outer lip, a strong curved fold on the inner lip, a similar one on the columella, and incipient folds on the columella midway between the last two and on the inner lip between its principal fold and the outer lip.

The most perfect type specimen, with apex restored, measures 26 mm. in height and 8 mm. in greatest breadth.

This species is evidently rather closely related to *N. pellucida* Cragin (p. 86), and additional collections may prove it to be not more than a variety of that species. It is considerably more slender than the average examples of *Nerinea pellucida,* the surface sculpture is less conspicuous and differs in pattern, and the internal structure is made a little more complex by the addition of 1 small fold on the inner lip.

Types: Cotypes, U.S.N.M. 77666a-b; unfigured paratypes, 77667.

Locality and position: Edwards limestone about 6 miles northeast of Kerrville, Kerr County, Tex. (type locality).

A small *Nerinea* abundant near the south end of Finlay Mountains, Hudspeth County, Tex., where it is associated with *Exogyra texana* Roemer and *Ostrea crenulimargo* Roemer, is apparently referable to this species. It has the size, general form, and internal structure of the types, and differs only in being almost entirely smooth. A *Nerinea* similar

to that from the Finlay Mountains but attaining a larger size is locally abundant in the limestone at the top of Big Spring Mountain near Big Springs, Howard County, Tex. It also is tentatively identified with *N. kerrvillensis*.

Nerinea occidentalis Stanton, n. sp.

Plate 62, figures 11, 17

Shell large, slender, almost cylindrical, consisting of numerous whorls that in internal molds are divided by a narrow furrow into a broader flat portion above, and a more prominent slightly convex portion below, which is somewhat less than ¾ as wide as the upper portion; suture a little broader than this furrow in the mold; surface not preserved but probably smooth; interior with 3 simple spiral folds, 1 each on columella, inner lip, and outer lip, as in *Nerinea schottii* Conrad (p. 90), but relatively much smaller and thinner than in that species.

A fragment consisting of 2½ whorls is 80 mm. in height and 35 mm. in breadth. Another shorter fragment is 38 mm. in breadth.

The resemblance of this species to *Nerinea schottii* and the distinguishing features are pointed out in the description of that species. *N. occidentalis* Stanton seems to have a relatively much thinner shell and a smaller apical angle. *Nerinea texana* Roemer (p. 93), as indicated by the published figure, has a similar form, but the lower part of the whorl is more prominent and angular, and the shell is probably thicker.

Types: Holotype, U.S.N.M. 77668; 4 unfigured paratypes 77669.

Locality and position: The types are 5 large fragments sent to the U. S. National Museum by J. M. Hamilton, of Marathon, Tex., and collected by him in the Big Bend country not far from where the 103d meridian crosses the Rio Grande in Brewster County, Tex. I have collected another specimen on the west side of Quitman Arroyo near the Rio Grande southeast of the town of Sierra Blanca, Hudspeth County, Tex., in beds that are believed to be in the upper part of the Washita group.

Nerinea pecosensis Stanton, n. sp.

Plate 57, figures 11, 14–16

Shell of medium size, moderately stout, consisting of numerous whorls with concave sides; apical angle about 15°; suture hardly visible unless magnified, not more conspicuous than the delicate impressed line that forms the lower boundary of the narrow slit-band; sculpture of the first 10 or 15 whorls consisting of 3 relatively prominent revolving ridges, of which the middle one is smallest; later and adult whorls marked only by 10, 12 or more closely arranged, fine, revolving lines, of which 2 or 3 are somewhat more prominent than the others; base mainly flat and without sculpture; the form of the whorl also varying with age, the earlier whorls being somewhat abruptly constricted by a broad band around the middle, whereas in the adult the curves are more gentle and regular; interior with 2 small, subequal folds on the columella, and a much larger one in the middle of the outer lip.

The largest of the type specimens, a fragment consisting of about 6 whorls, measures 41 mm. in height and 17 mm. in greatest breadth. With the apex restored the height would be about 62 mm. The species is fairly common.

This species differs from all other Comanche species with which it might be compared, by the absence of a fold on the inner lip, that is, the upper wall as seen in longitudinal section. *Nerinea incisa* Giebel and *N. aquilina* Stanton, both of which have some superficial resemblance to *N. pecosensis* Stanton in form of whorl, are distinguished by their more slender form and by differences in surface sculpture.

Several small specimens that agree in sculpture with the young of this species are somewhat more slender than the types, and in section show no internal folds except the one on the outer lip; but as the columellar folds even in adult specimens are relatively very small, it is likely that they would not be developed in the earliest stages of growth.

Types: Cotypes, U.S.N.M. 77670a-c; 5 unfigured paratypes, 77671.

Locality and position: Upper part of the Devils River limestone of Washita age, at the high bridge of the Galveston, Harrisburg, & San Antonio Railway (Southern Pacific) across the Pecos River; and at Painted Caves on the Rio Grande just below the mouth of the Pecos River, Val Verde County, Tex. It has also been collected from the same stratigraphic position in the bed of the middle fork of Sycamore Creek, ¾ of a mile southeast of the Haveline Oil Company's Weatherbee Well No. 10, Del Rio quadrangle, Tex.

Nerinea pellucida Cragin

Plate 62, figures 9, 10, 12–16

1893. *Nerinea pellucida* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 226, pl. 42, fig. 5.

?1928. *Nerinea pellucida* Cragin. Adkins, Texas Univ. Bull. 2838, p. 186.

Shell small, rather stout for a member of this genus, elongate conical, consisting of 10 or 12 rapidly increasing whorls; apical angle variable, most commonly about 25° but ranging between 15° and

30°; sides of the whorls ordinarily more or less concave, in some specimens almost flat so that the spire forms an even slope; last whorl subcarinate below; suture inconspicuous, bordered on each side by a more or less prominent, generally tuberculate ridge; surface also marked by 2, or less commonly 3, additional spiral lines bearing minute tubercles or granules, and by very fine sinuous lines of growth; interior with a small fold near the middle of the outer lip, a slender curved one on the inner lip, a similar slender fold on the middle of the columella, and an incipient fold midway between the last two.

A medium-sized specimen measures 24 mm. in height and 11 mm. in greatest breadth, with an apical angle of somewhat more than 25°; in a collection of more than 200 specimens all but 3 are smaller than this. In the original description the dimensions are: "Height 33, breadth of body whorl 11.2 mm.; divergence 14 to 26 degrees. An exceptionally broad example is 35 mm. in height and 16.7 mm. in breadth." A more slender specimen must have had a height of about 48 mm. when complete.

Some internal molds from a locality near Granbury, Tex., that are referred to this species with some doubt, have nearly the same dimensions. In these molds the whorls are divided by a narrow groove into 2 unequal portions; the lower one, about 2/3 as broad as the upper, is narrowly rounded and projects beyond the flat upper portion so as to be flush with the corresponding part of the succeeding larger whorl. The species is fairly common.

This species varies greatly both in form and sculpture. Specimens in which the sides of the whorls are most deeply concave have the strongest sculpture and bear a row of relatively large tubercles on the ridge above the suture They also bear 3 more or less distinct intermediate granular lines, varying in arrangement but generally having a broader groove-like interspace near the middle of the whorl. Specimens with flat whorls commonly have only 2 intermediate lines, which may be nearly equal to the marginal ridges, or may be almost obsolete.

Plesiotypes: U.S.N.M. 77672a-g.

Locality and position: The types were obtained in the "Caprina [Edwards] limestone at Deep Eddy bluff on the Colorado River between South Austin and the dam." The species also occurs in the Edwards limestone on Bartons Creek, 3 or 4 miles from Austin, Travis County; 6 miles northeast of Kerrville, Kerr County; and from upper part of Glen Rose limestone in the vicinity of Granbury, Hood County, Tex.

Nerinea (Ptygmatis) ponsaltensis Stanton, n. sp.

Plate 59, figures 4–6, 11

Shell large, robust, consisting of 18 or 20 whorls; apical angle 25° to 30° with the divergence of the slopes of the spire decreasing to 20° or less in the adult; suture slightly impressed; slit-band very narrow; whorls relatively broad (the breadth equalling or exceeding twice the height), their sides slightly concave in the young, and flat or very slightly convex in the adult; last whorl broadly rounded below and produced in a short, broad canal; surface marked only by very fine lines of growth and the narrow slit-band; interior with a very strong fold on the middle of the outer lip, 2 subequal, stout folds on the columella, the upper one opposite that on the outer lip, a stout fold on the inner lip, and an incipient fold on the base; umbilicus rather narrow.

The largest specimen in the type lot consists of 12 whorls, lacks several from the apex, and measures 127 mm. in height and 37 mm. in greatest breadth. Corresponding measurements of another specimen (pl. 59, fig. 6) are 90 mm. and 33 mm. The species is abundant.

The presence of an umbilicus, and the other internal features, place this species in *Ptygmatis*, as defined and amended by Cossman (1896, pp. 32–34, pl. 2, figs. 3, 4; pl. 4, figs. 2, 3). In external characteristics it closely resembles *Ptygmatis requieni* (D'Orbigny) (1843, p. 94, pl. 153, figs. 1–3), from the Turonian of France.

Nerinea riograndensis Stanton, with which *N. ponsaltensis* is associated, has some superficial resemblance in its smooth, flat-sided whorls and narrow slit-band, but it is distinguished externally by its more slender form and the absence of an umbilicus, and internally by the strikingly different form and arrangement of the internal folds.

Types: Cotypes, U.S.N.M. 77674a-b; figured paratypes, 77673, 103174; 5 unfigured paratypes, 77675.

Locality and position: Upper part of the Devils River limestone, of Washita age, at the high bridge across the Pecos River on the Galveston, Harrisburg, & San Antonio Railway (Southern Pacific), 3 miles east of Shumla, Val Verde County; from the bank of the Rio Grande in Terrell County; in equivalent beds on top of a mesa 1½ miles north of the Texas Oil Company's Santa Rita well 14 miles west of Big Lake, Reagan County; and 1½ miles north of Leon Springs, about 9 miles west of Fort Stockton, Pecos County, Tex.

Nerinea pseudoconvexa Stanton, n. sp.

Plate 60, figures 8, 10–12

Shell small, slender, consisting of 20 or more

rather short whorls; apical angle 10° or less; sides of the whorls divided in the middle by a deep and relatively narrow constriction, the upper portion of the whorl joined to the lower portion of the preceding whorl to form a broadly convex ridge, near the middle of which is the very inconspicuous suture; last whorl subangular below and produced into a short canal; surface marked by 4 more or less granular spiral lines, 2 above and 2 below, all borne on the ridge bordering the suture; interior with 3 rather prominent, subequal, simple folds on the columella, and a thicker fold with its free margin expanded in the middle of the outer lip; in some specimens there is a second faint fold higher on the outer lip.

A small specimen consisting of 18 whorls measures 13 mm. in height and 2.5 mm. in greatest breadth. Another specimen with 10 whorls, lacking at least as many more from the apex, measures 16 mm. in height and 4 mm. in greatest breadth. With the spire restored its height would be about 25 mm. The largest example seen is nearly 30 mm. high. The species is abundant.

As the description, and still more clearly, the figures indicate, on casual examination this species appears to have very convex whorls, whereas the whorls are really deeply concave. The sutures between the whorls is seen with difficulty, and would naturally be expected in the deep spiral groove rather than on the rounded ridge. The nearest relative of this species is *Nerinea geminata* Stanton, with which it is associated, and which in one of its varieties resembles it rather closely. In *N. geminata* the suture is much more distinct, the whorls are more flattened and have a narrow ridge bordering the suture above and below, and the spiral sculpture is more evenly distributed.

Types: Cotypes, U.S.N.M. 77676a-c; figured paratypes, 77678; 9 unfigured paratypes, 77677, 77679.

Locality and position: Edwards limestone on the Colorado River above the mouth of Bartons Creek, near Austin, Travis County; 6 miles northeast of Kerrville, Kerr County; near Kickapoo Springs on the west fork of Nueces River, Edwards County, Tex. The typical form of the species occurs abundantly in limestone of Fredericksburg age on the east side of Quitman Mountains near their southern end, about 16 miles south of the town of Sierra Blanca; Hudspeth County, Tex. The species is doubtfully identified in the Glen Rose formation exposed in Paluxy River at Glen Rose, Somervell County, Tex.

A form with almost smooth surface but having the general proportions and internal structure of this species occurs in the upper part of the Devils River limestone at the high bridge across Pecos River on the Galveston, Harrisburg & San Antonio Railway (Southern Pacific), 3 miles east of Shumla, Val Verde County, Tex. This will probably prove to be a distinct species.

Nerinea quadrilineata Stanton, n. sp.

Plate 62, figures 1, 2

Shell of medium size, very slender, subcylindrical, consisting of numerous whorls; apical angle about 3°; sides of the whorls slightly concave, with a narrow subcarinate ridge bearing the inconspicuous suture, the most prominent part of the ridge formed by the upper margin of the succeeding whorl; surface also marked by 4 rather prominent equidistant granular spiral lines, some specimens with a fifth line interpolated in the middle; interior with rather broad but short fold on the middle of the outer lip, a small fold on the columella, and another generally smaller fold on the inner lip.

The type, an external mold in flint of 13 whorls of a specimen that lacks a considerable amount of the spire, measures 85 mm. in height and 7 mm. in greatest width. A much smaller specimen (see pl. 62, fig. 2) from the Glen Rose formation near Glen Rose, Tex., has the same general proportions and surface sculpture, and doubtless belongs to this species, although the internal folds are more nearly equal than in a mold associated with the type that shows the fold on the inner lip considerably smaller than the other folds.

The species is easily distinguished from other American species by its very slender form, elongated whorls, and distinctive sculpture. Several European species, especially in the Jurassic, have a somewhat similar aspect, but none of them seems to be very closely related. *Nerinea clavus* Coquand (1866, p. 65, pl. 5, figs. 1, 2) is similar in general form and aspect, but its whorls are relatively shorter, the sutures much more conspicuous, and the spiral lines are more interrupted.

Types: Holotype, U.S.N.M. 4534a; 4 unfigured paratypes 4534b-e; figured paratype, 77680.

Locality and position: Five specimens, including the type, are represented by molds of the exterior and parts of internal molds on a single small mass of flint in the U. S. National Museum collection, No. 4534 labeled "Nerinea, San Lucas Springs, Texas, Cretaceous." The catalogue entry made by F. B. Meek indicates that the specimen probably came from the collection of Jules Marcou made in connection with the Pacific Railroad surveys. No such locality as "San Lucas Springs" is known, and some later student has suggested that San Lucas be changed to San Marcos on the label. The matrix is precisely like that of the flints found at many places in the Edwards limestone, and it yields a small

Toucasia resembling *T. patagiata* (White), and impressions of an *Arca* and a *Cardium* or *Cardita*. Whatever the exact locality may have been, there is no reason to doubt that the specimen came from Texas and from the Edwards limestone.

The small specimen shown (pl. 62, fig. 2) was collected in the upper part of the Glen Rose limestone in the bed of Paluxy River at Glen Rose, Somervell County, Tex.

Nerinea riograndensis Stanton, n. sp.

Plate 59, figures 7–10, 12–16

Shell large, slender, subcylindrical, consisting of more than 20 whorls in the adult; apical angle 15° to 20°, but the divergence of the slopes of the spire rapidly decreases, and in the adult is 10° or less; suture impressed, commonly very inconspicuous; slit-band narrow, barely 1 mm. wide on a whorl 25 mm. in diameter, bordered below by a faint impressed line; sides of the first 8, 10, or more whorls concave or constricted in the middle by a relatively rather broad flat band, with a prominent tuberculated ridge bordering the suture above and below; in later stages the whorls rapidly become less concave, the tuberculated ridges decrease in size until they disappear, and the sides of the whorls become flat, or in some adult specimens very slightly convex, and are marked only by the fine lines of growth and the slit-band; the size of the shell at which the early sculpture disappears ranges in different individuals from 5 mm. to 11 mm. in breadth; last whorl subangular below and produced into a distinct anterior canal; the inconspicuous growth lines with the form characteristic of the genus cross the whorl in a very gentle curve whose convexity is directed away from the aperture and deflected sharply backward as they approach the slit-band; interior with 4 spiral folds, of which 2 are on the columella, 1 on the inner lip, and 1 on the outer lip. As seen in axial section of the shell, the fold on the outer lip is straight and slender, with a slight enlargement or tendency to bifurcate at the extremity, a little below the middle of the whorl and directly opposite the lower fold on the columella, so that the cavity is almost bisected; the fold on the inner lip and the lower one on the columella are also slender but sharply curved so that the free extremities point upward; the fourth fold, midway between the two last, is straight and much smaller than the others.

A specimen imperfect at both extremities consists of 18 whorls, and measures 144 mm. in height and 23 mm. in greatest breadth, the angle of divergence of the slopes being about 9° on the later whorls. The ratio of height of whorl to breadth is about 1 to 2 in the early stages of growth, and 2 to 3 in the adult. A smaller specimen showing 10 of the early sculptured whorls consists of 17 whorls and measures 55 mm. in height and 15.5 mm. in breadth. Represented by about 100 specimens in the Geological Survey collections.

The subgenus *Ptygmatis*, as originally defined by Sharpe (1850, p. 104) would include *Nerinea riograndensis*, which is indeed quite similar in form, surface, and internal structure to *Nerinea* (*Ptygmatis*) *conimbrica* Sharpe (1850, p. 114, pl. 13, figs. 4a-b) from the Lower Cretaceous of Portugal. Cossmann (1896, pp. 23–46), however, in a review of the Nerineidae, restricts *Ptygmatis* to the umbilicated forms and refers those like the present species to *Nerinea senu stricto*. These distinctions seem to me artificial, but Cossmann is doubtless correct in considering the presence or absence of the umbilicus more important than the mere form of the internal plications.

This species has sometimes been confused with *Nerinea volana* Cragin and with *N. schottii* Conrad, and might be mistaken for *N. occidentalis* Stanton or *N. sanmartinensis* Stanton, all of which in the adult have a slender form, smooth surface, and flat whorls. *Nerinea volana* and *N. sanmartinensis* are larger species with relatively broader whorls, and show differences in the relative development and form of the internal folds, especially in the upper one on the columella, which is minute or absent in both of these species, and well-developed in *N. riograndensis*, though the general arrangement of the folds is identical in all three. *Nerinea schottii* has a much broader slit-band, and both *N. schottii* and *N. occidentalis* have a different arrangement of the folds, that is, the fold on the outer lip is higher than that on the columella, instead of directly opposite, and there is no indication of a second fold on the columella. Of course there is no difficulty in distinguishing any of these forms when the earlier whorls showing the characteristic sculpture are preserved.

The "*Nerinea hieroglifica?*" figured by Bárcena (1875, p. 380, fig. 11; 1878, p. 201, fig. 23) suggests this species in its internal structure, but it has 2 folds instead of 1 on the outer lip, and it is not so slender. I may remark here that the name *Nerinea hieroglifica*, quoted without reference to author as a European species, has given me considerable trouble, as it is omitted from most lists. It is used in Lyell's Elements of Geology (1839, p. 218, fig. 207) in connection with the figures of a specimen from the "Coral rag." It is treated as a synonym of *N. bruntrutana* by Sharpe (1850, p. 108). The Mexican form figured by Bárcena is named *N. barcenae* by Heilprin (1891, p. 468, pl. 13, figs. 3, 4), and is referred by Aguilera (1897, p. 219) to

N. castilloi Bárcena, making Heilprin's name a synonym.

Types: Holotype, U.S.N.M. 77681; 7 figured paratypes, 77682a–c, 77683a–b, 103171, 103172.

Locality and position: The species is abundant in the upper part of the Devils River limestone, of Washita age, at Painted Caves on the Rio Grande near the mouth of Pecos River; at the high bridge of the Galveston, Harrisburg, & San Antonio Railway (Southern Pacific), across the Pecos River 3 miles east of Shumla, Val Verde County; and on the Rio Grande in Terrell County, Tex., where its immediate associates are *Nerinea schottii* Conrad, *N. pecosensis* Stanton, *N. shumlensis* Stanton, *Caprina crassifibra* Roemer, *Actaeonella pecosensis* Stanton, *Trochactaeon cumminsi* Stanton. It has been collected from the same formation farther east in Kinney County, about 12 miles north of Brackettville, associated with *Actaeonella pecosensis* and *Caprina*. It is associated with *N. schotti* at a locality on the highway as it descends from the east toward Pecos River about 1 mile above its mouth; and from Devils River near the mouth of Rough Canyon, on Belcher ranch about 20 miles northwest of Del Rio, Val Verde County, Tex.

Nerinea sanmartinensis Stanton, n. sp.

Plate 60, figures 9, 13, 14

Shell very large, of robust habit, especially in the earlier stages of growth, consisting of 20 or more relatively short whorls; apical angle about 30°, but the divergence of the slopes of the spire rapidly decreases, and in the adult is not more than 10°; suture distinctly impressed; slit-band comparatively narrow and very distinctly marked; sides of the first 10 or 12 whorls concave and marked by 5 or 6 rather prominent, somewhat granular spiral lines; on the succeeding whorls the angle of divergence of the sides changes rapidly, and the shell takes on the more slender form, after which the sides become flat, and the spiral sculpture, except for fine growth lines, disappears within the space of 1 or 2 whorls; last whorl subangular below with a rounded base which is produced as a short anterior canal; interior with a thin, slender fold on the columella, the inner lip, and the outer lip; fold on the outer lip shorter and stouter than the other two, that on the inner lip very slender and curved upward, and the fold on the columella also slender but with a much heavier base, slightly curved upward, and directly opposite the fold on the outer lip, so that the chamber is almost completely divided by these two.

The type is a large specimen (see pl. 60, figs. 13, 14) which was almost complete when found, but it is filled with calcite, and its middle portion was shattered in collecting. It measures about 200 mm. in height and 50 mm. in greatest breadth. A whorl 47 mm. broad is 19 mm. high, the ratio being very nearly the same as in *N. cumminsi*. The internal structure is described from a fragment of a smaller specimen found with the type.

At the type locality the species is associated with *Nerinea kentensis, Requienia* sp., and a large pecten, probably *Neithea roemeri* (Hill).

This species seems to be closely related to *Nerinea volana* Cragin (p. 93), the adult whorls almost identical in form and sculpture. The earlier stages of growth differ so greatly, however, that they cannot reasonably be referred to a single species. In *Nerinea sanmartinensis* the whorls are distinctly concave, and the spiral sculpture is well marked until the shell has reached a length of more than 30 mm. and a breadth of about 20 mm. These features then disappear so rapidly that within 2 whorls the sides become smooth and straight, with the divergence of the slopes reduced to about 10°. In *N. volana*, on the contrary, the earlier whorls have the same smooth, straight sides and small angle of divergence as the adult. Among more than 50 specimens examined none shows any trace of spiral sculpture or of concave whorls, although some of them retain whorls less than 3 mm. broad. The number and arrangement of internal folds is the same in both species, the only difference being that in whorls of the same size the folds of *N. sanmartinensis* are much more slender. This is especially noticeable in the fold on the inner lip, which is slender throughout in *N. sanmartinensis*, whereas in *N. volana* it has a very thick, heavy base.

Nerinea schottii Conrad, *N. riograndensis* Stanton, and *N. occidentalis* Stanton, are distinguished from *N. sanmartinensis* Stanton and from *N. volana* Cragin by the relatively greater height of their whorls, and the first 2 by differences in sculpture. There are also differences in the internal structure, *N. volana* having 1 additional fold on the columella, whereas in each of the other 2 the fold on the outer lip is not directly opposite that on the columella but is a little higher.

Types: Holotype, U.S.N.M. 77684; figured paratype, 77685.

Locality and position: From San Martine water tank on the Texas and Pacific Railway in Reeves County, 8 miles east of Kent, Culberson County, Tex., in the upper 20 feet of the Buda limestone, which is the formation that at a locality 12 miles farther west yields *Nerinea volana* Cragin.

Nerinea schottii Conrad

Plate 60, figures 4, 15

1857. *Nerinea schottii* Conrad, U. S. and Mex. Boundary Survey Rept., vol. 1, pt. 2, p. 158, pl. 14, figs. 3a, 3b.

1928. *Nerinea schottii* Conrad. Adkins, Texas Univ. Bull. 2838, p. 187.

Shell large, slender, consisting of not less than 15 whorls; apical angle about 10°; whorls flattened on the sides, with a broad, shallow constriction below the middle, which is more marked on the upper whorls and becomes obsolete on the adult; last whorl subangular below and produced into a short, somewhat narrow canal; suture impressed, bordered below by the narrow slit-band of the posterior sinus, whose lower limit is marked by a faint impressed line which on a whorl 28 mm. in diameter is nearly 3 mm. below the suture; surface of adult whorls otherwise smooth, the lines of growth very faint, but the earlier whorls of the type specimen show traces of 2 or 3 obscure revolving ridges; interior with 3 strong, simple spiral folds, one each on the columella, the inner lip, and the outer lip.

The type specimen, which lacks a portion of the spire, measures 135 mm. in height, 32 mm. in greatest breadth, and 12 mm. in diameter at the broken apical end. A specimen from Rough Canyon in Devils River consists of 11 whorls, measures 200 mm. in height, 33 mm. in greatest breadth, and 15 mm. in breadth at the broken apical end.

This description is drawn from Conrad's types, U.S.N.M. 9873, one of which was figured by him and is again illustrated here (see pl. 60, fig. 15). Another specimen of the type lot (see pl. 60, fig. 4) has the aperture better preserved, and a portion of its spire has been cut to show the internal folds.

In size and general aspect this species resembles *Nerinea riograndensis*, which has sometimes been erroneously identified with it in collections, but a closer comparison shows that *N. riograndensis* has more nearly flat whorls that show no traces of spiral ridges, a less conspicuous suture, a relatively narrower slit-band, and a more complex interior distinguished by 1 additional fold on the columella, and by folds differently shaped and arranged.

The internal structure as seen in longitudinal section is closely similar to that of *Nerinea hicoriensis* Cragin (p. 83), but that species is easily distinguishable by its concave whorls.

Another somewhat similar species, which I have separated under the name *Nerinea occidentalis*, is more nearly cylindrical in form, has the lower part of the whorl below the internal fold of the outer lip more prominent in the mold, and all 3 folds of the interior much smaller and more slender.

Types: Cotypes, U.S.N.M. 9873a–b; unfigured plesiotype, 77686.

Locality and position: The types were collected on "Oak Creek, near mouth of Puercos [Pecos] River," where they were associated with *Caprinula? occidentalis* Conrad, *Caprinula? planata* Conrad, and *"Hippurites?"* sp., the horizon being evidently in the upper part of the Devils River limestone of Washita age. Specimens that apparently belong to this species occur in the form of natural longitudinal sections in the Devils River limestone about 12 miles north of Bracketville, Kinney County, Tex. It has also been found in the same stratigraphic position in and near a cut on the Kansas City, Mexico, & Orient Railway, 2½ miles southeast of Big Lake, Reagan County, Tex.; it is associated with *N. riograndensis* about 90 feet below the top of the Devils River limestone on the highway descending from the east into the gorge of Pecos River, about a mile from its mouth; in the upper 25 feet of the same formation on Devils River; on Belcher Ranch about 20 miles northwest of Del Rio, Val Verde County; and in approximately the same position 1½ miles north of Leon Springs, 9 miles west of Fort Stockton, Pecos County, Tex.

Nerinea shumlensis Stanton, n. sp.

Plate 61, figures 8, 9

Shell rather small, slender, subcylindrical, consisting of numerous flat-sided whorls; apical angle about 5°; suture inconspicuous; surface of each whorl marked by 5 prominent, tuberculated, spiral ridges, of which the upper occupies the space of the slit-band, the second and third are close together on the middle of the whorl, separated from the first and fourth by broader interspaces, and the fourth and fifth are also close together near the base of the whorl. This arrangement places the fifth close to the upper ridge of the succeeding whorl. The general aspect of the sculpture is that of a pair and a triplet of tuberculated ridges. The interspace below the slit-band is somewhat deeper and broader than the others, giving the impression that it contains the suture joining the whorls. The tubercles are arranged in about 18 more or less vertical rows on each whorl. Whorls high in proportion to their breadth; interior with 1 strong fold on the columella, 1 on the inner lip, and a very strong one below the middle of the outer lip.

The larger of the 2 type specimens, a fragment consisting of 5 whorls, measures 35 mm. in height, 8.5 mm. in breadth at the base and 6.5 mm. at the top.

The only species in the Comanche fauna that resembles this is *Nerinea quadrilineata* Stanton, from which *N. shumlensis* Stanton is distinguished by its straightsided (not concave) whorls, and by minor differences in the sculpture. The internal structure is almost identical in the 2 species.

Cotypes: U.S.N.M. 77687a-b.

Locality and position: The specific name is de-

rived from Shumla, in Val Verde County, the station on the Galveston, Harrisburg & San Antonio Railway near the high bridge across Pecos River, where the species occurs in the Devils River limestone of Washita age, associated with *Nerinea riograndensis* Stanton and *N. pseudoconvexa* Stanton.

Nerinea (Aptyxiella) subula Roemer

Plate 62, figures 3, 4

1888. *Nerinea subula* Roemer, Palaeont. Abh., Band 4, p. 296, pl. 31, fig. 10.
1925. *Aptyxiella subula* Roemer. Dietrich, Fossilium catalogus, pt. 31, p. 143.
1928. *Nerinea subula* Roemer. Adkins, Texas Univ. Bull. 2838, p. 187.

Translation of the original description follows:

The long pointed subulate shell consists of a great number of whorls that are quite flat and scarcely elevated even at the sutures, which are barely indicated by a fine impressed line. In this manner the whole surface of the shell forms a single long, pointed conical surface. When well preserved the surface of each whorl is ornamented in the middle by 2 spiral rows of small tubercles or granules. At times between these 2 a third row of small granules is recognizable, and finally near the sutures of the whorls above and below a fourth and fifth row of quite small granules is fully indicated. Moreover these rows of granules vary in size, number, and position. The lower surface of the last whorl is ornamented by closely arranged fine spiral lines which in some cases appear to be somewhat granulated. The same sculpture is seen on the under side of the other whorls where it is made visible by breaks. The aperture of the shell is elongate-oval and is produced below into a well-developed oblique canal. No folds nor plications are visible on the columella or the outer lip. It may be doubted, therefore, whether the species belongs to the genus *Nerinea*, but the whole habit of the shell is that of the true Nerineas. D'Orbigny has unhesitatingly referred to the genus a closely related species from the French Cretaceous, *Nerinea pulchella*, in which likewise folds are entirely lacking on the columella and the opposite inner surface of the outer wall of the whorl.

Occurrence: The form is one of the more common species of the fauna [from the Edwards limestone on Bartons Creek], and a large number of specimens are under examination.

The figure, which is said to represent an example of medium size, shows a shell consisting of 25 whorls and measuring 59 mm. in height and 8.5 mm. in greatest breadth. Apical angle about 5°.

The form figured has not been exactly duplicated in the collections from the same neighborhood, made by the Texas and the Federal Geological Surveys and by correspondents of the U. S. National Museum. A few small, fragmentary specimens from the bluffs of the Colorado River above Bartons Creek probably belong to the species, although the sculpture is almost obsolete. These, like the original type, are preserved as calcite pseudomorphs, and their lack of tubercles and other prominent sculpture may be partly due to weathering. A number of larger silicified specimens (see pl. 62, figs. 3, 4) more clearly referable to the species were collected from the Edwards limestone 6 miles northeast of Kerrville, Kerr County, Tex. They are all smaller than the original figure and have more complex though variable sculpture, most of them bearing 5 granulated spiral lines that vary in size and arrangement, as shown in the 2 figured. The sculpture closely resembles that of *Turritella seriatim-granulata* Roemer, but the more slender proportions of the shell, and the form of the aperture with its well-marked anterior canal, at once distinguish it.

Roemer's assignment of the shell to *Nerinea* because of its general aspect is followed in this paper, although the material I have studied does not show the growth lines clearly enough to indicate whether the species has a slit-band and posterior sinus such as is found in all representatives of the family. Admitting the correctness of its reference to the Nerineidae, the absence of all internal folds puts it in the subgenus *Aptyxiella* Fischer (= *Aptyxis* Zittel), which is common in the Upper Jurassic of Europe and has been reported in the Lower Cretaceous.

Plesiotypes: U.S.N.M. 77688a–b.

Nerinea (Aptyxiella) supracostata Stanton, n. sp.

Plate 57, figures 20, 21

Shell rather small, slender, subcylindrical, consisting of 20 or more whorls; apical angle 8° to 10°; suture between the whorls impressed, very inconspicuous; sides of the whorls mainly flat except just below the suture where they bear a relatively prominent, broad, rounded ridge; surface also ornamented by 6 or 7 fine tuberculated spiral lines, of which 2 or more with larger tubercles are on the upper marginal ridge; aperture subquadrate, produced below with a distinct but short anterior canal; interior without any folds or plications.

The large figured type, lacking whorls at the apex, consists of 13 whorls, has an apical angle of about 10°, and measures 38 mm. in height and 8 mm. in greatest breadth. With the apex restored the height would be about 50 mm. The other figured specimen is somewhat more slender and differs slightly in details of sculpture. Its 10 whorls measure 29 mm. in height, and the total height with apex restored would be about 47 mm. Its greatest breadth is 6.5 mm. Species represented by 16 specimens.

This species appears to be rather closely related to *Nerinea subula* Roemer, with which it is associated, but the differences in the form of the whorls and in the details of the sculpture are sufficient to justify its separation. The generic reference is only provisional, like that of *N. subula*, but is prob-

ably correct. Choffat (1886, p. 13, pl. 3, figs. 1–12) describes a species, *N.* (*Aptyxiella*) *infravalanginiensis*, from the lowest Cretaceous of Portugal, which though much larger has the same general form and type of sculpture.

Types: Cotypes, U.S.N.M. 77689a-b; 13 unfigured paratypes, 77690.

Locality and position: Edwards limestone 6 miles northeast of Kerrville, Kerr County, Tex. Questionably from the Glen Rose limestone on Paluxy River, 2½ miles above Glen Rose, Somervell County, Tex.

Nerinea texana Roemer

Plate 60, figures 5–7

1849. *Nerinea* sp., Roemer, Texas, p. 412.
1852. *Nerinea texana* Roemer, Die Kreidebildungen von Texas, p. 41, pl. 4, fig. 7.
1928. *Nerinea texana* Roemer. Adkins, Texas Univ. Bull. 2838, p. 187.

Translation of the original description follows:

Shell long, turreted; the whorls, when preserved as internal casts, divided by a spiral furrow; the lower part, forming scarcely a third of the entire breadth of the whorl, raised in the form of a keel; the upper larger part of the whorl quite flat and even, and so situated with reference to the lower part of the preceding whorl that the latter scarcely projects beyond it.

A number of specimens of this species preserved as casts are present. These casts have the closest resemblance to those of *Nerinea visurgis* (A. Roemer, Versteinerungen des Norddeutschen Oolithen-Gebirge, pl. 11, fig. 26) from the Upper Jura near Hildesheim, but are distinguished in that the keel, which is separated by the spiral furrow from the rest of the whorl, is narrower and less sharply carinate than is that Jurassic species, and also by the lesser breadth of the furrow.

Occurrence: Not rare near Fredericksburg; also with the following species [*N. incisa*] at a locality far up the Pedernalis River.

Roemer's figure represents a mold consisting of 6 whorls, with an apical angle of 8°, and measuring 70 mm. in height, 19 mm. in breadth at the base and 11 mm. at the top.

Except a few very poorly preserved fragments, all the specimens I have studied are smaller than the type, but they agree so well in general form and in the outline of the whorls that there can be little doubt as to their identity. Some of them, however, as suggested, are with difficulty separated from *Nerinea incisa* Giebel (p. 84). The arrangement of the internal folds (pl. 60, fig. 5) is the same, except that the upper fold on the columella is relatively larger, and the other folds are somewhat more complex in form, the one on the outer lip and the lower one on the columella showing a strong tendency to thicken or even bifurcate at the free extremity, and the one on the inner lip curved sharply upward. A small specimen from the Goodland limestone (pl. 60, fig. 7) 20 miles southwest of Gainesville retains the shell in a fair state of preservation. The sides of the whorls are broadly concave but not as deeply excavated as in *N. incisa* Giebel or *N. hicoriensis* Cragin. The surface is smooth, or at least without any conspicuous sculpture.

Figured specimens: U.S.N.M. 103169, 103170.

Locality and position: The forms here referred with some doubt to *N. texana* occur in the Comanche Peak formation at 2 localities in the neighborhood of Fredericksburg, Gillespie County; on Bear Creek near Austin, Travis County; 9 miles northeast of Kerrville, Kerr County; in Bexar County, Tex.; and in the Goodland limestone 20 miles southwest of Gainesville, Cooke County, Tex.

Nerinea volana Cragin

Plate 61, figures 1, 6, 7, 10–12

1893. *Nerinea volana* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 226, pl. 42, fig. 8.
1925. *Ptygmatis volana* (Cragin). Dietrich, Fossilium catalogus, pt. 31, p. 137.
1928. *Nerinea volana* Cragin. Adkins, Texas Univ. Bull. 2838, p. 187.

Shell large, slender, subcylindrical, consisting of numerous relatively short whorls; apical angle about 10°; sides of the whorls smooth, flat, or very slightly convex, forming an almost even continuous slope; last whorl subangular below and produced in a short canal; suture very slightly impressed, inconspicuous; slit-band very narrow, 1 mm. wide on a large whorl, bordered below by an impressed line which on some specimens is almost as distinct as the suture; surface otherwise marked only by fine lines of growth that trend obliquely on the sides of the whorl and curve sharply backward at the slit-band; interior with 1 strong fold each on the columella, the inner lip and the outer lip, and in some specimens a second incipient fold on the columella; the principal fold on the columella and that on the outer lip are directly opposite each other and almost meet in the middle of the chamber; fold on the inner lip very stout and thick at the base but thinning outward to a thin edge that is slightly curved upward.

One of the figured specimens (pl. 61, fig. 11) consists of 7½ whorls, and measures 108 mm. in height and 37 mm. in maximum breadth. With the apex of the spire restored the height would be about 215 mm. The most characteristic measurements are those showing the proportions of the short whorls. A whorl 27 mm. in breadth is only 11.5 mm. in height. Another specimen consisting of 14 whorls is 150 mm. in height and 36 mm. in

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greatest breadth. Some of the largest fragments have whorls 39 mm. in breadth.

The original description was based on an imperfect specimen that did not show the surface features, and the figure, which is not very accurately drawn, shows only the axial section. However, the size, the relative proportions of the whorls, and the internal structure, agree so well with the beautifully preserved fossils from west Texas here shown that there can be little doubt of their specific identity. One of Cragin's unfigured types is illustrated here (see pl. 61, fig. 10).

The more closely related species is *Nerinea sanmartinensis* Stanton, the description of which includes detailed comparisons (see p. 90). In general aspect *N. volana* resembles *N. riograndensis* Stanton, *N. schottii* Conrad, and *N. occidentalis* Stanton, the most conspicuous feature in which it differs from all of them being the relative shortness of its whorls. Considering whorls as nearly as possible of the same size as the one whose measurements are given above, the breadths and heights, respectively, are for *N. schottii* 27 and 16.5 mm., for *N. occidentalis* 29 and 21 mm., for *N. riograndensis* 23 and 14 mm. *N. volana* also differs from *N. schotti* and *N. riograndensis* in its apparent lack of sculpture on the earlier whorls, and in its smaller apical angle. The internal structure, although of the same general character as that of *N. riograndensis*, differs in details, especially in the slight development, or the absence, of the second fold on the columella. The arrangement of the folds, especially the relative positions of those on the outer lip and the columella, is decidedly different from that in *N. schotti* and *N. occidentalis*.

Plesiotypes: U.S.N.M. 103081a-d, 103082a-b. Cotype in the Texas State collection at Austin. The specimen illustrated by Cragin is probably now lost, but was examined by me.

Locality and position: Cragin's types were collected from the Buda limestone on San Gabriel River, 6 miles below Georgetown, Tex. The specimens here described and figured are from equivalent beds, 4½ to 6 miles west of Kent, Culberson County, Tex.

Genus PSEUDONERINEA De Loriol, 1890

I have not been able to study any authentic European fossils belonging to *Pseudonerinea*, but a number of Texan forms that seem to agree fairly well with *Pseudonerinea* are described under that name. They are not all perfectly smooth, some of them showing spiral lines or small tubercles, though the sculpture is never conspicuous. The aperture is not absolutely complete on any specimen I have seen, but it is certainly produced in front into what I should describe as a short canal. They are undoubtedly closely related, all possessing the slit-band, inconspicuous sculpture, if any, and very short canal, and there are no internal folds. Another common characteristic of our Texan species is their variability both in form and sculpture. *P. proctori*, *P. multiformis*, and *P. terebroides* each shows considerable latitude of variation in both these respects. None of the specimens is sufficiently well preserved at the apex to show the embryonic whorls, which, according to Cossmann (1896, p. 15), in one of the European species are heterostrophes, i.e., coiled in the direction opposite to that of the rest of the spire.

Pseudonerinea multiformis Stanton, n. sp.

Plate 63, figures 14-20

Shell of medium size, commonly rather stout, consisting of 15 to 20 relatively short whorls; apical angle 15° to 20°; suture impressed, in most specimens conspicuous; form of the whorls variable, commonly flattened on the sides but in some specimens gently convex; the flattened whorls ordinarily unite to form a continuous, almost even slope; other whorls are distinctly shouldered above; and more rarely the later whorls (see pl. 63, fig. 17) show a tendency to contract and to depart from the regular spiral, so that the lower part of the whorl projects considerably beyond the upper part of the succeeding one; slit-band narrow, in most specimens more or less elevated above the general surface of the shell, bordered below by a very faint impressed line which is ordinarily hardly recognizable; surface also marked by the oblique inconspicuous lines of growth which curve strongly backward at the slit-band, and in a few specimens by 1 or 2 small spiral ridges, of which the upper ridge is below the middle of the whorl, and the lower ridge either appears just above the suture or is concealed by the succeeding whorl; last whorl more or less angulated at the base, the angle bearing the lower ridge, if the lower ridge is present; aperture elongate subquadrate, produced below in a very short twisted canal or beak.

A medium-sized specimen, lacking a large part of the spire, consists of 5 whorls, and measures 30 mm. in height and 16 mm. in greatest breadth. The height with apex restored would be about 46 mm.

The extreme variations of *Pseudonerinea multiformis* Stanton, as shown in the specimens figured, if considered alone would doubtless be determined of specific or at least of varietal rank; but the collection of more than 50 specimens from one locality shows every gradation, and in fact, single shells show great changes, in the form and sculpture of the whorls within the life span of the individual.

Compared with other species its convex-whorled variety approaches most closely to *P. proctori* (Cragin) (this page), but is distinguished by its more variable form, generally flatter whorls, more angulated and shorter last whorl, shorter beak, absence of tubercles or granules.

Types: Cotypes, U.S.N.M. 103096a-g; paratypes, 103097.

Locality and position: Collected in a boulder 12 miles south of Weatherford, Parker County, Tex., in an area of Glen Rose beds. The boulder probably is a remnant of an overlying formation in the Fredericksburg group.

Pseudonerinea? arkansensis Stanton, n. sp.

Plate 63, figures 9, 10

Shell small, very slender, consisting of 20 or more whorls; apical angle about 8°; sides of whorls moderately convex; suture impressed, conspicuous; base of last whorl regularly convex, without any angulation, and produced below in a short, narrow canal or beak; surface smooth, the lines of growth and other sculpture inconspicuous; a fine impressed line faintly visible below the suture on some specimens apparently marks the limit of a slit-band. There are no internal folds.

The figured type, about average size, measures 31 mm. in height and 4 mm. in maximum breadth. It is associated with about 50 other specimens of the same species on a small rock fragment.

The general aspect and other characters, so far as they can be distinguished, are suggestive of *Pseudonerinea proctori* (Cragin), *P. multiformis* Stanton, etc., and the species has therefore been referred provisionally to the same genus. The specimens studied are fairly well preserved, retaining the shell, but the growth lines cannot be distinctly seen and the presence of the sutural slit and slit-band has not been fully demonstrated, though the growth lines, when visible, have the same oblique direction as in the other species mentioned.

Types: Holotype, U.S.N.M. 22598; figured paratype, 103098.

Locality and position: The type was collected probably from the Dierks limestone member of the Trinity formation, in T. 7 S., R. 27 W., Howard County, Ark.

Pseudonerinea? presidiensis Stanton, n. sp.

Plate 63, figures 26, 27

Shell large, slender, composed of numerous rather short, gently convex whorls; apical angle about 15° or more in some specimens; suture impressed; slit-band beneath the suture relatively broad, limited below by a faint but distinct impressed line; growth lines inconspicuous, passing obliquely across the whorl and strongly deflected backward on approaching the slit-band; surface otherwise smooth; last whorl broadly rounded below and produced into a short broad anterior canal.

One of the types, consisting of 5 whorls with the aperture nearly complete, but lacking a large part of the spire, measures 59 mm. in height and 24 mm. in greatest breadth. With the spire restored the height would be about 100 mm.

This species is evidently congeneric with *Pseudonerinea proctori* (Cragin) (below), which it resembles in form and general appearance, but from which it is distinguished by its greater size and the entire absence of tubercles and of spiral sculpture, except the impressed line bordering the slit-band. It is represented by 11 imperfect specimens.

Types: Cotypes, U.S.N.M. 103099a-b; 9 unfigured paratypes, 103100.

Locality and position: West flank of mountain on south side of Rio Grande opposite Presidio, Tex. Another specimen apparently belonging to this species was found in the National Museum collections in the same tray with the types of *Nerinea schottii* Conrad and marked with the same catalogue number. Stratigraphic position of species not well determined but probably high in the Washita. The species, or a closely related form, is common in the Devils River limestone 30 feet below the top on the highway as it descends from the east into the gorge of Pecos River, about a mile from its mouth, Val Verde County, Tex.

Pseudonerinea proctori (Cragin)

Plate 63, figures 22, 23, 28–30

1893. *Cerithium proctori* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 222, pl. 42, figs. 11, 12.
1928. *Cerithium proctori* Cragin. Adkins, Texas Univ. Bull. 2838, p. 188.

Shell of medium size, rather stout, consisting of about 15 or more relatively short whorls; apical angle about 20°; suture rather deeply impressed so as to be conspicuous; sides of whorls flattened or very gently convex; last whorl broadly rounded at the base and produced into a distinct, slightly twisted canal; surface sculpture inconspicuous but variable, the most constant feature being the relatively broad slit-band limited below by a fine impressed line. The slit-band usually shows a few very faint tubercles on the lower part of the whorl just above the suture. The lines of growth are rather indistinct, except on the adult whorls where they may become very prominent ridges. They pass obliquely across the whorls and are strongly curved backward as they approach the slit-band.

A medium-sized specimen (pl. 63, fig. 30), lacking

several whorls from the apex and imperfect at the lower extremity, consists of 9 whorls and measures 41 mm. in height and 14 mm. in greatest breadth. It shows very distinctly the 3 rows of granules, 1 on the slit-band and the other 2 near together just above the suture, though, owing to the imperfect state of preservation, they are visible on only a small part of the spire. One of the types (pl. 63, figs. 28, 29), represented by Cragin's figure 11, is a little larger and slightly more slender than this specimen, but it clearly belongs to the same species. The surface is considerably weathered and eroded in small pits, but part of the slit-band is recognizable and the direction of the growth lines can be traced. It also shows traces of spiral lines on the last whorl, and, less distinctly, on some of the other whorls.

Three specimens from the Hill collection have the surface well preserved. These show clearly the presence of a deep sutural slit and slit-band, and that these spiral rows of faint granules are a constant feature. One of them (see pl. 63, figs. 22, 23) has the base of the last whorl marked only by lines of growth, but the other 2 show 8 or 10 faint spiral lines. The one figured consists of 7 whorls, lacking several from the apex, has an apical angle of 20°, and measures 29 mm. in height and 12.5 mm. in greatest breadth. The height with the apex restored would be about 35 mm.

This species is closely related to *Pseudonerinea terebroides* Stanton, which is distinguished by its smaller size, generally more slender form, and relatively more conspicuous sculpture. It is also related to the larger, smooth *P. presidiensis* Stanton.

Types: Cotype, U.S.N.M. 32697; figured plesiotype, 103101; one figured plesiotype in the R. T. Hill collection at Johns Hopkins University.

Locality and position: Edwards limestone on Bartons Creek; on the Colorado River near Austin, Travis County; and in Hood, Gillespie, and Bexar Counties, Tex.

Pseudonerinea terebroides Stanton, n. sp.

Plate 63, figures 24, 25

Shell small, moderately stout, consisting of 15 or more whorls; apical angle about 15°; suture impressed, or in some specimens distinctly channeled; sides of the whorls flattened or very slightly convex, most prominent just beneath the suture where a relatively rather broad slit-band forms a rounded spiral ridge bordered below by a more or less distinct fine impressed line; surface also marked by inconspicuous, vertically elongated tubercles on the slit-band, by 1 to 4 minutely granular lines below it, and by fine growth lines that curve abruptly backward on approaching the slit-band and cross it with a short concave curve, thus clearly indicating the presence of a deep slit or sinus; last whorl rounded below, either smooth, or bearing several fine spiral lines, and produced into a distinct canal; interior without folds or plications.

An average specimen consisting of 14 whorls measures 19 mm. in height and 5 mm. in greatest breadth.

This description is drawn from 10 more or less perfect specimens showing considerable variation in sculpture, but all so closely interrelated that they cannot be reasonably separated even as varieties.

Pseudonerinea terebroides is distinguished from *P. proctori* (Cragin) by its smaller size, more slender form, and relatively more conspicuous sculpture.

Types: Cotypes, U.S.N.M. 103102a-b; 8 unfigured paratypes, 103103.

Locality and position: Edwards limestone, 6 miles northeast of Kerrville, Kerr County, Tex.

Pseudonerinea terebroides glabra Stanton n. var.

Plate 63, figure 31

This variety has the general aspect and proportions of the typical variety, but a much smoother surface, the tubercles and spiral lines only faintly indicated on the earlier whorls and almost entirely absent from the adult stages. The slit-band is not so distinctly marked off by an impressed line but occupies a somewhat angular ridge, sloping up to the suture and giving the whorl a slightly shouldered appearance. The specimen figured consists of 15 whorls and measures 23 mm. in height and 6 mm. in greatest breadth.

The species has a superficial resemblance to forms of *Terebra,* but the deep posterior sinus and other differences in form of the aperture prevent reference to that genus. A somewhat similar form from the Lower Cretaceous of Spain is described and figured by De Verneuil and De Lorière (1868, p. 29, pl. 3, figs. 4, 4a-b) as *Pleurotoma utrillasi,* but the more natural reference of such forms seems to me to be to the Nerineidae.

Types: Holotype, U.S.N.M. 103104; 9 unfigured paratypes, 103105.

Locality and position: Edwards limestone, 6 miles northeast of Kerrville, Kerr County, Tex.

Genus CERITHIUM Bruguière, 1789

Cerithium austinense Roemer

Plate 64, figure 29

1888. *Cerithium austinense* Roemer, Palaeont. Abh., Band 4, p. 16 (294), pl. 1 (31), fig. 12.
1928. *Cerithium? austinense* Roemer. Adkins, Texas Univ. Bull. 2838, p. 188.

Shell rather small, of robust habit, consisting of

10 or more convex whorls; apical angle about 25°; whorls with 6 very prominent, rounded varices generally arranged in continuous rows the entire length of the shell; surface also marked by about 6 rather coarse, revolving lines which are swollen where they cross the varices, and alternating with finer lines, the whole crossed by fine lines of growth which under a lens give the spiral lines a granular appearance at their intersections; last whorl produced below in a short, narrow, but distinct, slightly twisted canal, this basal portion of the whorl bearing 10 or 12 fine revolving lines.

The figure of Roemer's type, said to represent an average specimen, is 30 mm. high and has a maximum breadth of 11.5 mm. The only example in the National Museum collections has the same proportions, but is somewhat smaller, and is imperfect at both extremities.

Roemer states that the coarse spiral lines vary in number from 6 to 8 on each whorl, and that there may be 2 of the finer lines in the interspaces, but these variations are not shown on our specimen. The last varix on this specimen does not aline with those on the earlier whorls.

In the original description this species is compared with D'Orbigny's *Cerithium requienianum, C. prosperianum,* and *C. provinciale* (D'Orbigny, 1843, pp. 377–380, pl. 232 figs. 4–6; pl. 233, fig. 3) all of which agree with it in having strong varices, but differ in other details. A more similar form from the Gosau beds of Austria has been described by Zekeli (1852, p. 113, pl. 23, figs. 3a-b) under the name *C. sexangulum,* which agrees in size, general proportions, and number and form of the varices, and differs only in the details of the finer sculpture.

Plesiotype: U.S.N.M. 77599.

Locality and position: Edwards limestone on Bartons Creek near Austin (type locality); and on Colorado River above the mouth of Bartons Creek, Travis County, Tex.

Cerithium? bartonense Stanton, n. sp.

Plate 64, figures 1–4

Shell small, consisting of 10 or 12 rather convex whorls; apical angle about 20°; sutures deeply impressed and conspicuous; surface of each whorl marked by about 20 moderately prominent costae which show a tendency to fall into continuous rows across successive whorls, and which bear small tubercles or granules arranged in 4 spiral rows alternating with fine raised spiral lines. The spiral sculpture becomes finer, on the later whorls, which bear a few larger varices. Full form of the aperture not preserved, but there was evidently a short anterior canal.

The largest of the 5 types consists of 12 whorls, and measures 14 mm. in height and 7 mm. in greatest breadth.

In form and sculpture this species resembles *Cerithium mexicanum* Gabb (1869, p. 263, pl. 35, fig. 8) from Arivechi, Sonora. It is not so slender, however, and has a smaller number of spiral rows of granules.

The small size of the specimens, and the fact that all are imperfect at the anterior end, make it doubtful whether they are adult shells, and whether they really belong to *Cerithium.* The sculpture is of a type that is common in the Aporrhaidae, and these may be the young or apical portions of some species belonging to that family, though they are clearly distinct from the recognized *Aporrhais* with which they are associated.

Cotypes: U.S.N.M. 77600a-c; unfigured cotypes, 77601.

Locality and position: Edwards limestone on the Colorado River above the mouth of Bartons Creek, near Austin, Travis County, Tex.

Cerithium bosquense Shumard

Plate 64, figures 22, 27, 28, 31

1860. *Cerithium bosquense* Shumard, Acad. Sci. St. Louis Trans., vol. 1, p. 596.
1860. *Chemnitzia occidentale* Gabb, Acad. Nat. Sci. Philadelphia, Proc., 2d ser., vol. 4, p. 391, pl. 68, fig. 10.
1893. *Cerithium bosquense* Shumard. Cragin, Texas Geol. Survey 4th Ann. Rept., p. 220, pl. 42, figs. 9, 10.
1925. *Cerithium bosquense* Shumard. Winton, Texas Univ. Bull. 2544, p. 51, pl. 20, fig. 9.
1928. *Cerithium bosquense* Shumard. Adkins, Texas Univ. Bull. 2838, p. 188.

Shell large, robust, consisting of about 12 relatively short and broad whorls; apical angle about 25°; whorls flattened on the sides, shouldered above, with a row of large, rounded or vertically elongated tubercles, 12 or 13 to each whorl, on the shoulder; last whorl subangular in the middle, rounded below and produced in a probably short canal; surface also marked by distinct lines of growth, and by numerous fine impressed spiral lines which appear to be best developed on the flattened portion of the side, and to vary in strength on different specimens, being entirely absent from some that have the surface of the shell fairly well preserved.

An average specimen consisting of 7 whorls, and lacking much of the apex of the spire, measures 68 mm. in height and 34 mm. in greatest breadth. With the apex restored the height would be about 90 mm. Other molds and fragmentary specimens indicate shells with corresponding dimensions fully a third greater than these.

A specimen in Cragin's collection, from a locality

8 miles west of Fort Worth, shows younger stages of growth than any other specimen studied. It consists of 8 whorls, and has a height of 51 mm. and a maximum breadth of 21 mm. The last 2 whorls show the common type of ornamentation, consisting of a row of strong, round tubercles on the upper margin. On the preceding volution these tubercles are vertically elongated and extend about halfway across the whorl, and on the younger whorls they are represented by costae that cross the whorl completely and show a slight tendency to become thickened at the upper end.

The material studied is all incomplete, many of the specimens being internal molds with little or none of the external sculpture, though generally the presence of the nodes or tubercles is indicated even on the molds. Neither the apical whorls of the spire nor the full form of the aperture have been seen. It is evident, however, that there is a distinct, though relatively short, anterior canal, and that the species should therefore be referred to *Cerithium* rather than to *Turbonilla* (*"Chemnitzia"*). The axial section figured by Cragin is re-illustrated on plate 64, figure 22.

The names *Cerithium bosquense* and *"Chemnitzia" occidentale* were published almost simultaneously, and a comparison of the descriptions makes it evident that they were applied to the same species. Gabb's description was accompanied by a fairly good figure, and the volume in which it appears contains the statement that extra copies of his paper were printed for the author in November 1860. The part of the volume containing Shumard's paper also bears the title-page date 1860 with no more definite reference to date of publication, but a "separate" bound in a volume of pamphlets collected by Prof. F. B. Meek has penciled in his handwriting on its title page "Aug. 27, 1860," which is probably the date on which he received it. With the knowledge of Professor Meek's careful, methodical habits in all such matters this circumstance may be considered as establishing the priority of Shumard's paper.

The only American Mesozoic species with which *Cerithium bosquense* should be compared is *C. riograndense* (page 101), which has similar general form and size. Weathered internal molds retaining none of the sculpture cannot be placed with certainty in either species. When the shell is preserved the differences are well marked. In *C. riograndense* the whorls are not shouldered, nor ornamented by the large tubercles, but the sides of the whorls form almost uniform, continuous slopes and are crossed by straight, small costae even in the adult. The 2 species are not associated in the same formation, *C. bosquense* being confined to the Fredericksburg group and *C. riograndense* to the Washita group, so far as known, though some of the specimens are very difficult to distinguish.

Cerithium tourneforti Coquand (1866, p. 85, pl. 5, fig. 8), from the Aptian and upper Neocomian of Utrillas, Spain, is similar in form and sculpture, except that it is slightly more slender, has relatively higher whorls, and has no spiral sculpture.

Plesiotypes: U.S.N.M. 77602, 77603. Shumard's types are probably lost. Cragin's plesiotype illustrating an axial section is in the collections of the Texas Bureau of Economic Geology.

Locality and position: Fredericksburg group, mainly below the Edwards limestone, at many localities in Texas and Oklahoma. Shumard's type is from a locality near Bosque Creek, Bosque County, Tex.; Gabb's specimen from a locality near Choctaw Mission, Okla. Cragin reports the species from the vicinity of Granbury in Hood County, San Gabriel River 2 miles above Georgetown in Williamson County, Kent in Culberson County, Signal Peak in Howard County, Tex., and Casey's Creek in Oklahoma. Specimens in the collections of the Geological Survey and National Museum are from 6 miles west of Fort Worth; Benbrook, in Tarrant County; 15½ miles southwest of Gainesville in Cooke County; Chalk Mountain in Erath County, about 12 miles southwest of Glen Rose; from the vicinity of El Paso; and in the Finlay Mountains northwest of Sierra Blanca, Hudspeth County, Tex.

Cerithium diversecingulatum Stanton, n. sp.

Plate 64, figures 7, 8, 26

Shell of medium size, slender, consisting of 25 or more short whorls; apical angle about 15°; suture impressed but inconspicuous; sides of the whorls flattened, forming an almost even continuous slope; sculpture relatively strong, consisting of a coarse tuberculate spiral ridge near the middle, a beaded ridge about half the size bordering the suture above, and a somewhat smaller plain ridge below, which is nearly or quite concealed except on the last whorl; base flattened, with no spiral sculpture; anterior canal very short and narrow; columella with a rather prominent fold extending only a short distance back in the aperture.

A young specimen, or the apical portion of an adult, consisting of 15 whorls, measures 10 mm. in height and 3 mm. in greatest breadth. Another fragment with 8 whorls is 17 mm. in height, 5 mm. broad at the top and 7 mm. at the base. The largest specimen is represented by a fragment with the maximum breadth of 11 mm., indicating a shell about 38 mm. high.

The 8 specimens on which this description is based are constant both in form and sculpture, and the sculpture is sufficiently distinct to separate the

species easily from any described form in the American Cretaceous faunas.

Cotypes: U.S.N.M. 77604a-c; unfigured cotypes, 77605.

Locality and position: Limestone of Fredericksburg age in the eastern foothills of the Quitman Mountains near their southern end, about 16 miles south of the town of Sierra Blanca, Hudspeth County, Tex.

Cerithium kansasense Stanton, n. sp.

Plate 64, figures 5, 6

Shell small, rather slender, consisting of 8 or 10 whorls; apical angle about 20°; sides of the whorls nearly flat; suture channeled; surface marked by 3 coarse granular, revolving, equidistant ridges, with one or more very fine inconspicuous lines in each interspace, and a fourth, plain, smaller ridge that is ordinarily visible only on the subangular lower portion of the last whorl; base also marked by 6 or 8 fine revolving lines, anterior canal very short; inner lip with moderately heavy callus.

The best-preserved type, which lacks 2 or 3 whorls at the apex, consists of 8 whorls, and measures 14 mm. in height and 5.5 in greatest breadth. The species is represented by 7 specimens.

In general aspect and sculpture this species resembles *Cerithium kickapooense* Stanton very closely, but it may be distinguished from the typical form of that species by its imperforate axis, stouter form, and coarser sculpture. *Cerithium pecosense* has similar coarse granules, but lacks the intermediate fine spiral lines, and seems to have no sculpture on the base.

Holotype: U.S.N.M. 77606; unfigured paratypes, 77607.

Locality and position: Upper part of the Kiowa shale on West Bear Creek, about 11 miles northwest of Ashland, Clark County, Kans.

Cerithium? obliterato-granosum Roemer

Plate 64, figures 16, 25

1888. *Cerithium obliterato-granosum* Roemer, Palaeont. Abh., Band 4, p. 16 (294), pl. 1 (31), fig. 11.

1928. *Cerithium? obliterato-granosum* Roemer. Adkins, Texas Univ. Bull. 2838, p. 189.

Translation of the original description follows:

The moderately elongated turreted shell consists of a large number, 14 to 16, slightly convex whorls, of which the last 3 increase somewhat more rapidly in breadth than those above. In the usual state of preservation, perhaps somewhat altered by weathering, the surface of the whorls is almost smooth, but when perfectly preserved, 6 rows of small, blunt tubercles or granules are recognizable on each whorl. The aperture is obliquely oval; the outer lip sharp-edged; the inner lip formed by a rather broad deposit on the columella. At the junction of the outer and inner lips the limits are marked by a fine furrow. Below, the aperture is produced in a short but well-developed, slightly twisted canal, which, however, is seldom well preserved.

Occurrence: The species is one of the most common gastropods of the fauna, and numerous examples are at hand [from the Edwards limestone on Bartons Creek near Austin, Texas]. In most specimens the lower end of the shell with the aperture is broken off.

Among the numerous species already described from the Cretaceous strata, Sowerby's *Cerithium pustulosum* seems to be most nearly comparable, but the tubercules of the surface are much stronger and they are in only 4 rows instead of 6.

Roemer's figure, said to be of natural size, represents a shell consisting of 9 whorls, and measuring 38 mm. in height and 14 mm. in maximum breadth, with an apical angle of about 28°. In the collection here examined 9 specimens are referable to this species, but they are all imperfect and much smaller than the type. The surface of most of them is smooth, but 3 show part of the rows of granules very faintly on the last whorl.

The species is easily distinguishable from all associated species by its pupoid form and smooth convex whorls. The correctness of its reference to *Cerithium* is doubtful, but it may as well be left in that genus until better-preserved specimens showing the complete form of the aperture are obtained. The shell is rather suggestive of some of the form referred to *Pseudomelania* and *Rhabdoconcha;* and somewhat similar fossils from the Cretaceous of Brazil have been described by White (1888, pp. 158, 159, pl. 14, figs. 15–17) under the names *Vicarya? sappho* and *V.? daphne.*

Plesiotypes: U.S.N.M. 77608a–b.

Locality and position: Edwards limestone on Bartons Creek (type locality); on the Colorado River near Austin in Travis County; and near Kickapoo Springs on the west fork of Nueces River in Edwards County, Texas.

Cerithium pecosense Stanton, n. sp.

Plate 64, figures 18, 19

Shell rather large, robust, consisting of about 12 rapidly increasing whorls; apical angle 25°; sides of the whorls very gently convex, uniting to form an almost continuous regular slope; each whorl with about 10 strong, broad, rounded varices that pass entirely across the whorl from suture to suture but do not pass below the middle of the last whorl, those on contiguous whorls tending to form continuous somewhat irregular rows; interspaces slightly broader than the varices; surface also marked by 4 rather coarse spiral ridges and by numerous very fine spiral lines; base of last whorl regularly rounded, bearing a number of coarse spiral lines

and produced below in a distinct but probably short canal.

The type is a fairly well-preserved specimen, U.S.N.M. 4552, consisting of 9 whorls but defective at both extremities. It measures 52 mm. in height and 25 mm. in maximum breadth. With the apex and beak restored the height would be about 60 mm.

The smaller fragmentary specimens, U.S.N.M. 77610, from the Edwards limestone near Austin, seem to differ only in having a slightly greater number of varices, and probably belong to the same species. Two other specimens, differing somewhat from the type, have been collected from limestone of Fredericksburg age in foothills at the eastern base of Quitman Mountains about 16 miles south of the town of Sierra Blanca, Hudspeth County, Tex. The better preserved specimen, U.S.N.M. 77609, is slightly more slender than the type and has 9 narrow, prominent, widely separated costae on each whorl crossed by 5 strong spiral lines and numerous very fine lines. Additional material may prove it to be a distinct species, combining in some respects the characteristics of *Cerithium pecosense* and *C. austinense*. The specimen is shown on plate 64, figure 30.

None of the other Texan Cretaceous species seems to be very closely related to this one, though the type of sculpture is nearly the same in *Cerithium bartonense, C. shattucki,* and *C. austinense.*

Holotype: U.S.N.M. 4552.

Locality and position: The type has long been in the U. S. National Museum collection and is labeled "Pecos shoals, Texas". It is probably from the Edwards limestone, as are certainly those from Austin, Tex., which are somewhat doubtfully referred to this species.

Cerithium kickapooense Stanton, n. sp.

Plate 64, figures 9–11

Shell small, rather slender, more or less pupiform, consisting of about 15 or more whorls; angle of divergence of sides varying from about 20° at the apex to 15° or 10° in the adult shell; sides of the whorls flat or very gently convex; suture impressed, distinct; surface ornamented by 3 rather coarsely granular spiral lines alternating with much finer spiral lines, and by a few distant, irregularly arranged varices. The coarser granular lines border the suture above and below, and the third line is midway between them. The 2 interspaces each bear a finer line in the middle, and on some specimens a third fine line is visible in the sutural channel. More than half the specimens show a narrow umbilicus and a perforated axis, whereas the others are closed. The last whorl is subangular below, produced into a very short anterior canal, and marked on its base by 6 or 8 fine spiral lines.

The largest of the type specimens, which is imperfect at the apex, consist of 13 whorls and measures 17 mm. in height and 5 mm. in greatest breadth. Another specimen, consisting of 15 whorls, is 13 mm. in height and 4 mm. in maximum breadth. The species is represented by about 40 specimens preserved as calcite pseudomorphs.

The presence or absence of an umbilicus and a perforated axis would usually be considered sufficient basis for separating such forms as these, or even for referring them to different genera. But these specimens all agree so closely in general aspect and in details of sculpture, and the umbilicated specimens show so much variation, from the merest chink to a distinct open umbilicus, that I have no hesitation in referring them to a single species.

The perforated specimens resemble *Fastigiella,* except that the whorls are not convex and the canal is straight. The form and sculpture rather suggest *Bittium,* but taken altogether the most satisfactory disposition of the form seems to be to refer it to *Cerithium* used in the broadest sense.

Types: Cotypes, U.S.N.M. 77611a-c; 40 unfigured paratypes, 77612.

Locality and position: Edwards limestone on Colorado River above the mouth of Bartons Creek near Austin, Travis County; and near Kickapoo Springs on the west fork of Nueces River, Edwards County, Tex.

Cerithium kickapooense valverdense Stanton, n. var.

Plate 64, figure 24

Shell with the form and proportions of the types of the species but differing in the sculpture, which has the 3 granular spiral lines somewhat coarser and lacks entirely the alternating finer lines. The axis is imperforate in all the collected examples of the variety. Variety represented by 8 specimens.

Types: Holotype, U.S.N.M. 77613; 7 unfigured paratypes, 77614, 77615.

Locality and position: Upper part of the Devils River limestone of Washita age from the high bridge across the Pecos River, on the Galveston, Harrisburg & San Antonio Railway (Southern Pacific), 3 miles east of Shumla; and from Painted Caves on the Rio Grande near the mouth of Pecos River, Val Verde County, Tex.

Cerithium quitmanense Stanton, n. sp.

Plate 64, figures 12, 17

Shell small, rather stout, consisting of 15 or more slightly convex whorls; apical angle about 25°;

suture slighty channeled; sculpture consisting of moderately prominent, slightly curved costae, about equal in breadth to the interspaces and numbering 15 to 20 on each whorl, with a few irregularly arranged, much larger varices, crossed by 4 rather coarse, equidistant spiral lines that form well-marked tubercles at their intersections with the costae, the whole surface covered with closely arranged, fine spiral lines; full form of last whorl and aperture not known, but apparently there are several of the coarser spiral lines on the base, and the anterior canal is short.

The larger type, whose apex and base are missing, consists of 11 whorls, and measures 16.5 mm. in height and 6 mm. in greatest breadth. The smaller specimen, whose apex lacks not more than 1 or 2 whorls, is 10 mm. in height and 4 mm. in greatest breadth. The species is represented by 2 silicified specimens.

This species resembles *Cerithium pecosense* but has finer sculpture and much more numerous costae.

Cotypes: U.S.N.M. 77616a-b.

Locality and position: Limestone of Fredericksburg age in foothills at eastern base of Quitman Mountains near their southern end, about 16 miles south of the town of Sierra Blanca, Hudspeth County, Tex.

Cerithium riograndense Stanton, n. sp.

Plate 64, figures 15, 20

Shell large, robust, consisting of 12 or more short, broad whorls; apical angle 20° to 25°; sides of the whorls flattened, or very slightly convex; suture slightly impressed; surface marked by numerous low, narrow, straight costae that cross the visible portion of the whorls of the spire, and in the later stages are slightly thickened above near the suture; surface also marked by fine lines of growth and inconspicuous, impressed revolving lines; full form of the aperture not preserved, but the anterior canal is evidently short.

One of the figured types, a fragment consisting of 6 whorls, imperfect at the extremities and retaining only a little of the shell with its sculpture, is 73 mm. in height and 37 mm. in greatest breadth. Another imperfect specimen with 7 whorls is 60 mm. in height and 27 mm. in greatest breadth.

Internal molds of this species have convex whorls and a general aspect similar to *Cerithium bosquense* in the same state of preservation, but specimens retaining any considerable portion of the shell are easily differentiated specifically.

Types: Cotypes, U.S.N.M. 77617, 77619; 3 unfigured paratypes, 77618, 77620.

Locality and position: Washita group near the Rio Grande about 25 miles south of the town of Sierra Blanca, and in the pass between the two principal peaks of Sierra Blanca, Hudspeth County, Tex.; questionably near Kent, Culberson County; and near El Paso, Tex.

Cerithium? shattucki Stanton, n. sp.

Plate 64, figures 13, 14

Shell small, rather slender, consisting of 8 or 10 slightly convex whorls; apical angle 15° or more, but the divergence of the slopes decreasing in later stages of growth; suture impressed, not conspicuous; whorls most convex below the middle, slightly constricted just beneath the suture; surface marked by numerous small costae with a few distant, irregular larger varices, crossed by 4 rather prominent spiral lines that form conspicuous granules at the intersection with the costae, the interspaces each bearing 1 or 2 very fine spiral lines; full form of the aperture with its short canal not preserved.

The larger type, imperfect at both extremities, is 14 mm. in height and 6.5 mm. in greatest breadth. Its height restored is about 18 mm.

The species is rather closely related to *Cerithium bartonense* with which it is associated, but differs in its more slender form, the shape of its whorls, and in details of surface sculpture, especially in the presence of more prominent distant varices. This also may possibly be an aporrhaid rather than a *Cerithium*.

Cotypes: U.S.N.M. 77621a–b.

Locality and position: Edwards limestone on the Colorado River above the mouth of Bartons Creek near Austin, Travis County, Tex.

Cerithium coloradense Stanton, n. sp.

Plate 64, figures 21, 23

Shell small, slender, subcylindrical, consisting of at least 12 or 15 whorls; apical angle about 9°; suture impressed, distinct; sides of the whorls very slightly convex; last whorl rounded below and produced into a short anterior canal; surface ornamented by rather prominent tubercles arranged so that they form 3 spiral rows, and also more obvious vertical rows, about 14 on each whorl, the tubercles being elongated in the direction parallel to the axis of the shell. These vertical rows of tubercles coincide more or less closely with those on adjacent whorls, producing the general effect of vertical costation.

The type specimen, which lacks several whorls of the spire, consists of 9 whorls, and measures 17 mm. in height and 4 mm. in greatest breadth. With the apex restored the height would be about 27 mm. Two other fragments that belong to the same species indicate a considerably larger size.

The slender form of this species suggests its reference to the Nerineidae, but it does not possess a posterior sinus and slit-band or internal folds. Its characteristic surface sculpture and slender proportions easily separate it from all the associated forms.

Types: Holotype, U.S.N.M. 77622; 2 unfigured paratypes, 77623.

Locality and position: Edwards limestone on Colorado River near Austin, Travis County, Tex.

Genus TRIFORIS Deshayes, 1824

Triforis? antiquus Stanton, n. sp.

Plate 55, figures 17, 18

Shell small, slender, sinistral, consisting of about 12 convex whorls; apical angle 10° to 12°; surface of each whorl bearing near the middle 2 coarse spiral lines, with commonly another finer line above, and in some specimens a fourth fine line visible below near the suture, crossed by about 12 longitudinal costae or varices that show some tendency to be arranged in continuous rows, so that the entire surface under a lens has a coarsely reticulate appearance; last whorl rounded below and produced into a short canal, the full form of which is unknown.

The largest of the type specimens, consisting of 12 whorls, measures 10 mm. in height and 3 mm. in greatest breadth. Species represented by 6 specimens.

In size, form, sinistral habit, and type of sculpture this little species closely resembles some of the Recent forms of *Triforis*, but its reference to that genus is somewhat doubtful because the full form of the aperture is not preserved, consequently it has not been determined whether it has the closed anterior canal characteristic of the genus. Another fact that causes some hesitation in referring it to that genus is that the earliest species of *Triforis* hitherto reported are from the Eocene, whereas this form comes from strata well down in the Cretaceous.

Types: Cotypes, U.S.N.M. 103117a-b; 4 unfigured paratypes, 103118.

Locality and position: Edwards limestone on Colorado River above the mouth of Bartons Creek near Austin, Travis County, Tex.

Genus ANCHURA Conrad, 1860

Anchura (Drepanocheilus) kiowana Cragin

Plate 65, figures 6–10

1895. *Anchura kiowana* Cragin, Colorado Coll. Studies, Ann. Pub. 5, p. 66.
1895. *Anchura kiowana* Cragin. Stanton, Am. Jour. Sci., 3d ser., vol. 50, p. 217.
1923. *Anchura kiowana* Cragin. Reeside, U. S. Geol. Survey Prof. Paper 131, p. 204, pl. 48, figs. 6–8.
1924. *Anchura kiowana* Cragin. Twenhofel, Kansas Geol. Survey Bull. 9, p. 53, pl. 9, figs. 2, 3.
1928. *Anchura kiowana* Cragin. Adkins, Texas Univ. Bull. 2838, p. 190.
1940. *Anchura kiowana* Cragin. Stainbrook, Texas Univ. Bull. 3945, p. 713, pl. 33, figs. 4–6.

Shell small, rather stout, consisting of 6 or 7 convex whorls; apical angle about 25°; suture impressed; each whorl with 18 to 20 (in some specimens more) moderately prominent curved costae which do not extend below the middle of the last whorl and are absent from the expanded outer lip; surface also marked by a number of fine revolving lines, of which about 10 are visible on the spire, and an equal number of somewhat stronger lines on the lower half of the last whorl; aperture long and rather narrow, the outer lip prolonged backward on the spire to the penultimate whorl, where it is considerably thickened; anterior canal short and broad; inner lip with a moderately heavy callus which is broadest in its lower two-thirds; outer lip considerably expanded, its middle portion produced almost at right angles to the axis of the shell in a rather narrow, carinated, subfalcate process, with the outline concave above, bluntly pointed at the upturned outer extremity and broadly convex below, passing by a sinuous curve into the short canal; interior of the subfalcate process grooved as in *Anchura mudgeana* White.

One of the figured specimens, larger than the average, measures 24 mm. in height, and 17 mm. in greatest breadth including the wing; breadth of last whorl exclusive of wing 10 mm. Corresponding dimensions of the best-preserved type in Cragin's collection are 20 mm., 15.5 mm., and 8.5 mm.

In the original description of the species Cragin compared it with *Anchura ruida* White (1876, p. 120; 1879, p. 312, pl. 7, figs. 4a-b), which is about the same size but differs considerably in details of outline and especially of sculpture. A much more closely related species is *A. mudgeana* White, as a comparison of the descriptions and figures will show. (See pl. 65, figs. 1–4.) The relationship seems to be so close that the present form might be treated as a mere variety of the Texan species if their strict contemporaneity could be proved. The average *Anchura kiowana* is considerably smaller and more slender, the costae are finer and more numerous, and the wing is much narrower, more distinctly carinate, and more falcate in form. The outer lip is also less thickened. As in all species of this family the form of the outer lip differs greatly in different stages of growth, and there seems to be some variation in adult shells.

Types: Cotypes, U.S.N.M. 32673 (9 specimens);

figured plesiotypes, 77562, 77563a–b; cotype figured on plate 65, figure 6, is probably lost.

Locality and position: Species first reported from the Kiowa shale near Belvidere, Kiowa County, and from equivalent beds in Clark County, Kans. Other specimens have been obtained from the Kiowa shale at Black Hill four miles west of Sun City, and near Belvidere, Kans.; and from the Kiamichi shale near Tahoka, Lynn County, Tex.

Anchura (Drepanocheilus) kiowana marquettensis Stanton, n. var.

Plate 65, figures 5, 11

This variety is in some respects intermediate between *Anchura kiowana* and *A. mudgeana,* but is connected with *A. kiowana* by the more important characters. Its winglike outer lip is like that of typical *A. kiowana,* relatively thin and sickle-shaped with an acutely pointed outer extremity, whereas the revolving lines are fine and closely arranged as in *A. mudgeana.* Some of the specimens are as large as the smaller examples of *A. mudgeana.* The relative stoutness of form varies somewhat, specimens from Brookville, Kans., being slightly more slender than those from Marquette.

One of the figured specimens measures 21 mm. in height, and 10 mm. in breadth exclusive of the expanded wing, 16 mm. inclusive of the wing. The other has the same height and is 1 mm. broader. Corresponding measurements of a large specimen from Brookville are 34 mm., 13 mm., and 27 mm.

Cotypes: U.S.N.M. 77654a–b.

Locality and position: Mentor formation 4½ miles southwest of Marquette, Kans., and equivalent beds at Brookville, Kans.

Anchura (Drepanocheilus) mudgeana White

Plate 65, figures 1–4

1879. *Anchura (Drepanocheilus) mudgeana* White, U. S. Geol. and Geog. Survey Terr. 11th Ann. Rept., p. 312, pl. 7, figs. 3a, 3b.

1920. *Anchura mudgeana* White. Adkins, Texas Univ. Bull. 1856, p. 139, pl. 10, figs. 39, 40.

1928. *Anchura mudgeana* White. Adkins, Texas Univ. Bull. 2838, p. 190.

Shell of medium size, rather stout, consisting of 8 to 10 convex whorls; apical angle about 30°; suture strongly impressed; each whorl marked with about 15 prominent costae which are distinctly curved and somewhat oblique on the earlier whorls and become more nearly straight and vertical on the later whorls, passing entirely across the visible portion of the whorls of the spire but confined to the upper half of the last whorl and not present on the expanded outer lip where they are replaced by strongly curved wrinkles or growth lines; surface also marked with numerous fine revolving lines, 15 to 18 of which are visible on the spire, and about as many more on the basal half of the last whorl, all of them more widely separated and larger on the expanded outer lip than elsewhere; aperture long and narrow, the outer lip prolonged backward on the spire to the penultimate whorl; anterior canal very short and broad, slightly emarginate at the extremity; inner lip forming a heavy callus on the columella, especialy prominent on the lower two-thirds of the aperture; outer lip broadly expanded, the middle third produced in a subquadrate wing with its outer margin greatly thickened and bluntly pointed, the lower angle broadly rounded; interior of the wing with a shallow curved groove terminating at the upper external angle and corresponding in position with a faintly marked ridge on the back of the wing; outline of outer lip deeply concave above, nearly straight and obliquely retreating along outer margin of wing, broadly concave below, and then passing by a gentle convex curve to the slight notch at the anterior end.

The original types are rather below the average size of the species; one of them measures 27 mm. in height, 11 mm. in breadth of last whorl exclusive of wing, 18 mm. inclusive of wing, 16 mm. in height of aperture. In the largest specimen seen the corresponding dimensions are 35, 13, 25, and 21 mm. The species is represented by several hundred specimens.

As White pointed out in the original description, this species is intermediate in some respects between *Anchura* or *Alaria* and *Aporrhais.* In fact it resembles *Aporrhais singleyi* (p. 106) more closely than it resembles any species of the typical section of *Anchura.* The only closely related species with which I am acquainted is *Anchura kiowana* Cragin, which is somewhat smaller, more slender, and has a much narrower and more distinctly carinated wing, so that the form may be distinguished though the differences may not deserve more than varietal rank. *Anchura monilifera* Gabb (1869, p. 262, pl. 35, fig. 7), from the beds of Fredericksburg age near Arivechi, Sonora, Mexico, has a more slender form and different outer lip which distinguish it from *A. mudgeana.*

Types: Cotypes, U.S.N.M. 8086; plesiotypes, 77565–67.

Gutta-percha casts of White's cotypes are available in the National Museum, but the original external mold of the type figured by him (1879, p. 312, pl. 7, fig. 3b) is missing.

Locality and position: Pawpaw sand in the vicinity of Denison, Grayson County; and 4½ miles northeast of Gainesville, Cooke County, Tex.

Anchura quitmanensis Stanton, n. sp.

Plate 65, figures 14, 15

Shell of medium size, rather slender, consisting of about 10 convex whorls; apical angle about 25°; each whorl with about 15 slightly curved, narrow but prominent costae which rapidly become shorter and broader on the outer half of the last whorl of the adult, until the last 2 or 3 near the expanded outer lip are represented by large tubercles; surface also marked by closely arranged fine revolving lines, of which 15 or more are visible on the spire; aperture moderately long, truncate behind, without any tendency to form a posterior canal; anterior canal rather long and narrow; callus of inner lip not very heavy; posterior portion of outer lip extended in a slender, winglike expansion slightly curved upward (backward) and bearing a well-marked carina extending back across about one-third of the last whorl, giving it a distinctly shouldered appearance; wing and anterior portion of last whorl covered with fine spiral lines like those on the spire; outer lip in front of the wing slightly sinuous.

An average specimen, one of the figured types, measures 37 mm. in height, and 13 mm. in greatest breadth exclusive of the wing, about 13 mm. inclusive of wing. Species represented by about 30 imperfect specimens.

This species has some resemblance to *Anchura kiowana* and *A. mudgeana*. It differs from both in its relatively finer sculpture, much longer anterior canal, form and relative proportions of the outer lip, more posterior winglike expansion, and in the more prominent and higher carina on its last whorl.

Types: Cotypes, U.S.N.M. 77568a–b; 14 unfigured paratypes, 77569.

Locality and position: Near base of Quitman formation of Taff in the Trinity group 1 mile south of Quitman Canyon, Hudspeth County, Tex.

Anchura? sp.

An undescribed species of *Anchura* or *Aporrhais* in the Goodland limestone is represented by several imperfect specimens, U.S.N.M. 77570, from a locality 15½ miles southwest of Gainesville, Tex. They are not sufficiently complete for illustration or full description, but are evidently distinct from all the species here described. The form is small and slender, consisting of 9 or 10 convex whorls ornamented by numerous small curved costae crossed by closely arranged fine revolving lines. The middle of the last whorl is marked by a narrow, prominent carina passing out on the wing, the full form of which is not known. The largest specimen is 21 mm. in height, and the apical angle is about 15°.

Genus VANIKORO Quoy and Gaim, 1832

Vanikoro? propinqua Cragin

1895. *Vanikoro propinqua* Cragin, Colorado Coll. Studies Ann. Pub. 5, p. 65.

Original description:

Shell rather small, depressed-subglobose, thin or of moderate thickness; whorls four, convex, those of the spire not prominently so; body-whorl greatly enlarged, rounded, somewhat M. and H.; spire rather low, proportioned almost exactly as in *V. ambigua;* narrower and more elevated than in *V. ambigua* suture not deeply impressed; axis (? perforate); aperture rhomboidal-ovate, angular above obtuse below; ornamentation unknown.

Dimensions: Somewhat smaller than *V. ambigua* M. and H., the exact dimensions not mensurable owing to the imperfection of the labial region. Angle of slopes of spire a little less than 90 degrees.

Occurrence: In Nos. 3–4 of the Belvidere section of the Kiowa shales near Belvidere, Kansas. I have seen but one specimen.

This shell bears a striking resemblance in form to that of *V. ambigua* as figured by Meek in Vol. IX of the Hayden U. S. Geological Survey, differing from it chiefly by the relatively somewhat more elevated body-whorl and aperture and the smaller size. The surface of the shell is somewhat weather-worn in the type and does not reveal its original sculpture.

The type specimen, now lost,[4] was too imperfect for accurate identification, but it apparently had an anterior canal and an umbilicus, and if so it could not be a *Vanikoro*. The resemblance to Meek and Hayden's species (renamed *V. haydeni* Cossmann) was only superficial.

Genus APORRHAIS Da Costa, 1778

Aporrhais brittsi Stanton, n. sp.

Plate 65, figures 22, 23

Shell rather large, resembling *Aporrhais singleyi* Stanton in general form; apical angle about 40°; whorls of spire moderately convex, subangular in the middle and bearing a row of distant rounded tubercles on the angulation; no revolving sculpture visible on the type, which, however, is so eroded that fine lines may have been removed; last whorl with 2 very prominent rounded carinae that begin abruptly on the back of the shell nearly opposite the aperture, at points so placed that they divide the distance from the last suture to the anterior end into 3 subequal parts; from these points the carinae diverge slightly as they pass out to projecting angles on the margin of the broadly expanded and very thick outer lip or wing, which has a third, smaller projection on the upper margin from which a small ridge passes back a short distance on the shell;

[4] Cragin reports in a letter dated April 16, 1901, that the type specimen was destroyed by fire.

posterior canal closely applied to last 2 whorls of spire; anterior canal not preserved; aperture long and narrow; inner lip with heavy callus spreading over last 3 whorls.

The type, imperfect at both extremities, measures 34 mm. in height, and 18 mm. in greatest breadth exclusive of the expanded wing, 31 mm. inclusive of wing. With the apex of the spire and the anterior canal restored the height would be about 40 mm.

The most closely related species is *Aporrhais singleyi*, with which *A. brittsi* is associated; but the much larger size of *A. brittsi*, and differences in details of form and sculpture (p. 106) distinguish them easily.

The specific name is given in honor of Dr. John H. Britts, former resident of Clinton, Mo., who obtained the type and only known specimen and presented it to the U. S. National Museum.

Holotype: U.S.N.M. 77571.

Locality and position: Edwards limestone near Austin, Travis County, Tex.

Aporrhais? elpasensis Stanton, n. sp.

Plate 66, figures 10, 12

Mold large, stout fusiform, consisting of about 6 whorls; apical angle 55°; sides of the spire whorls moderately convex; suture not conspicuously channeled, even in the mold; outer third of last whorl broadly flattened and constricted in the middle; aperture long and narrow; full form and extent of anterior canal and expanded outer lip not known; surface probably nearly or quite smooth, as no traces of sculpture are retained on the mold.

The type specimen, which lacks the apex of the spire and the canal, measures 70 mm. in height and 54 mm. in greatest breadth. Another more distorted specimen associated with it is somewhat larger.

Although it is impracticable to identify the genus accurately from such imperfect material, the general features of this form, so far as preserved, are much like those of *A. tarrantensis* and *A. subfusiformis*, from both of which it is easily distinguishable, however, by its much stouter form.

The only other species in the Comanche fauna suggested by it is *Harpagodes shumardi* (Hill) (1889a, p. 5, pl. 2; Shattuck, 1903, p. 32, pl. 21) which if deprived of its winglike expansion would have a similar stout form, but its spire is more slender and its last whorl relatively longer.

Types: Holotype, U.S.N.M. 77572; unfigured paratype, 77573.

Locality and position: Highest fossiliferous bed of the Comanche series on the Rio Grande, 4 miles above El Paso, Tex.

Aporrhais? kentensis Stanton, n. sp.

Plate 65, figures 17–19

Shell small, stout fusiform, consisting of not more than 5 or 6 whorls; apical angle about 55°; suture inconspicuous; whorls of spire gently convex, almost smooth, in the mold showing only faint traces of very fine closely arranged spiral lines; last whorl relatively large, convex, produced below in a short canal, and bearing on the upper third a rather prominent carina, above which the surface, like the surface of the spire, is marked only by inconspicuous spiral striae, whereas the portion below the carina bears 8 to 10 strong spiral lines; aperture long and narrow; inner lip forming a heavy callus; outer lip evidently expanded, but its full form not known.

The larger figured specimen measures 21 mm. in height and 16 mm. in greatest breadth; with the canal and the apex of the spire restored the height would be about 27 mm. The other figured specimen, consisting of only the last whorl and part of the preceding whorl, measures 19 mm. in height and 14 mm. in breadth. Species represented by 6 internal molds that retain more or less of the sculpture.

In general form and sculpture, so far as preserved, this species resembles *Aporrhais histochila* Gardner (1875, p. 294, pl. 7, figs. 5, 6), from the Upper Greensand and Gault of England, except that it has only 1 carina instead of 2 on the last whorl. A somewhat similar bicarinate form was found in the Quitman formation of Taff 1 mile south of Quitman Canyon. It is evidently distinct from the present species, but as it is represented by only a single imperfect specimen it has not been described.

Cotypes: U.S.N.M. 77574a–b.

Locality and position: Washita group 1 mile southeast of Kent in Culberson County, and in the gap between the principal peaks of the Sierra Blanca, Hudspeth County, Tex. Also from the Comanche Peak limestone at Seven Knobs, 5 miles southeast of Glen Rose, Somervell County; and at White Nose Peak west of Oatmanville near Austin, Travis County, Tex.

Aporrhais nuecensis Stanton, n. sp.

Plate 66, figures 7, 9

Shell rather large, robust, consisting of 7 or 8 whorls; apical angle about 25°; suture inconspicuous; whorls of the spire more or less angular in the middle with a slightly concave slope to the suture above and below, and bearing on the angle rather coarse vertically elongated tubercles, or short costae, of which there are about 10 or 12 on each whorl; surface also apparently marked by fine

spiral striae not clearly preserved on the types; last whorl with a strong bifurcated carina on the back, sending a branch to each of the two larger digitations of the outer lip, and with a second ridge or carina not so well marked nor so constant, below and diverging from the principal carina; tubercles and costae apparently obsolete on the last whorl, and finer sculpture not preserved; posterior canal extending up the spire to the antepenultimate whorl; anterior canal comparatively short and narrow, slightly curved; outer lip broad, palmately spreading with 3 large, rather broad digitations, of which the upper one is the longest and forms an angle of about 30° with the spire, the middle one forming an angle of about 70°, and the shortest one below directed slightly downward and a little nearer to the beak than to the middle digitation; callus on the columella apparently heavy.

One of the types, an average specimen lacking the apex of the spire and the whole of the beak, measures 48 mm. in height and 20 mm. in greatest breadth, exclusive of the expanded outer lip which would add 33 mm. to the breadth. With the missing portions restored the height would be about 58 mm.

The species is represented by about 25 more or less imperfect specimens preserved in an impure limestone. Some specimens are mere fragmentary internal molds of the spire, but others are impressions of nearly all the expanded lip, or traces of external sculpture. No specimen shows the full form. It may be that some of the numerous internal molds from central Texas that have been referred to other species really belong to this one, but all the associated specimens retaining any of the sculpture show specific differences.

No described American species outside the Comanche series shows very close relationship with *Aporrhais nuecensis*. Similar forms from both the Jurassic and the Cretaceous in Europe are described, but I have seen none figured that could be considered identical.

Types: Holotype, U.S.N.M. 77575; paratype, 77576; unfigured paratypes, 77577, 77578.

Locality and position: Comanche Peak limestone from bed of west fork of Nueces River at Kickapoo Springs, Edwards County, Tex.; and from the banks of the same stream 1 mile below.

Aporrhais singleyi Stanton, n. sp.

Plate 66, figures 1–3, 11

Shell small, stout, consisting of 6 or 7 convex whorls; apical angle about 40°; suture deeply impressed; whorls of the spire increasing regularly in size, except the last one in which the rate of increase is so diminished that when viewed from the back it has a constricted appearance, looking smaller than the preceding whorl; whorls strongly convex, a tendency to become angulated near the middle particularly pronounced on the last whorl; each whorl marked by 15 to 20 rather prominent, slightly curved costae which are strongest and more or less tuberculated in the middle where they cross the spiral angulation or carina, and are almost obsolete on the lower part of the last whorl; costae also crossed by variable fine spiral lines of which 10 or 12 are visible on the spire; 2 or more spiral lines become enlarged below the principal angulation of the last whorl, and pass out on the wing as more or less prominent minor projections or digitations; outer lip very thick, expanded in a broad subquadrate wing which is produced at the upper exterior angle in a short, pointed, obliquely ascending digitation, grooved within and carinated without; outer border emarginate below the digitation, then obliquely descending with 2 more emarginations, more pronounced in immature shells than in adult shells, then passing by a gentle curve into the broad, short anterior canal; posterior canal not developed until the shell is almost fully adult, when it extends up the spire across 2 to 4 whorls, and in some specimens becomes free at the extremity; inner lip with a heavy deposit of callus.

An average specimen measures 19 mm. in height and 9 mm. in greatest breadth exclusive of the alate outer lip, or 15 mm. with the alation.

The species is named in honor of Mr. J. A. Singley, who found the first known example of the species near Austin, Tex. Species represented by about 38 specimens, of which 35 are from the type locality.

Types: Holotype, U.S.N.M. 22985; paratypes, 77579a–b; unfigured paratypes, 77580.

Locality and position: Edwards limestone near Austin in Travis County, and on the west fork of Nueces River near Kickapoo Springs in Edwards County, Tex. Goodland limestone 16½ miles southwest of Gainesville in Cooke County; and 1 mile east of the southern end of Quitman Mountains in Hudspeth County, Tex.

Aporrhais? subfusiformis (Shumard)

Plate 65, figures 20, 21

1853. *Eulima subfusiformis* Shumard, in R. B. Marcy, 32d Cong., 2d sess., S. Doc. 54, p. 208, pl. 4, fig. 8.
1928. *Rostellaria? subfusiformis* Shumard. Adkins, 1928, Texas Univ. Bull. 2838, p. 192.

Original description:

Shell subfusiform, elongate, smooth, spire produced, regularly conical; whorls about six, broad, very slightly convex; suture rather shallow, linear; aperture simple, subovate; body whorl obtusely angulated. Length 2.8 inches width 1.10 inch.

The collection contains only a single specimen of the cast of this species, and that badly water-worn. It was found at Camp No. 4, Cross Timbers, Texas.

Several internal molds, which comparison with the original description and figures shows almost certainly to belong to this species, were collected in the Comanche Peak formation at Benbrook near Fort Worth, and at Chalk Mountain 12 miles southwest of Glen Rose, Tex. They are associated with *Aporrhais tarrantensis* Stanton, and although they retain no traces of surface sculpture and only enough of the last whorl to show that it had an expanded outer lip, it is probable that they belong to the same genus.

The mold is large, robust, consisting of 6 or 7 whorls; apical angle about 35°; whorls moderately convex, in most specimens somewhat more so than indicated by the figure of the type; last whorl obtusely angulated above the middle, generally with a second obscure ridge below the middle, the 2 ridges separated by a broad, shallow constriction.

The largest specimen seen, lacking the apex of the spire and the beak, measures 82 mm. in height and 22 mm. in greatest breadth. Other examples are relatively somewhat broader. Species represented by 14 specimens.

This species, although known only in the form of molds, is readily distinguished from *Aporrhais tarrantensis* by its much greater size.

In George G. Shumard's "Geology of Western Texas," published by the State in 1886, this species is several times listed as *Pterodonta subfusiformis*, probably on the authority of B. F. Shumard, for whom the species is named, who was state geologist of Texas prior to 1860 when the report was written. This reference tends to confirm the identification of the species now made.

Plesiotypes: U.S.N.M. 77581, 77582.

Locality and position: Rather common in the Washita group at Kent in Culberson County; also from Comanche Peak formation at Benbrook near Fort Worth in Tarrant County, and at Chalk Mountain in Erath County, 12 miles southwest of Glen Rose, Tex.

Aporrhais tarrantensis Stanton, n. sp.

Plate 66, figures 4–6, 8

1849. *Rostellaria* sp. ind. Roemer, Texas, p. 414.
1852. *Rostellaria* sp. ind. Roemer, Die Kreidebildungen von Texas, p. 38.

Shell larger than *Aporrhais nuecensis* and of the same general form and robust habit, consisting of 8 or more whorls; apical angle 20° to 25°; suture impressed; whorls of the spire regularly convex, each bearing about 20 small, strongly curved costae crossed by about 15 moderately coarse spiral lines; last whorl bearing a large subcarinate ridge considerably above the middle and passing out to the principal digitation of the outer lip, also commonly bearing a second less conspicuous ridge a little above the middle; on internal molds a broad, rather deep furrow extends parallel with the axis from the principal carina about halfway to the anterior end and marks the beginning of the expanded outer lip; posterior canal short, attached to the penultimate whorl and sometimes to the preceding one; anterior canal relatively short and straight; full form of the palmately spreading outer lip not known, but probably very nearly like that of *A. nuecensis* Stanton; at least the broadly expanded portion is similar, and the anterior and posterior digitations have about the same relative positions; columella with a very heavy callus which is thickest just below the middle.

The best preserved of the types, a specimen of about average size, imperfect at both extremities, measures 61 mm. in height, and 25 mm. in maximum breadth exclusive of the expanded wing; with the apex and beak restored the height would be about 72 mm.

This species is one of the most common fossils of the Fredericksburg group and is the most abundant representative of the Aporrhaidae in the Comanche series. Several hundred specimens in the Geological Survey and National Museum collections are provisionally referred to it, but they are nearly all more or less imperfect internal molds, none showing the full form of the outer lip, and many without any traces of external sculpture.

The most closely related Comanche forms are *Aporrhais nuecensis* and *A. travisensis*, from both of which it may be easily distinguished, if any of the sculpture is preserved, by its finer and more numerous costae and more prominent spiral lines; the form of the outer lip also is clearly different from that of *A. travisensis*.

Types: Holotype, U.S.N.M. 77583; paratypes, 77584, 77585.

Locality and position: The Goodland limestone near Marshall's farm about 10 miles northwest of Denison in Grayson County (type locality); Comanche Peak limestone, and probably also the Walnut formation, 8 or 10 miles west of Fort Worth near Benbrook in Tarrant County; Comanche Peak limestone at Comanche Peak in Travis County, Seven Knobs in Somervell County, Chalk Mountain in Erath County, near Fredericksburg in Gillespie County, at numerous localities near Austin in Travis County, and in the Fredericksburg group near El Paso, Tex.; Fort Worth limestone at Fort Worth in Tarrant County, and near Bartons Springs in

the neighborhood of Austin, Travis County; Washita group near Kent in Culberson County, Tex. Thus it seems to range through the Fredericksburg group into the Washita.

Aporrhais travisensis Stanton, n. sp.

Plate 65, figures 12, 13, 16

Shell of moderate size, consisting of 7 or 8 whorls; apical angle about 25°; suture impressed; whorls of the spire strongly convex, each bearing about 8 broad, prominent, straight costae about equalling the interspaces in width; costae on the last whorl confined to the upper portion, but having about the same length and form as on the whorls of the spire; no spiral sculpture observed; last whorl not so large relatively as in *Aporrhais nuecensis* Stanton and *A. tarrantensis* Stanton, its lower portion apparently smooth; posterior canal short, extending up the spire to the antepenultimate whorl; anterior canal or beak moderately long, straight and broad; outer lip expanded in a rather broad wing, produced at the upper external angle in a slender, ascending point from which the outer margin descends obliquely inward; outline not perfectly preserved below, but apparently without other digitations, and passing with a broadly rounded curve into the beak; columella with apparently a thin callus.

An average specimen with apex and beak restored measures about 52 mm. in height, and 19 mm. in greatest breadth, exclusive of the expanded outer lip which is about 10 mm. wide. Species represented by 14 fragmentary specimens.

The nearest relatives of this species in the Comanche series are *Aporrhais nuecensis* and *A. tarrantensis*, all three being very similar when only internal molds of the spires are compared. *Aporrhais travisensis*, however, is the smallest of the three, and its less ventricose last whorl gives it a more slender appearance, although the apical angles of the spires are very nearly equal. The outer lip also has a much simpler form, but this portion is not ordinarily preserved for comparison. The best criterion for separating the species is the sculpture, which can usually be found sufficiently well preserved on some of the molds. Although *A. travisensis* is the smallest species it has the coarsest sculpture, with not more than 8 broad costae on each whorl, whereas *A. nuecensis* has 10 or 12, and *A. tarrantensis* has about 20.

Types: Holotype, U.S.N.M. 77587a; figured paratypes, 77586, 77587b; unfigured paratypes, 77588, 77589.

Locality and position: In the lower beds of the Trinity group on Cow Creek, 1 to 2 miles below Travis Peak Post Office, Travis County, Tex.

Genus ROSTELLARIA Lamarck, 1799

Rostellaria monopleurophila Roemer

1888. *Rostellaria monopleurophila* Roemer, Palaeont. Abh., Band 4, p. 294, pl. 33, figs. 3a, 3b.
1928. *Rostellaria monopleurophila* Roemer. Adkins, Texas Univ. Bull. 2838, p. 192.

Translation of original description:

Shell spindle-shaped, smooth; anterior canal moderately long, somewhat curved; outer lip of the mouth expanded in a large, broad, erectly spreading, entire margined wing which as a thin lamella is attached above to the spire and extends up to its middle; inner lip of the mouth with more or less callus deposit; somewhat more distant from the mouth on the last whorl, or even on its outer surface, an irregular elevation or rounded tubercle. The more or less distinctly marked ridge-like elevation on the last whorl gives the shell a certain irregular appearance. The lack of all surface sculpture distinguishes the species from most of the otherwise comparable Cretaceous species.

Occurrence: Six specimens are more or less perfectly preserved [from the Edwards limestone on Bartons Creek, near Austin, Tex.].

Roemer's figures, which are presumably natural size, represent a shell with an apical angle of 30°, measuring 90 mm. in height, of which the last whorl forms nearly two-thirds, and 25 mm. in greatest breadth exclusive of the wing, or 44 mm. including the expanded wing.

Not even a fragment of this species has been found in any of the large collections of calcified fossils obtained from the Edwards limestone on Bartons Creek and at other localities in the neighborhood of Austin, and Roemer's description and figures must be depended upon for knowledge of the species. Judging from these, the species probably belongs to the subgenus *Hippochrenes* and is one of the earliest representatives of the group.

Genus FALSIFUSUS Grabau, 1904

Falsifusus? blancensis Stanton, n. sp.

Plate 55, figures 27, 29

Shell large, rather robust, with ventricose whorls; apical angle apparently about 30°; last whorl abruptly contracted below and produced in a long anterior canal; surface marked by prominent spiral ridges, about 6 of which are visible on the spire, alternating with much smaller lines, crossed only by lines of growth; sculpture of the lower part of last whorl similar to that of the spire. The spiral ridges on the imperfectly preserved type are somewhat broken, and they were probably more or less beaded or tuberculate when well preserved.

The type, which is a fragment consisting of 1½ whorls, including the larger part of the anterior canal, measures 68 mm. in height and 39 mm. in greatest breadth.

With such a fragment it is not possible to give all the specific characteristics, nor to be certain of the generic reference, but enough of the form and sculpture are retained to make identification easy by means of the figure if better material is found, and it is therefore thought desirable to name it. No similar species is known in the American Lower Cretaceous.

Holotype: U.S.N.M. 77624.

Locality and position: Washita group in the pass between the north and south peaks of Sierra Blanca, Hudspeth County, Tex.

Falsifusus? gainesvillensis Stanton, n. sp.

Plate 55, figure 19

Shell rather small, consisting of 6 or 8 slightly convex whorls, of which the last constitutes more than half the length of the shell; apical angle about 30°; surface of each whorl marked by 9 or 10 moderately prominent, rounded costae that are crossed by numerous spiral threads, of which 11 or 12 are visible on the spire, and by a few finer intercalated lines. The costae do not extend below the middle of the last whorl, but the spiral sculpture covers the whole surface. The canal is not complete on the type, but evidently it is rather short.

The type is 42 mm. in height and 16 mm. in breadth.

The only specimen is an impression of the dorsal surface showing very perfectly the details of sculpture and almost the complete form, but as the aperture and internal structure are unknown, the generic reference is only tentative. It may be a *Fasciolaria* or a *Latirus*.

No closely related species are in the Comanche fauna. The only one with which it need be compared is *Fusus? pedernalis* Roemer (1852, p. 38, pl. 4, figs. 13a-b), which has a somewhat more robust form, much more convex whorls, and coarser spiral sculpture.

Holotype: U.S.N.M. 77625.

Locality and position: Pawpaw, 4½ miles northeast of Gainesville, Cooke County, Tex.

Genus CANCELLARIA Lamarck, 1799

Cancellaria? medicinensis (Cragin)

Plate 55, figures 15, 16

1894. *Petersia medicinensis* Cragin, Am. Geologist, vol. 14, p. 11.

1924. *Petersia medicinensis* Cragin. Twenhofel, Kansas Geol. Survey Bull. 9, p. 60.

Shell of medium size, consisting of about 5 convex whorls, of which the last comprises more than half the height; apical angle about 50°; suture impressed; whorls distinctly shouldered, each bearing about 14 prominent, narrow costae that fade out below the middle of the last whorl; surface also marked by 25 or more threadlike spiral lines of which only 7 or 8 are visible on the spire; anterior canal short, broad, and distinctly notched; aperture elongate-subquadrate, with a conspicuous posterior emargination on the shoulder of the whorl; inner lip forming a thin callus with several small denticles above and 2 prominent columellar plaits just below the middle; outer lip with simple, sharp margin, but thickened within and bearing 7 or 8 denticles.

Height 21 mm., greatest breadth 11.5 mm., height of aperture 13 mm. The description and measurements are taken from one of the 2 types, a very well-preserved specimen. The other type is a fragment which Professor Cragin said belonged to a shell about 50 mm. high. Another imperfect specimen, U.S.N.M. 77598, in the Geological Survey collection, is 36 mm. in height.

This interesting and well-marked species seems to have no close relatives in American Mesozoic faunas, and its generic position has not been very satisfactorily determined. It certainly does not show the distinctive characteristics of *Petersia*, the Jurassic genus to which Professor Cragin referred it. It seems to me more nearly related to some of the modern forms of *Cancellaria*, though it also has a superficial resemblance to some members of the Columbellidae.

Types: Cragin's types were borrowed by the writer and returned to Colorado College at Colorado Springs, Colo. They are probably now lost. Plesiotype 77598 is in the U. S. National Museum.

Genus ACTAEONELLA D'Orbigny, 1842

Actaeonella dolium Roemer

Plate 67, figures 1, 3, 4, 7, 10–12

1849. *Actaeonella dolium* Roemer, Texas, p. 411.

1852. *Actaeonella dolium* Roemer, Die Kreidebildungen von Texas, p. 43, pl. 4, fig. 4.

1928. *Volvulina texana* (Roemer) Adkins, Texas Univ. Bull. 2838, p. 196.

Shell large, stout fusiform or subovate, convolute so that the spire is completely concealed; greatest breadth near the middle, the shell sloping rapidly to the posterior end which has an apical angle in the adult of about 80°; anterior end much broader, and in large examples apparently with a narrow umbilicus, though the material studied is too imperfect to show the full form of the anterior end or to prove the presence of an umbilicus, which is certainly absent in small specimens; surface nearly smooth, showing only fine, slightly curved growth lines, and in one specimen a few faint impressed revolving striae; inner lip prominent toward the front and

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bearing 3 moderately prominent spiral folds, of which the anterior in some specimens is very feebly developed, especially in large specimens.

The ratio of height to breadth is about 3 to 2. Roemer's original figure, which is said to be natural size, measures 54 mm. in height and 35.5 mm. in maximum breadth, and he mentions fragments indicating specimens double that size. Corresponding dimensions of 2 specimens in the National Museum, plesiotypes 8306a-b from Bell County, Tex. (see pl. 67, figs. 1, 4), are 52, 34, 55, and 39 mm., respectively. These specimens are very similar to Roemer's figure. A large example of about the same form, plesiotype 18802, is from Lampasas County, Tex.

A large suite of specimens from Hudspeth County, Tex., near the town of Sierra Blanca, includes all sizes, the largest measuring 87 mm. in height and 60 mm. in greatest breadth. They differ somewhat from the typical form, the larger specimens especially being more distinctly ovate in form and having a greater apical angle and less convex sides. Possibly they should be separated as a distinct variety if not a species, but as none of the specimens is sufficiently perfect to show the full form, and as they differ considerably among themselves, I have considered it best to refer them to *Actaeonella dolium*. The small specimens were mostly obtained by breaking the outer whorls from larger specimens.

The larger size and much more robust form easily separate *Actaeonella dolium* Roemer from *A. pecosensis*, n. sp., and also distinguish it from the European species with which it might otherwise be compared.

Plesiotypes: U.S.N.M. 8306a-b, 18802, 77559a-e.

Locality and position: Roemer's types are from Fredericksburg, Tex., most probably from the Fredericksburg group of the Comanche series. Two specimens from Bell County, figured here, are presumably from the same group. The others figured are from Flat Mesa, 4 miles north of the town of Sierra Blanca, Hudspeth County, Tex., where the species occurs in immense numbers associated with *Exogyra texana* in a bed about 2 feet thick. It also occurs in several similar beds in the Finlay Mountains, and on the eastern slope of the Quitman Mountains south of Quitman Pass. These last 3 occurrences are at about the same stratigraphic position in the Fredericksburg group. The species also occurs in Lampasas County, Tex.

Actaeonella pecosensis Stanton, n. sp.

Plate 67, figures 2, 5, 6, 8, 9

Shell of moderate size, slender fusiform, with the spire entirely concealed and the aperture extending the full length of the shell; greatest breadth of shell a little in advance of the middle, from which the shell gradually tapers to the acute posterior end which has an apical angle of about 30°; anterior end broader, more abruptly narrowed, and obliquely truncate or slightly emarginate in front; surface smooth, not even showing growth lines on the best-preserved specimens studied; inner lip thickened toward the front and bearing 3 strong spiral folds of which the posterior fold is most prominent. The elevation on which the folds are borne is continued as a narrower rounded ridge on the back of the last whorl where it borders the anterior end of the shell. The aperture is very narrow, its widest part being near the columellar folds.

Internal molds are relatively stouter and more nearly cylindrical in form than the shells, as they lack the acute apex and are not so produced in front. Such molds show a broad, shallow constriction just in front of the middle, with the posterior third rather abruptly contracted.

The ratio of height to breadth is about 3 to 1. The largest of the types (see pl. 67, figs. 2, 5) measures 60 mm. in height and 21 mm. in greatest breadth. Corresponding measurements of another figured specimen (pl. 67, figs. 6, 8) are 44 mm. and 14 mm. Species abundantly represented and commonly associated with *Nerinea riograndensis* Stanton, n. sp.

Actaeonella pecosensis Stanton is very closely related to *A. laevis* (Sowerby) (1832, p. 419, pl. 39, fig. 33; Zekeli, 1852, p. 44, pl. 7, fig. 10; Cossmann, 1895, p. 148, pl. 2, fig. 20; 1896, p. 166) from the Upper Cretaceous Gosau beds of Austria, which has a similar slender form, but judging from the published figures its sides are more nearly parallel, its upper portion does not taper so regularly, and its apex is not so pointed as in the Texan form. *A. pecosensis* is in some respects intermediate between Sowerby's *A. laevis* and the French fossil which D'Orbigny (1843, p. 110, pl. 165, figs. 2, 3) figured under the same name, but which Cossmann (1896, p. 166) has with apparent justification separated under the name *A. uchauxiensis*.

The only other American species described are *Actaeonella dolium* Roemer, which is at once distinguished by its very robust form, and *A. oviformis* Gabb (1869, vol. 2, p. 173, pl. 28, fig. 58) which is probably a *Trochactaeon*.

The genus *Actaeonella*, as originally described by D'Orbigny (1843, p. 107), was made to include both the convolute forms like the present species, and those with visible spires such as are referred to *Trochactaeon*, without selecting any species as the type. In a revision of the Actaeonidae, Meek (1863, p. 89) revised the genus, selected *A. laevis* (Sow-

erby) as the type, and separated the turbinate forms with a distinct spire under the generic name *Trochactaeon*. A little later, without knowledge of Meek's paper, Stoliczka (1865, pp. 137–142) applied the name *Actaeonella* to the forms Meek had assigned to *Trochactaeon*, and selected *A. laevis* as the type of the new subgenus *Volvulina*. This later nomenclature has been adopted in the manuals both of Zittel and Fischer in direct violation of the law of priority, and in spite of the fact that Stoliczka (1868, p. 428) himself in a subsequent work had adopted Meek's names. Cossmann (1895, pp. 72, 73) has correctly given this history of the genus and its revision and has adopted Meek's nomenclature.

Types: Holotype, U.S.N.M. 77560; 2 figured paratypes, 77561a-b; 5 unfigured paratypes, 103173.

Locality and position: Washita group 12 miles north of Brackettville, Kinney County; upper part of Devils River limestone at the high bridge across Pecos River on the Galveston, Harrisburg & San Antonio Railway (Southern Pacific), 3 miles east of Shumla, Val Verde County; and "Rio Grande, Pecos County (now Terrell), Texas."

Genus TROCHACTAEON Meek, 1863

Trochactaeon cumminsi Stanton, n. sp.

Plate 63, figures 3–6, 13

Shell of medium size, slender, subfusiform, consisting of about 8 whorls, of which the last constitutes two-thirds to three-fourths of the entire length; spire variable, in some specimens mammillated at the summit, the apical angle commonly about 65° but ranging from 60° to nearly 80°; suture slightly impressed; whorls of the spire gently convex, but some whorls bear a very slight angulation near the middle, which marks the position of a fine impressed line that forms the anterior border of a broad slit-band or sinus comparable with that in *Nerinea;* last whorl relatively very large, subcylindrical, with an oblique flattening or shoulder behind occupied by the slit-band, and somewhat produced and contracted in front, the extreme anterior end being obliquely subtruncate; surface marked only by fine growth lines that pass almost straight across the whorl in a broad curve with its convexity directed forward, the curvature increasing suddenly as the lines approach the slit-band, which they cross in a short curve turned in the opposite direction; inner lip thickened in front and bearing 3 strong folds; aperture long and narrow, slightly increasing in width toward the front.

Internal molds differ greatly from the shell in form, the whorls being prominently shouldered with the maximum breadth behind, and the last whorl showing a well-marked spiral groove or constriction a little in advance of the middle, with a second and occasionally a third groove less distinctly marked in front of it.

The largest of the types, one of the more slender forms with an apical angle of 60°, has the following measurements: Height 76 mm., height of spire 26 mm., maximum breadth 27 mm., breadth of slit-band 5 mm. Corresponding measurements of a stouter specimen with an apical angle of 70° are 60, 15, 25, and 3.8 mm.

This species is highly variable, especially in the form and relative proportions of the spire, and if only the extreme variations were compared they would probably be assigned to different species; but study of a large series of more than 40 specimens shows many intermediate forms with no constant features by which they may be reasonably separated. Several of the European species also show similar variability.

According to Stoliczka (1868, p. 410), *Globiconcha coniformis* Roemer is probably a *Trochactaeon*, but if so it differs too much from *T. cumminsi* to require comparison, as its form is very stout and short.

The East Indian *Trochactaeon cylindraceus* Stoliczka, which has been recognized by Whiteaves (1884, p. 218, pl. 28, fig. 6) in collections from Maud Island, British Columbia, is a relatively shorter and stouter species than *T. cumminsi* and differs too much in other respects to require detailed comparison. The same may be said of most of the foreign species, which generally have the last whorl relatively shorter and the sides not so nearly parallel. *T. arnaudi* Cossmann (1895, p. 148, pl. 3, figs. 2, 3) has nearly the proportions of *T. cumminsi*, except that the last whorl is relatively broader and more convex. *T. boutillieri* Cossmann (1895, p. 149, pl. 6, figs. 18, 19) is much smaller and has a shorter spire than the shortest of the Texan forms. The form that seems to resemble *T. cumminsi* most closely is that described by Conrad (1852, p. 233, pl. 5, fig. 36) as *Nerinea abbreviata*, from beds in Syria that he referred, probably erroneously, to the Jurassic.

In Europe, *Trochactaeon*, like *Actaeonella*, is confined to the Cretaceous and is most abundant in the Turonian, though according to Cossmann (1895, p. 75) it ranges from the Barremian to the Senonian inclusive. The species now referred to *Trochactaeon* was originally included in *Actaeonella*, as defined by D'Orbigny (1843, p. 107).

The specific name is given in honor of Mr. W. F. Cummins, who collected several of the best specimens studied.

Types: Cotypes, U.S.N.M. 103121a-c; 1 figured

paratype, 103119; 8 unfigured paratypes, 103120, 103122.

Locality and position: Devils River limestone from Painted Cave on the Rio Grande near the mouth of Pecos River; at the high bridge across the Pecos on the Galveston, Harrisburg & San Antonio Railway (Southern Pacific), about 3 miles east of Shumla, Val Verde County, Tex.

Trochactaeon parvus Stanton, n. sp.

Plate 63, figs. 1, 2

Shell small, slender subfusiform, consisting of 5 or 6 whorls, of which the last constitutes nearly two-thirds of the entire length; greatest breadth near the posterior (upper) margin of the last whorl, from which the shell tapers regularly in both directions, the apical angle of the spire about 30°, whereas the sides of the last whorl converge toward the narrow anterior end with an angle of about 20°; exposed portions of whorls of the spire slightly convex, as in *Trochactaeon cumminsi* Stanton; surface apparently smooth, but the state of preservation is such that the growth lines are not visible, nor is the slit-band on the sloping shoulder of the whorl; aperture long and narrow; inner lip with 3 strong spiral folds near the front.

The better preserved and larger of the 2 type specimens measures 10 mm. in height, 3.5 mm. in height of spire, and 3.5 mm. in greatest breadth.

The specimens thus described may be the young of a larger species, but if they are, the adult would have approximately the same form. The narrow, gradually tapering anterior end prevents their reference to *Trochactaeon cumminsi*, which is the only similar Texan species.

Cotypes: U.S.N.M. 103123a-b.

Locality and position: Edwards limestone on Colorado River above the mouth of Bartons Creek near Austin, Travis County; and 6 miles northeast of Kerrville, Kerr County, Tex

Genus AVELLANA D'Orbigny, 1843

Avellana chispensis Stanton, n. sp.

Plate 63, figures 11, 12

Shell of medium size, broadly ovate, consisting of about 3 whorls; spire rather prominent; surface marked by about 25 fine spiral striae; external varix on the outer lip apparently narrow, its surface sculpture unknown; aperture long, narrow behind, rather broad in front; columella with 2 folds, of which the anterior is the more prominent; interior of outer lip not preserved but probably crenulate.

Height of holotype 13.5 mm., greatest breadth 12 mm. Only one specimen known.

This species is distinguished from all others in the Comanche fauna by its great breadth as compared with its height. It has 1 more columellar fold than *Avellana tarrantensis* (Cragin) (p. 113), and its spire is larger and broader. Its much greater size and differences in outline and sculpture separate it from *A. hilli* Stanton. *Cinulia pelleti* Whitney (1911, p. 23, pl. 10, figs. 5–7) is relatively higher and has 1 more columnar fold.

Holotype: U.S.N.M. 77590.

Locality and position: Washita group in hills about 7 miles southwest of Chispa, Jeff Davis County, Tex., on the west side of former railroad route to San Carlos coal mines.

Avellana hilli Stanton, n. sp.

Plate 63, figures 7, 8

Shell very small, broadly ovate, consisting of about 3 whorls; spire low, inconspicuous; surface marked by 22 or more relatively rather coarse spiral striae separated by much narrower furrows and crossed by very fine lines of growth; external varix of the outer lip moderately large, with the same spiral sculpture as the rest of the shell; aperture long, very narrow behind, broadening toward the front, apparently not emarginate; outer lip irregularly crenulate within and bearing 1 or 2 larger denticles toward the front; inner lip forming a moderately heavy callus, and bearing 2 folds, of which the anterior fold near the end of the columella is much the more prominent.

An average specimen measures 5 mm. in height and 3.5 mm. in greatest breadth. Species common in Weno formation, associated with *Ostrea quadriplicata, Remondia robinsi, Gervilliopsis invaginata, Nodosaria texana*, etc.

The species is distinguished especially by its small size, and by the extension of the spiral sculpture over the varix to the margin of the outer lip. The latter feature is not common among Cretaceous Ringiculidae, though it also occurs in *Ringicula pulchella* Shumard (1861, p. 192), from the uppermost Cretaceous beds of Navarro County, Tex. *Avellana texana* Shumard and *A. tarrantensis* (Cragin), which are possibly synonymous, are both much larger and come from an older formation. *A. texana* was described from imperfect material that did not show the sculpture of the outer lip, nor the detailed structure of the aperture, and it has not been recognized in later collections. *A. tarrantensis* has a more prominent spire, 1 additional fold on the columella, more regular crenulations on the interior of the outer lip, and the external surface of the varix bears no spiral striae.

Cotypes: U.S.N.M. 77591a-b; unfigured cotypes, 77592.

Locality and position: Weno formation, 8 miles north of Fort Worth, Tarrant County, Tex.

Avellana tarrantensis (Cragin)?

1893. *Cinulia tarrantensis* Cragin, Texas Geol. Survey 4th Ann. Rept., p. 223, pl. 42, figs. 1, 2.
1928. *Cinulia tarrantensis* Cragin. Adkins, Texas Univ. Bull. 2838, p. 197.

Original description:

Small, very solid short-spired and subglobose, consisting of three whorls, somewhat similar in size and form to *C. rectilabrum* Gabb, but with heavier and internally crenulated outer lip, and with three prominent folds on the thickened inner lip, of which two are upon the adnate portion about midway of the aperture, and one is upon the freely descending or columellar portion; aperture elongate, posteriorly narrowed, anteriorly subemarginate; body-whorl ornamented with rather coarse revolving lines or costellae, thickened margin of outer lip very heavy and broad, ornamented with vertical lines finer than the revolving costellae of the body-whorl.

Measurements: Height 12.2, greatest breadth of body-whorl 9.5 mm.

Occurrence: Top of *Exogyra texana* bed, Texas and Pacific Railway, two and a half miles east of Benbrook, with *Tylostoma? mutabilis* and *Cylindrites formosus*.

The internal crenulations of the outer lip, and the number of folds on the columella and inner lip, place the species in *Avellana* rather than *Cinulia*, as restricted by most authors. The distinctive differences between this species and *A. hilli* have been pointed out in describing *A. hilli*. Shumard's *Avellana texana* was briefly described from imperfect specimens and was not figured, hence comparisons are difficult; but the fact that it came from the same formation and is about the same size raises a suspicion that it may be identical with *A. tarrantensis*. The types of Shumard's species are lost, however, and so far as known no authentic examples of it have been preserved; therefore it is thought best to quote the two descriptions and keep them separate for the present.

An imperfect specimen, U.S.N.M. 77593, of the size and general aspect of this species, is labeled Marietta beds (Denton formation), 3 miles north of Denison, Grayson County, Tex.

Avellana texana Shumard

1860. *Avellana texana* Shumard, Acad. Sci. St. Louis Trans., vol. 1, p. 597.
1928. *Cinulia texana* (Shumard). Adkins, Texas Univ. Bull. 2838, p. 197.
?1940. *Avellana texana* Shumard. Stainbrook, Texas Univ. Bull. 3945, p. 714, pl. 33, figs. 8, 9.

Original description:

Shell small, globose; spire occupying about one-fifth of the total length, convex; volutions about three and a half, rounded, last one gibbous; aperture oblique, subovate, rounded below and contracted above; lip thickened (expanded?); surface with rounded revolving lines, of which there are from 22-25 on the last volution.

We have two specimens of this species in both of which the columella is so enveloped with matrix that we are not able to ascertain whether it is plaited or not. The species, however, has all the external characters of *Avellana*.

Length 0.36 inch, width about 0.26; height of last coil 0.29.

Resembles *Actaeon concinna* of Hall and Meek, but it is a larger shell and has fewer revolving striae.

Locality. Found in the upper part of the Cretaceous limestone, near Bosque Creek, in Bosque County, in connection with *Exogyra texana* and *Ammonites pedernalis*.

It is possible that *Avellana tarrantensis* (Cragin) is identical with this species; but in the absence of the types, authentic specimens, and figures of *A. texana* their identity cannot be proved, and it seems best to retain both names.

WORKS TO WHICH REFERENCE IS MADE

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PLATES 1-67

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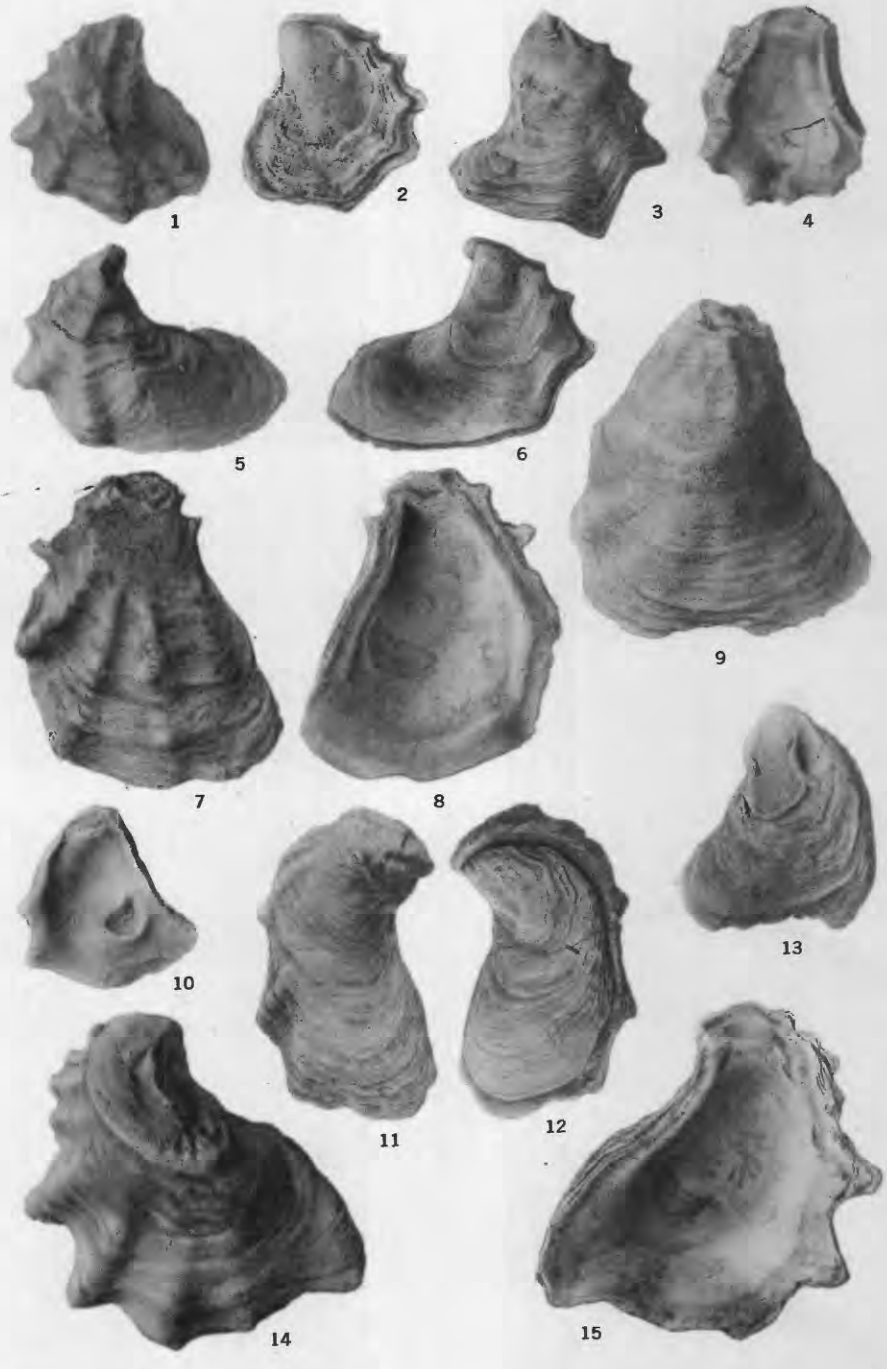
PLATE 1

[All figures natural size.]

FIGURES 1–15. *Ostrea crenulimargo* Roemer. (1, 2) Plesiotype U.S.N.M. 21767a; (3) plesiotype U.S.N.M. 103176a; (4) plesiotype U.S.N.M. 103176b; (5, 6) plesiotype U.S.N.M. 21767b; (7, 8) plesiotype U.S.N.M. 103177a; (9) plesiotype U.S.N.M. 21767c; (10) plesiotype U.S.N.M. 103176c; (11, 12) plesiotype U.S.N.M. 21767d; (13) plesiotype U.S.N.M. 21767e; (14, 15) plesiotype U.S.N.M. 103177b.

Specimens represented by figures 1, 2, 5, 6, 9 and 11–13 are from the Paluxy sand of Double Mountain in Stonewall County, Tex. Specimens represented by figures 7, 8, 14, and 15 are from the Walnut clay at Clear Creek, about 23 miles southwest of Gainesville, Tex. Specimens represented by figures 3, 4, and 10 are from the Walnut clay at Blocker Creek, about 20 miles southwest of Gainesville on road to Decatur, Tex. (p. 19).



COMANCHE PELECYPODS

PLATE 2

[All figures natural size.]

FIGURES 1–11. *Ostrea franklini* Coquand. (1) Right valve of plesiotype U.S.N.M. 22597a; (2) left valve of plesiotype U.S.N.M. 22597b; (3, 4) plesiotype U.S.N.M. 22548a, left valve shows faint radiating sculpture; (5) right valve of plesiotype U.S.N.M. 22548b; (6) right valve of plesiotype U.S.N.M. 22548c; (7) interior of left valve of plesiotype U.S.N.M. 22548d; (8, 9) plesiotype U.S.N.M. 22548e; (10) left valve of plesiotype U.S.N.M. 22548f, showing twisted beak; (11) interior of right valve of plesiotype U.S.N.M. 22651.

Specimens represented by figures 1 and 2 are from the Trinity group near the old Muddy Fork Post Office, Pike County, Ark. Specimens represented by figures 3–10 are from the Trinity group at Wolf Creek Post Office, about 2½ miles northwest of Delight, Pike County, Ark. Specimen represented by figure 11 is from the Trinity group on the Antoine Road, 1½ miles northeast of Murfreesboro, Pike County, Ark. (p. 20).

COMANCHE PELECYPODS

PLATE 3

[Figures slightly reduced.]

FIGURES 1–3. *Ostrea franklini camelina* Cragin. Exterior, interior, and lateral views of plesiotype U.S.N.M. 103178a. Near base of DeQueen limestone member of the Trinity formation on roadside 2 miles north of Provo, Sevier County, Ark. (p. 22).

COMANCHE PELECYPODS

PLATE 4

[All figures natural size.]

FIGURES 1–4. *Ostrea franklini camelina* Cragin. (1) Exterior of left valve of a cotype in the Texas State collection at Austin, Texas; (2, 4) exterior and interior of a right valve of plesiotype U.S.N.M. 103178b; (3) exterior of left valve of plesiotype U.S.N.M. 103178c.

Specimen represented by figure 1 is from the Glen Rose limestone in Bosque County, Tex. Specimens represented by figures 2–4 are from the basal part of the DeQueen limestone member of the Trinity formation on roadside 2 miles north of Provo, Sevier County, Ark. (p. 22).

COMANCHE PELECYPODS

PLATE 5

[Both figures natural size.]

FIGURES 1, 2. *Ostrea riograndensis* Stanton, n. sp. Exterior of right valve of cotype 103183a; (2) interior of right valve of cotype 103183b. Both specimens from the Quitman formation of Taff in the Trinity group at the head of Red Bull Canyon, about 3¼ miles from Hot Springs on trail from Quitman Arroyo, Hudspeth County, Tex. (p. 24).

2

1

COMANCHE PELECYPODS

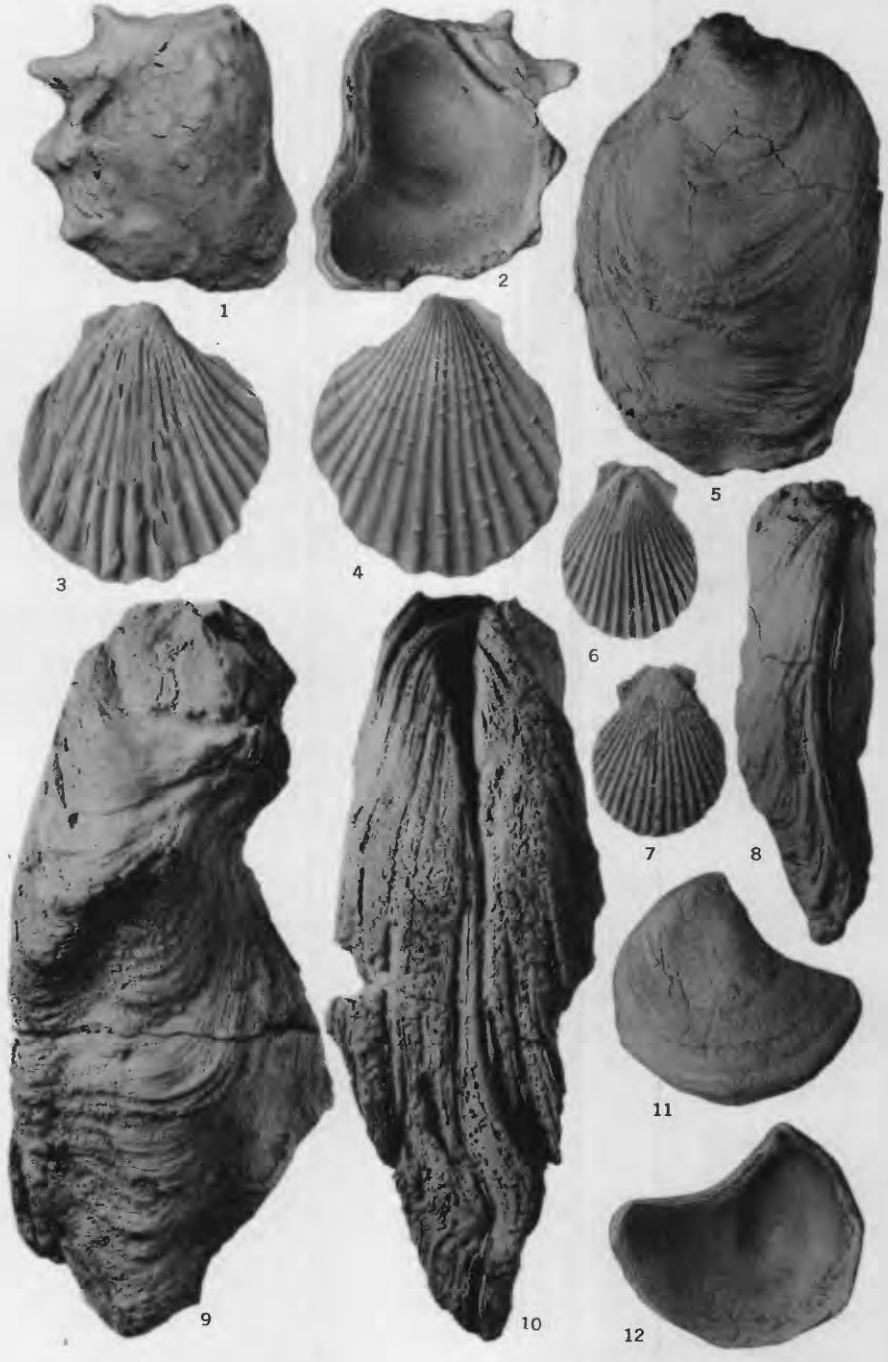
PLATE 6

[All figures natural size.]

FIGURES 1, 2, 11, 12. *Ostrea kansasensis* Logan. (1, 2) Exterior and interior of left valve of cotype; (11, 12) exterior and interior of left valve of one of the cotypes of *O. willistoni* Logan. Both specimens from the Mentor formation near Kanapolis, Ellsworth County, Kans. (p. 22).

FIGURES 3, 4, 6, 7. *Pecten (Chlamys?) catherina* (Cragin). (3, 4) Views of holotype in the Texas State collection at Austin, Tex. From Georgetown limestone on Bartons Creek about one-eighth of a mile southwest of Bartons Spring, near Austin, Travis County, Tex.; (6, 7) plesiotype U.S.N.M. 103218, from Edwards limestone 5 miles west of Crawford, McLennan County, Tex. (p. 41).

FIGURES 5, 8–10. *Ostrea perversa* Cragin. (5, 8) Plesiotype U.S.N.M. 103457a; (9, 10) plesiotype U.S.N.M. 103457b. Both specimens from 20 to 25 feet below top of exposure of Grayson marl member of Denison formation a quarter of a mile north of Denton Creek and 5 miles northeast of Roanoke, Denton County, Tex. (p. 23).



COMANCHE PELECYPODS

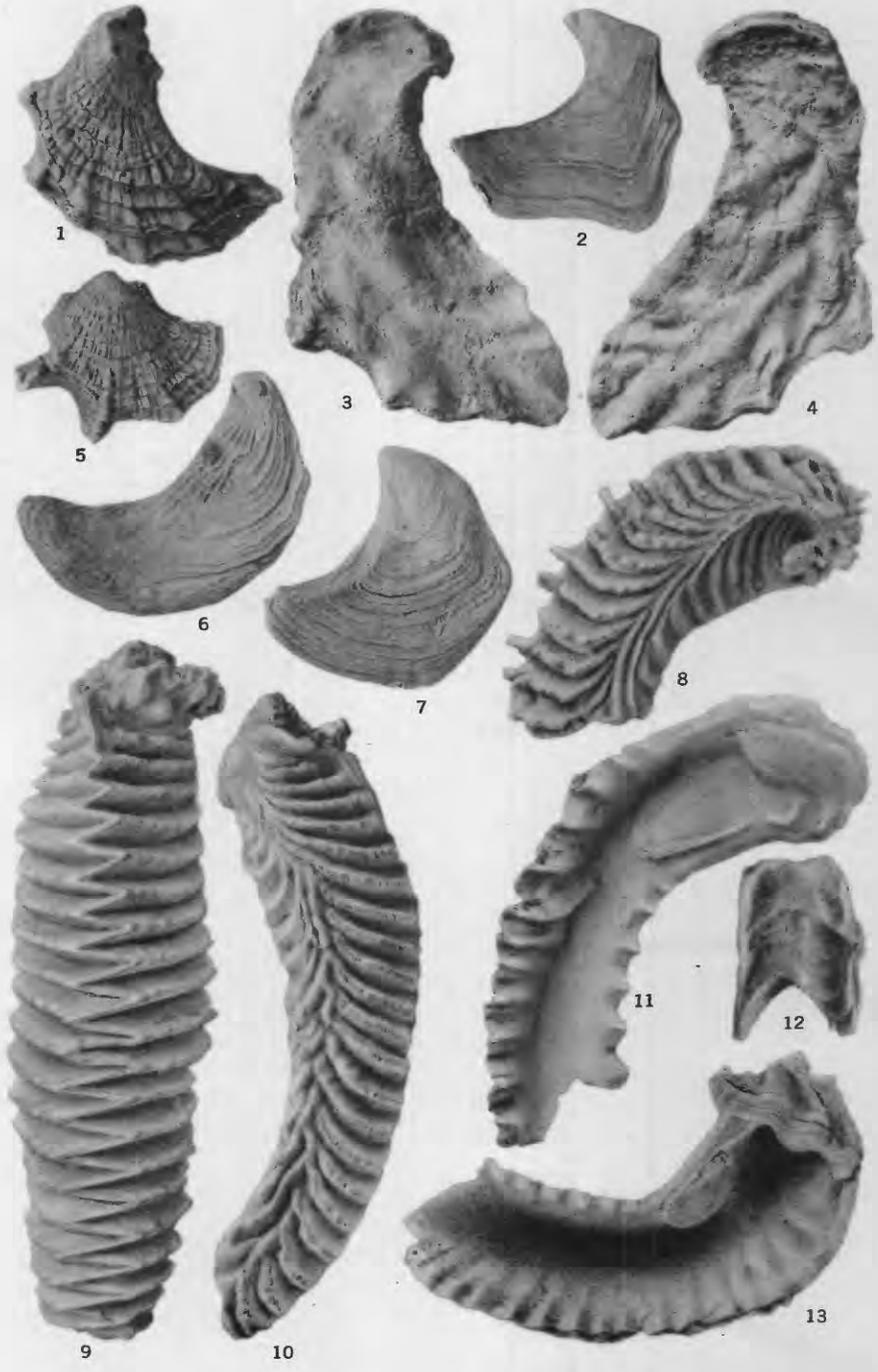
PLATE 7

[All figures natural size.]

FIGURES 1, 2, 5–7. *Ostrea (Lopha) quadriplicata* Shumard. (1) Left valve with slightly developed digitations, plesiotype U.S.N.M. 8077, from a locality near Denison, Tex.; (2) plesiotype U.S.N.M. 103181a, from 1¼ miles north of Denison, Tex.; (5) plesiotype U.S.N.M. 103180, from 1 to 2 miles south of Forth Worth, Tex.; (6) plesiotype U.S.N.M. 103181b from 1¼ miles north of Denison, Tex.; (7) plesiotype U.S.N.M. 103182 from a horizon near middle of section on hill 5 miles west of Kent, Tex. (p. 23).

FIGURES 3, 4. *Ostrea (Lopha) welleri* Logan. Interior and exterior of right valve of holotype from Mentor formation near Kanapolis, Ellsworth County, Kans. (p. 25).

FIGURES 8–13. *Ostrea (Arctostrea) carinata* Lamarck. (8) Plesiotype U.S.N.M. 103185a; (9, 10) plesiotype U.S.N.M. 103185b; (11) plesiotype U.S.N.M. 103185c, showing interior of right valve; (12) cross section of a thick left valve, plesiotype U.S.N.M. 103185d; (13) interior of a left valve, plesiotype U.S.N.M. 103185e. All specimens from Main Street limestone member of the Denison formation near one-mile post on railroad north of Denison, Tex. (p. 18).



COMANCHE PELECYPODS

PLATE 8

[Figure 9/10 natural size.]

FIGURE 1. *Ostrea (Lopha) subovata* Shumard. Plesiotype U.S.N.M. 19108, from Georgetown limestone at "The Gap," near Austin, Tex. (p. 24).

1

COMANCHE PELECYPODS

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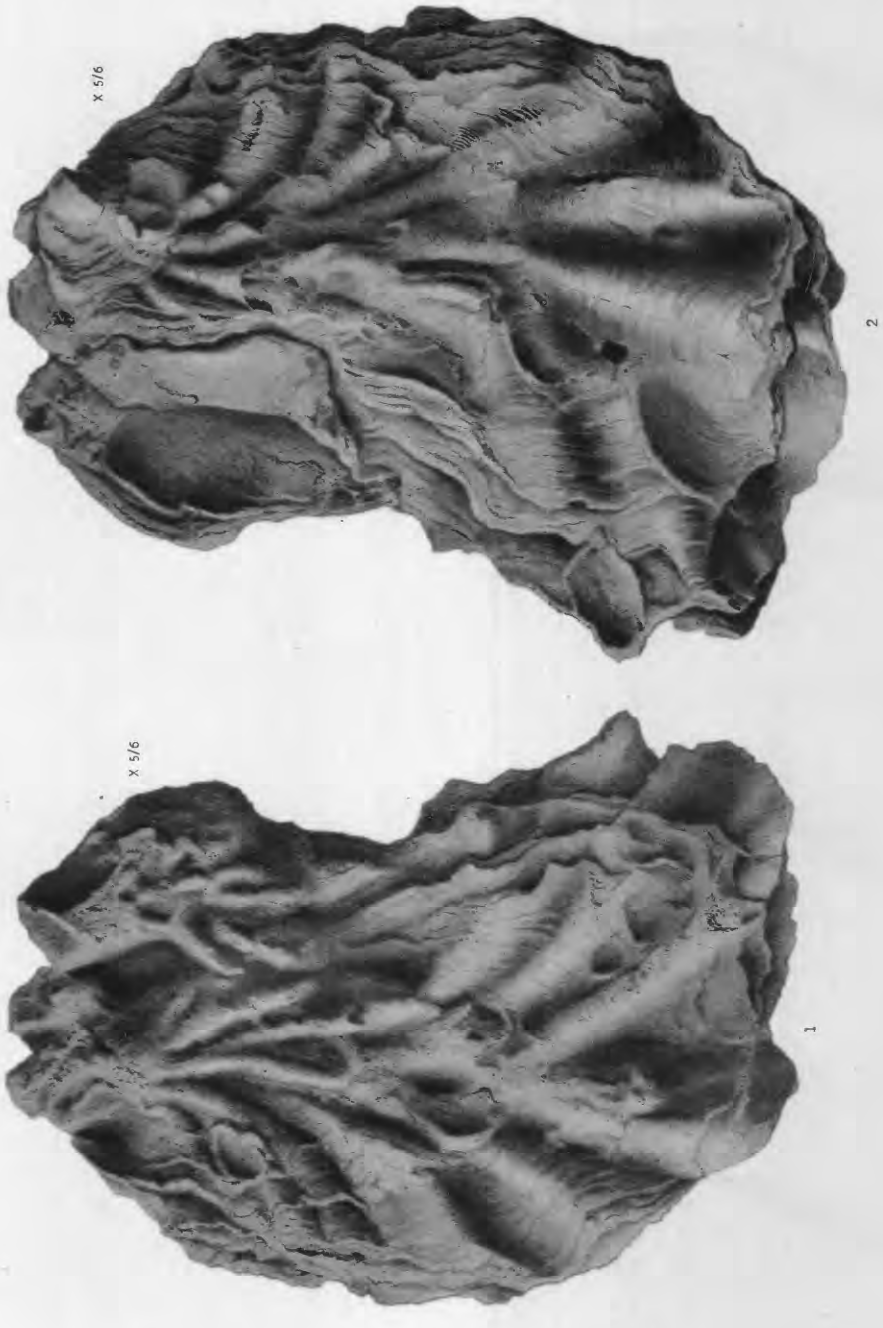
PLATE 9

[Both figures 5/6 natural size.]

FIGURES 1, 2. *Ostrea (Lopha) subovata* Shumard. Plesiotype U.S.N.M. 103184, from Denton clay member of the Denison formation, 2½ miles west of Denison, Tex. (p. 24).



COMANCHE PELECYPODS

PLATE 10

[All figures natural size.]

FIGURES 1, 2, 7. *Ostrea (Lopha) alternans* Cragin. (1) Interior of a left valve of a cotype in the Texas State collection at Austin, Tex.; (2) exterior of a small right valve of a cotype in the Texas State collection; (7) left valve of one of the cotypes in the Texas State collection. All specimens from the Glen Rose limestone on Sandy Creek, about 12 miles northwest of Burnet, Burnet County, Tex. (p. 18).

FIGURES 3–6. *Gryphaea corrugata* Say. (3, 6) Plesiotype U.S.N.M. 28771, from a locality near Belvidere, Kans.; (4, 5) cast of holotype of *G. pitcheri* Morton, U.S.N.M. 28773 (p. 26).

COMANCHE PELECYPODS

PLATE 11

[All figures natural size.]

FIGURES 1, 3, 4. *Gryphaea corrugata* Say. Views of right valve of plesiotype U.S.N.M. 28771, from Black Hill, near Belvidere, Kans. (p. 26).

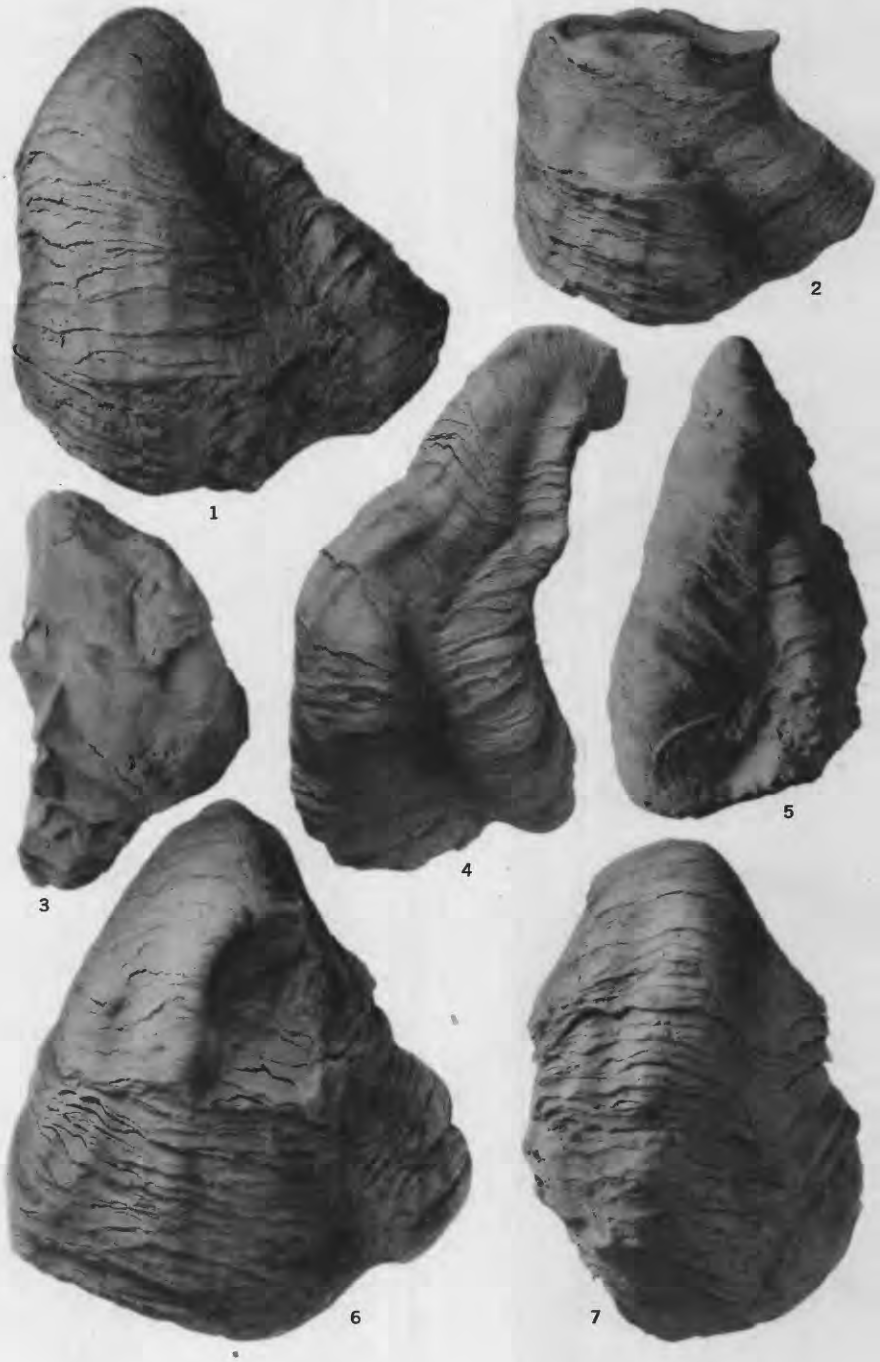
FIGURES 2, 5–11. *Gryphaea graysonana* Stanton, n. sp. (2, 7) Right valves; (5, 6, 8, 11) left valves; (9, 10) interior and exterior of left valve. All cotypes U.S.N.M. 28779, from Del Rio clay on Shoal Creek near Linders Spring, Travis County, Tex. (p. 28).

COMANCHE PELECYPODS

PLATE 12

[All figures natural size.]

FIGURES 1–7. *Gryphaea graysonana* Stanton, n. sp. Cotypes U.S.N.M. 28779, showing variation in form of left valves. All from Del Rio clay on Shoal Creek near Linders Spring, Travis County, Tex. (p. 28).



COMANCHE PELECYPODS

PLATE 13

[Figures 9/10 natural size.]

FIGURES 1, 2. *Gryphaea corrugata belviderensis* Hill and Vaughan. Cotype U.S.N.M. 28774, from Black Hill, near Belvidere, Kans. (p. 26).

COMANCHE PELECYPODS

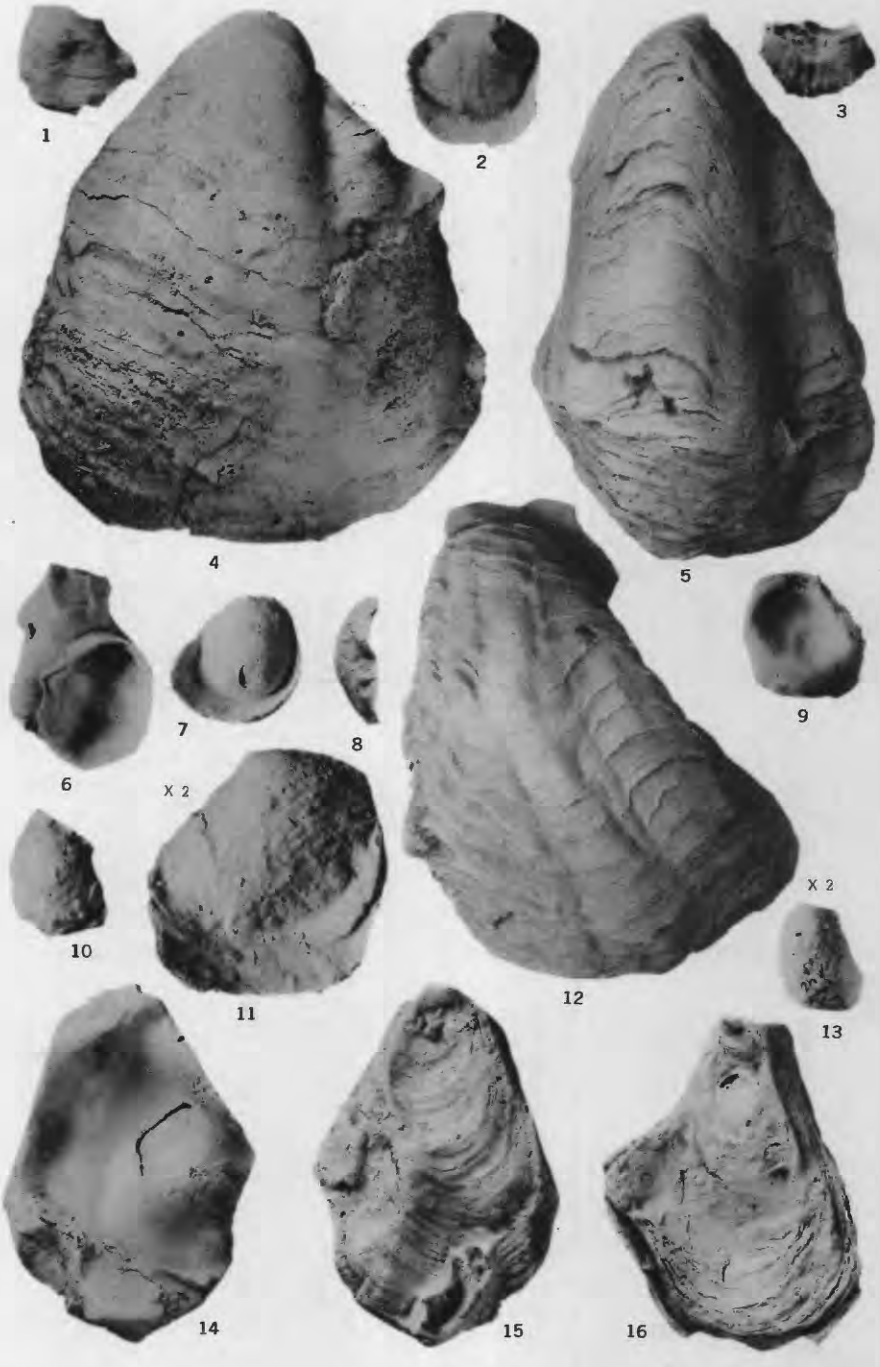
PLATE 14

[Figures natural size unless otherwise indicated.]

FIGURES 1–3, 6–11, 13. *Gryphaea wardi* Hill and Vaughan. (2, 7, 11) Exteriors of right valves (fig. 11 is ×2); (9) interior of right valve shown in figure 11; (1, 3, 10, 13) exteriors of left valves (fig. 13 is ×2) (8) lateral view of left valve shown in figure 10; (6) interior of left valve. Cotypes U.S.N.M. 28775, from lower part of Fredericksburg group on roadside between Bee Creek and Pedernales River, Travis County, Tex. (p. 27).

FIGURE 4. *Gryphaea corrugata tucumcarii* (Marcou). Plesiotype U.S.N.M. 22233, from Mesa Tucumcari, New Mexico (p. 26).

FIGURES 5, 12, 14–16. *Gryphaea graysonana* Stanton, n. sp. (5, 6) Left valves; (14, 15) interior and exterior of a right valve; (16) right valve. Cotypes U.S.N.M. 28779, from Del Rio clay on Shoal Creek near Linders Spring, Travis County, Tex. (p. 28).



COMANCHE PELECYPODS

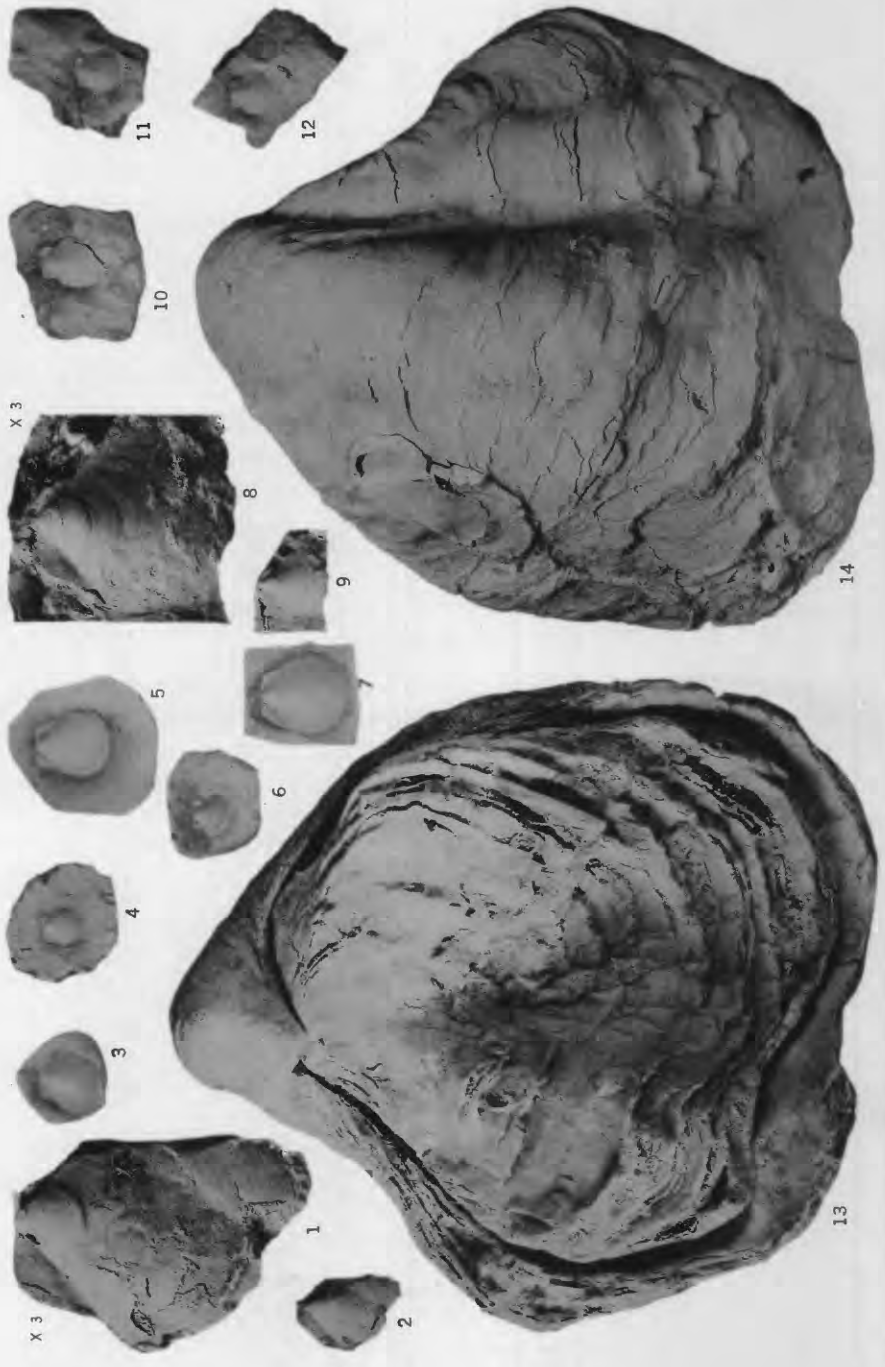
PLATE 15

[Figures natural size unless otherwise indicated.]

FIGURES 1–9. *Pecten (Syncyclonema) inconspicuus* Cragin. (1, 2) Cotype U.S.N.M. 32684 (fig 1 is × 3) (3) squeeze of small left valve, plesiotype 103214a; (4) small right valve, plesiotype 103214b; (5) mold of medium sized left valve, plesiotype 103215a; (6) mold of small right valve, plesiotype 103215b; (7) rather large right valve retaining part of the shell, plesiotype 103214c; (8, 9) cotype U.S.N.M. 32684 (fig. 8 is × 3).
Specimens represented by figures 1–4, 7–9 are from the Pawpaw sandy member of the Denison formation on Pawpaw Creek, half a mile southeast of depot in Denison, Tex. Specimens represented by figures 5 and 6 are from Kiowa shale at Blue Cut Mound, Comanche County, Kans. (p. 40).

FIGURES 10–12. *Pecten (Syncyclonema) inconspicuus pecosensis* Stanton, n. var. (10) Large right valve, cotype 103216a; (11) small right valve, cotype 103216b; (12) small left valve, cotype 103216c. All specimens from the Devils River limestone at the high bridge across the Pecos River on the Galveston, Harrisburg & San Antonio Railway, Texas (p. 40).

FIGURES 13, 14. *Gryphaea corrugata* Say var. *tucumcarii* (Marcou). Plesiotype U.S.N.M. 22233, from Mesa Tucumcari, N. Mex. (p. 26).



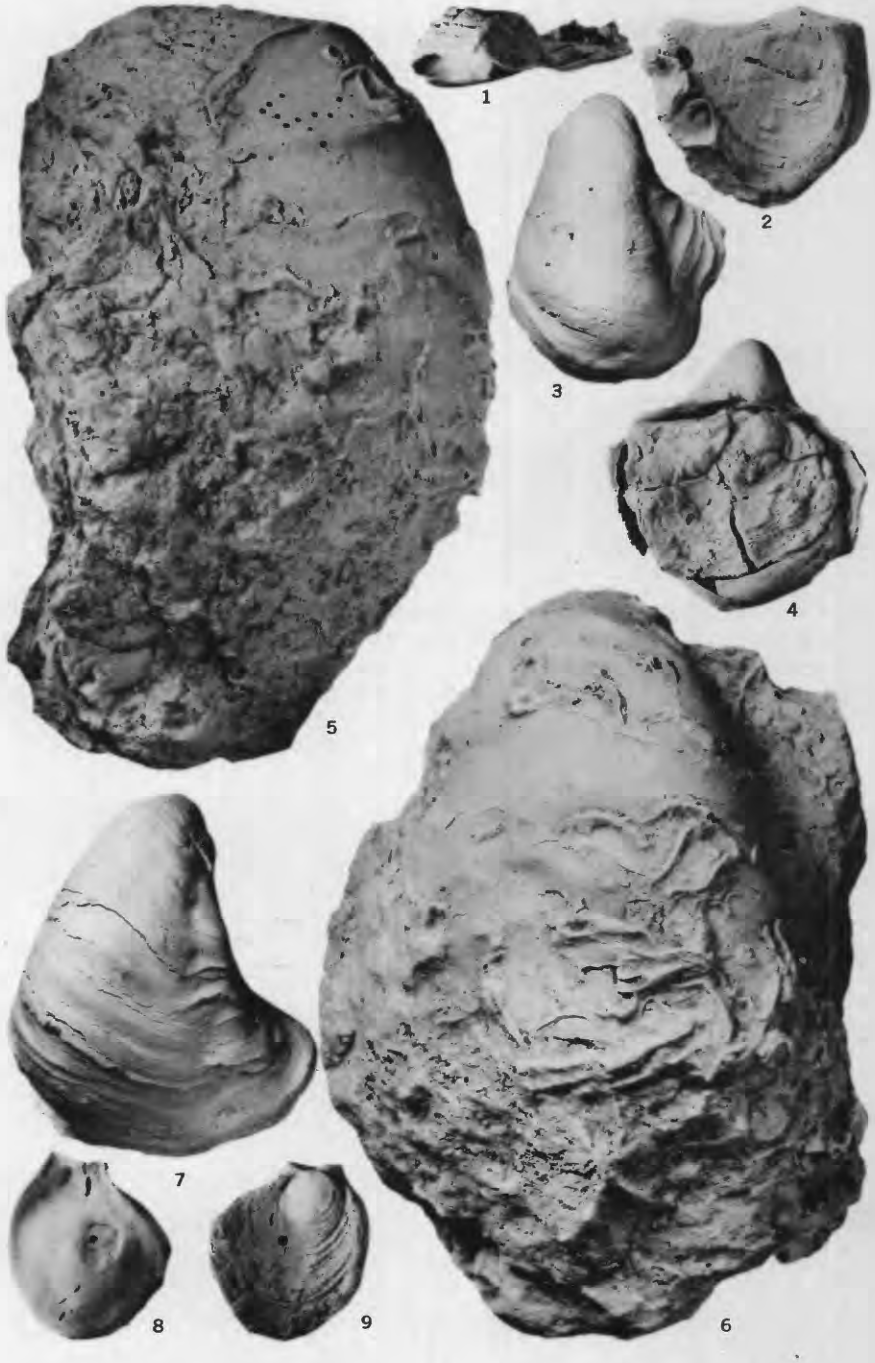
COMANCHE PELECYPODS

PLATE 16

[All figures natural size.]

FIGURES 1–4, 7–9. *Gryphaea washitaensis* Hill. (1, 2) Right valve, cotype U.S.N.M. 28782; (3) left valve, cotype U.S.N.M. 28782; (4) cotype U.S.N.M. 28785; (7) cotype U.S.N.M. 28783; (8, 9) right valve, cotype U.S.N.M. 28782. Specimens represented by figures 1–3, 8, 9 are from 2 miles north of Denison, Tex. Specimen represented by figure 7 is from the Duck Creek formation north of Denison, Tex. Locality of specimen represented by figure 4 is unknown (p. 29).

FIGURES 5, 6. *Gryphaea gibberosa* Cragin. Paratype in the Texas State collection at Austin, Texas. From the Georgetown limestone one-eighth of a mile southwest of Bartons Springs, near Austin, Travis County, Tex. (p. 29).



COMANCHE PELECYPODS

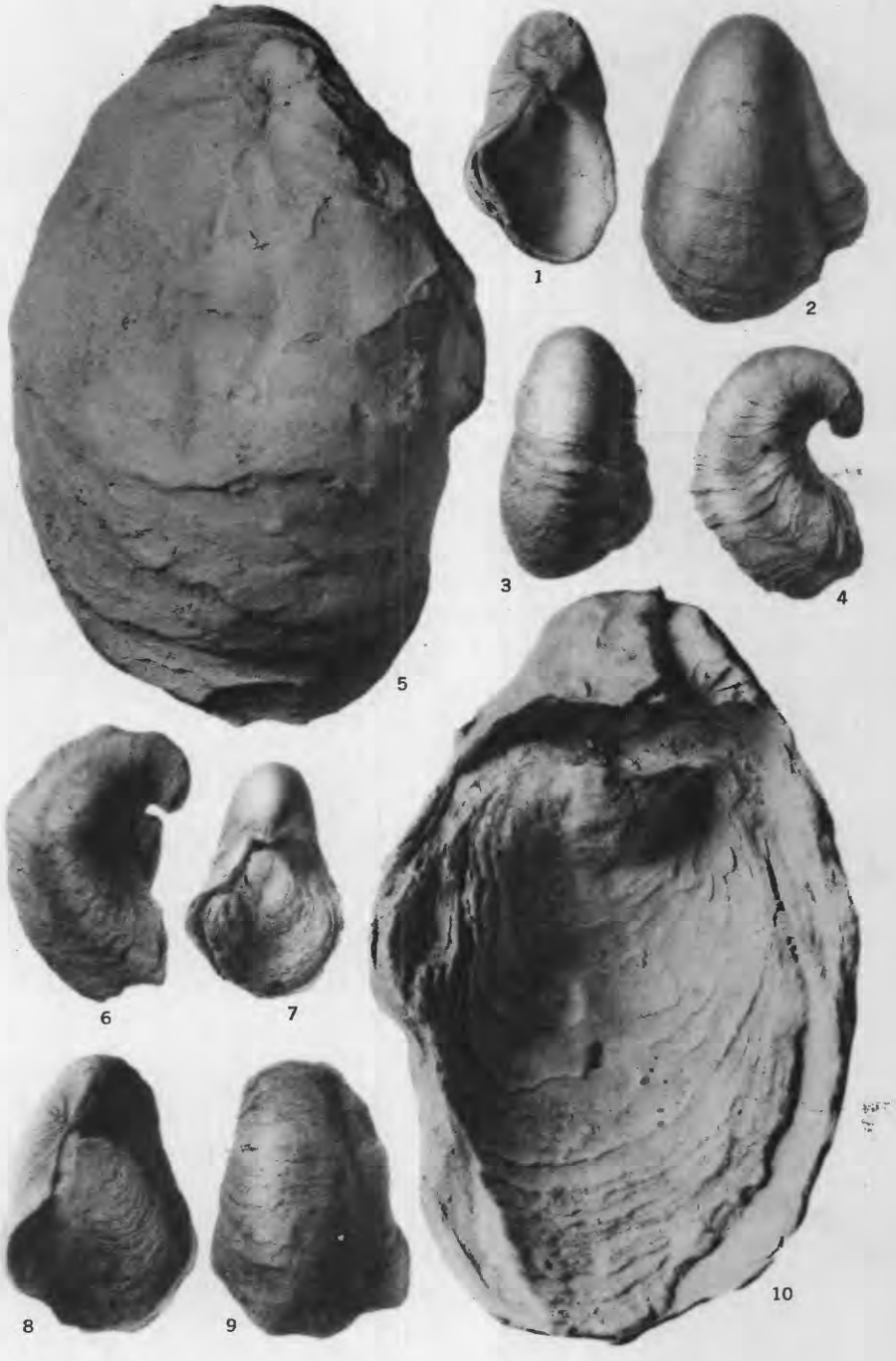
695463—47——11

PLATE 17

[All figures natural size.]

FIGURES 1–4, 6–9. *Gryphaea hilli* Cragin. (1, 3, 4) Plesiotype U.S.N.M. 103187a; (2) plesiotype U.S.N.M. 103187b; (6, 8, 9) plesiotype U.S.N.M. 103187c; (7) plesiotype U.S.N.M. 103186. All specimens are from the Champion Shell bed at the base of the Kiowa shale, half a mile to 2 miles south of Belvidere, Kans. (p. 26).

FIGURES 5, 10. *Gryphaea gibberosa* Cragin. Plesiotype U.S.N.M. 28784, from the Georgetown limestone near Austin, Tex. (p. 29).



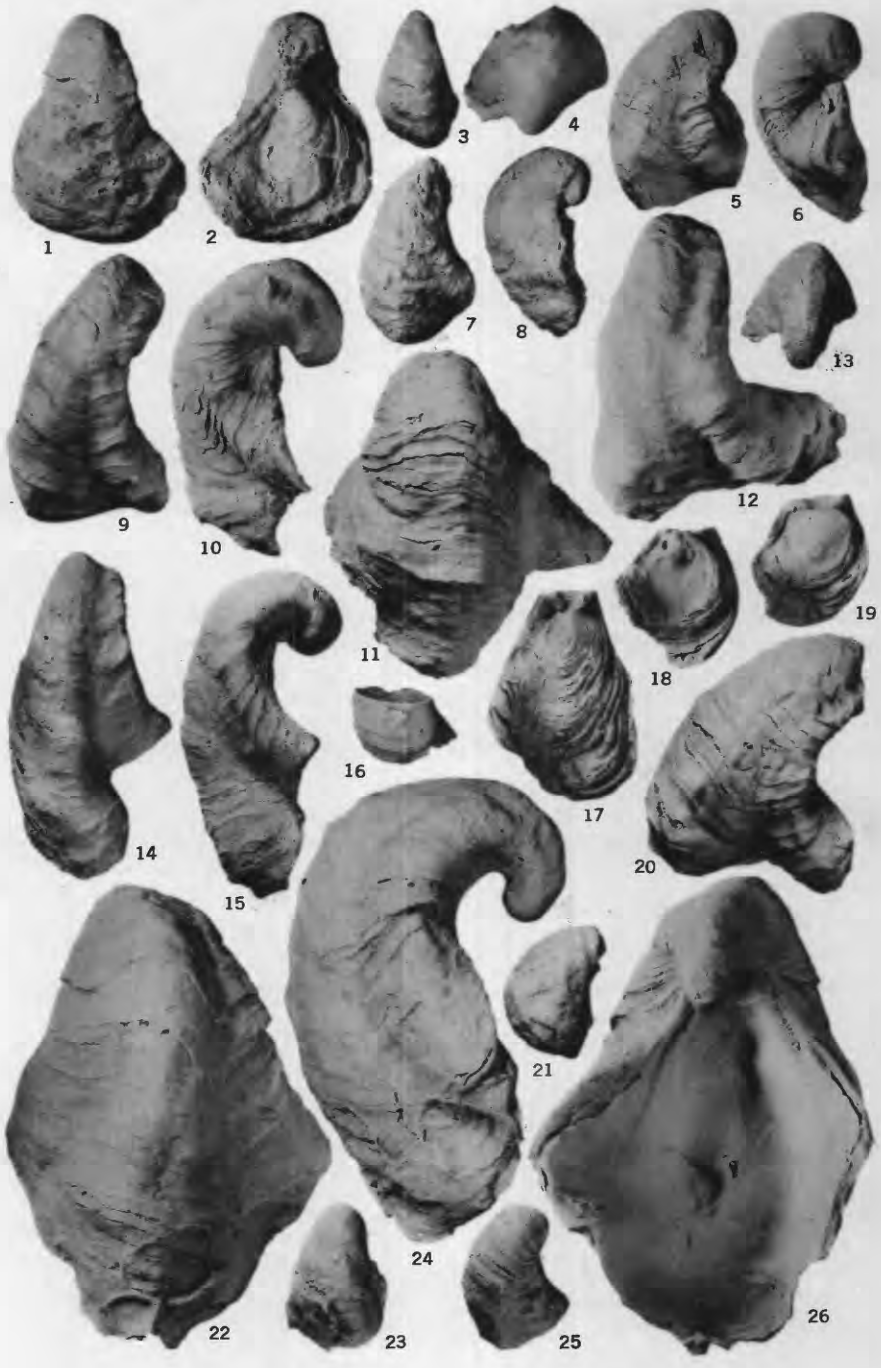
COMANCHE PELECYPODS

PLATE 18

[All figures natural size.]

FIGURES 1–26. *Gryphaea mucronata* Gabb. (1, 2) Left and right valves of a cotype; (3) small left valve of a cotype; (4–6) views of a left valve of a cotype; (7, 8, 13) views of a cotype; (9) slender adult left valve (10, 20) broad left valve; (11) broad left valve; (12) old left valve; (14, 15) slender adult left valve; 16, 21, 23, 25) young left valves; (17, 18, 19) young right valves; (22, 24, 26) large adult valve showing method of growth similar to *G. corrugata* Say.

All cotypes are in the Philadelphia Academy of Natural Sciences, are numbered 4773, and are from the Potrero formation of the Sierra de las Conchas, near Arivechi, Sonora, Mex. Plesiotype U.S.N.M. 28776, represented by figures 9–12, 14–21, 23, 25, are from the lower part of the Fredericksburg group, 9 miles west of Austin, Tex.; plesiotype U.S.N.M. 28777, represented by figures 22, 24, 26, is from the Walnut formation near Austin, Tex. (p. 28).



COMANCHE PELECYPODS

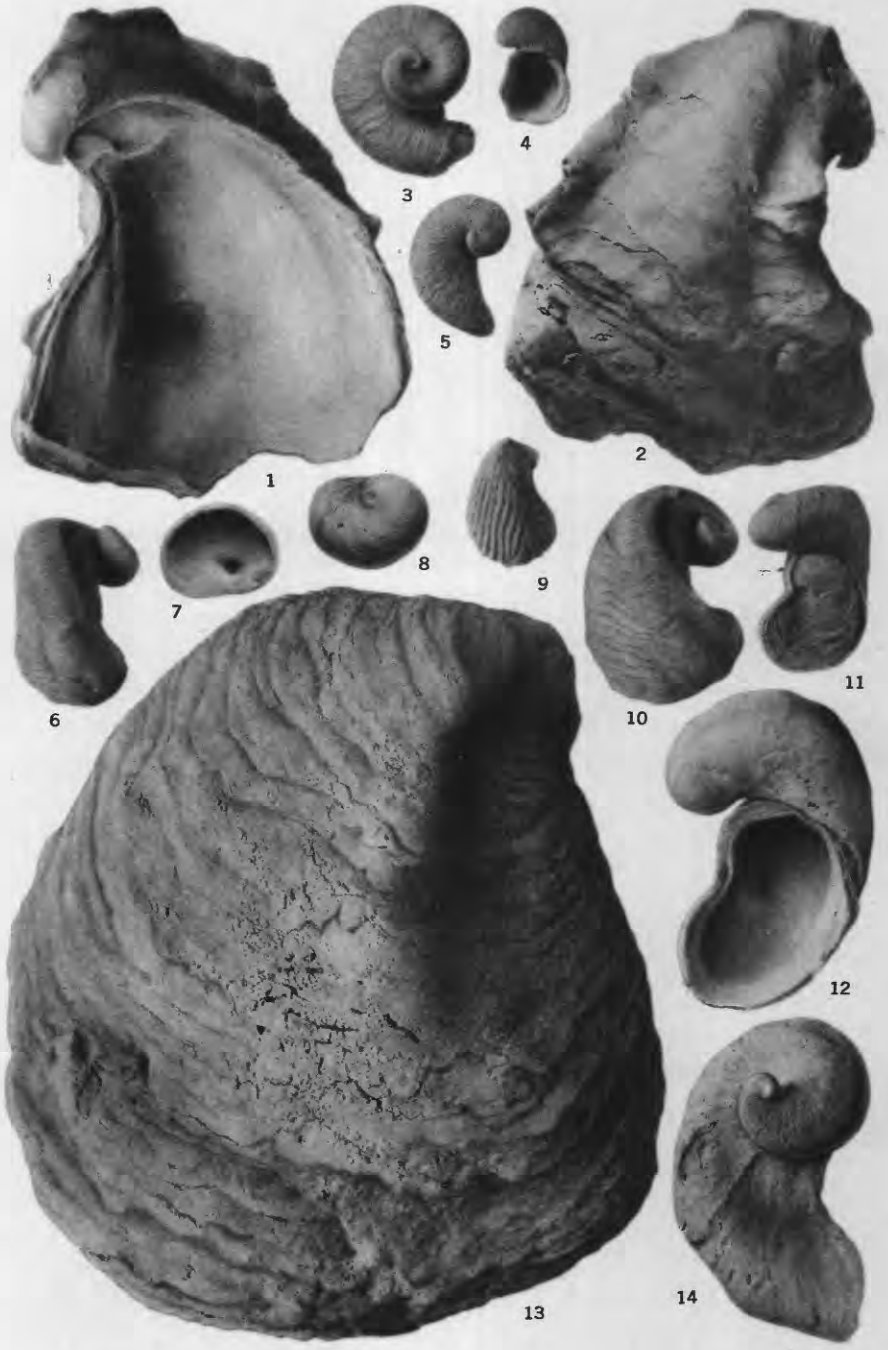
PLATE 19

[All figures natural size.]

FIGURES 1, 2. *Gryphaea navia* Hall. Cotype U.S.N.M. 8022 of *Exogyra forniculata* White, from Bexar County, Tex. (p. 27).

FIGURES 3–12, 14. *Exogyra arietina* Roemer. (3) Plesiotype U.S.N.M. 21752, from the Del Rio formation at Del Rio, Tex.; (4) plesiotype U.S.N.M. 103193a; (5) plesiotype U.S.N.M. 103189, from the Del Rio formation 3 miles northwest of New Braunfels, Tex.; (6, 11) plesiotype U.S.N.M. 103193b; (7, 8) plesiotype U.S.N.M. 103193c, right valve; (9) plesiotype U.S.N.M. 103191, from the Main Street limestone at Denison, Tex.; (10) plesiotype U.S.N.M. 103193d; (12, 13) plesiotype U.S.N.M. 103192, from the Del Rio clay at Fish Pond Point near Bartons Springs, Austin, Tex. Plesiotypes 103193a–d are from the Del Rio formation at Shoal Creek near Austin, Tex. (p. 30).

FIGURE 13. *Exogyra aquila* (Brongniart). Plesiotype U.S.N.M. 103194, from the Trinity group of Bexar County, Tex. (p. 31).



COMANCHE PELECYPODS

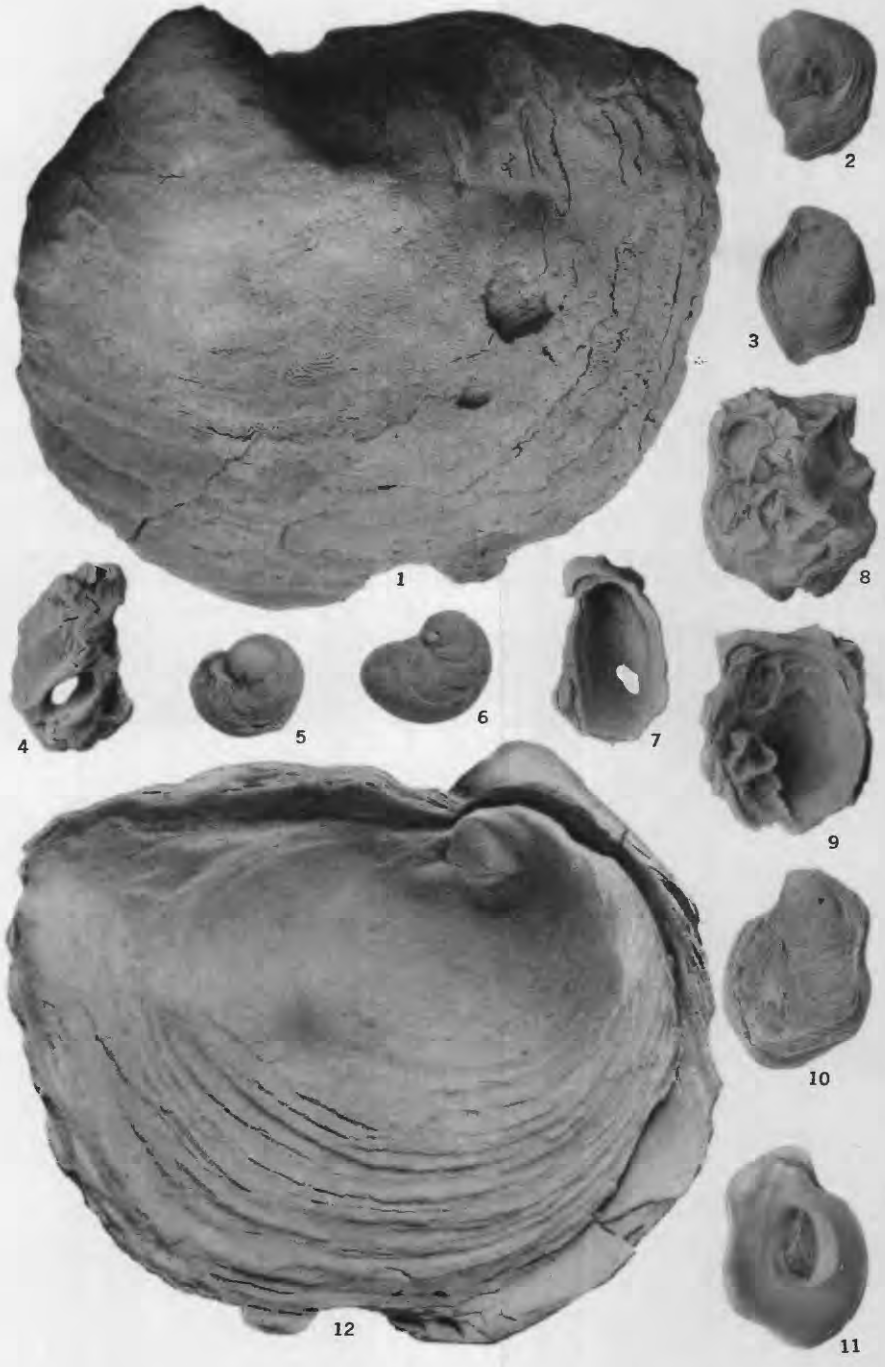
PLATE 20

[All figures natural size.]

FIGURES 1, 12. *Exogyra aquila* (Brongniart). Plesiotype U.S.N.M. 9609, from Bexar County, Tex. (p. 31).

FIGURES 2–4, 7–11. *Exogyra paupercula* Cragin. (2) Plesiotype U.S.N.M. 103202a, small right valve; (3) plesiotype U.S.N.M. 103202b, small right valve; (4, 7) plesiotype U.S.N.M. 103202c, slender left valve; (8, 9) plesiotype U.S.N.M. 103202d, broad left valve; (10, 11) plesiotype U.S.N.M. 103202e, large right valve. All specimens are from the upper part of the Glen Rose limestone, 11 or 12 miles southwest of Fredericksburg on road to Kerrville, Gillespie County, Tex. (p. 35).

FIGURES 5, 6. *Exogyra arietina* Roemer. (5) Right valve, plesiotype U.S.N.M. 103190, from the Grayson marl member of the Denison formation near Waco, Tex.; (6) right valve, plesiotype U.S.N.M. 103193e, from the Del Rio formation at Shoal Creek, near Austin, Tex. (p. 30).



COMANCHE PELECYPODS

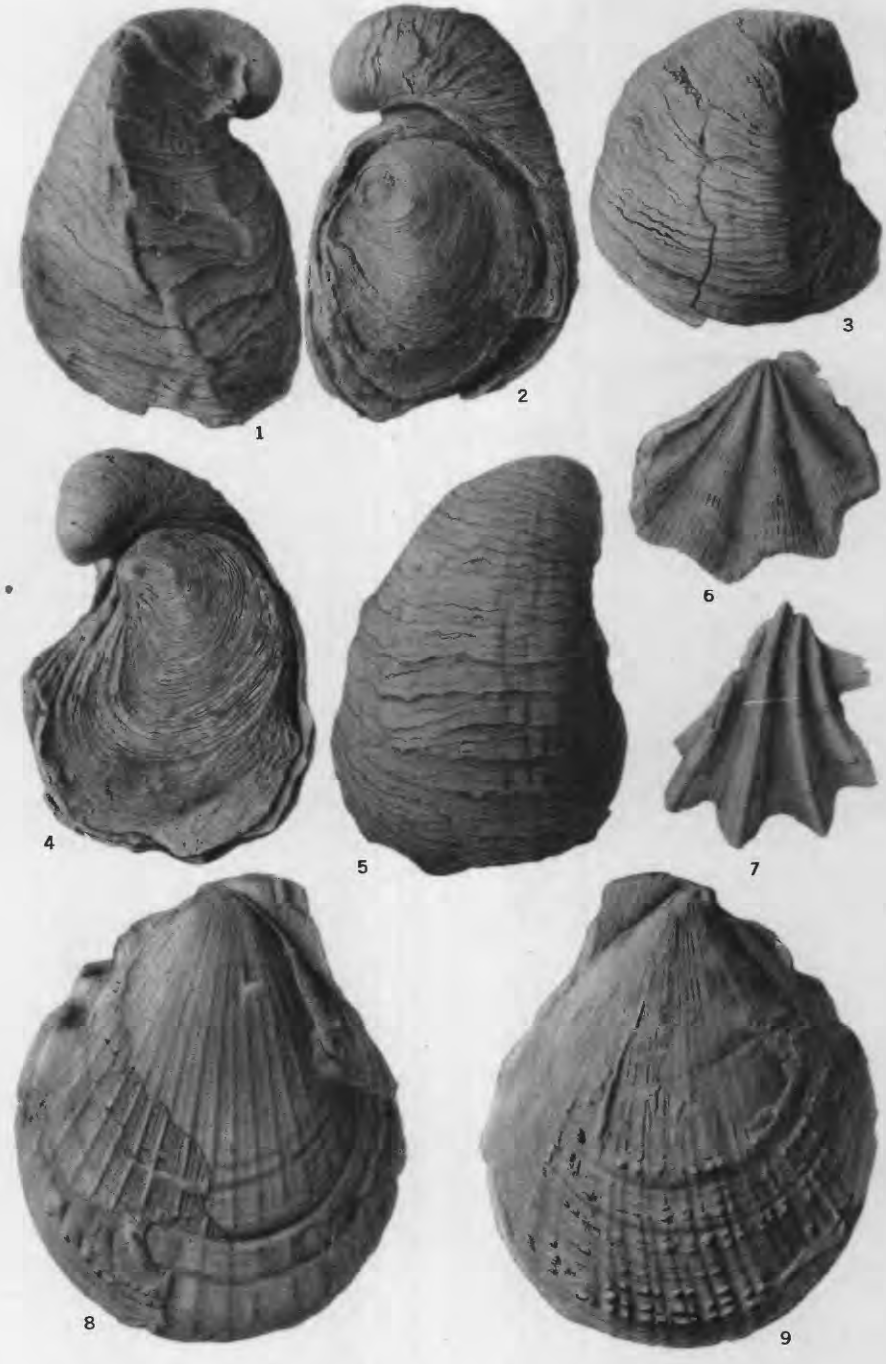
PLATE 21

[All figures natural size.]

FIGURES 1–5. *Exogyra cartledgei* Böse. (1, 2) Plesiotype U.S.N.M. 103197a; (3) plesiotype U.S.N.M. 103197b; (4, 5) plesiotype U.S.N.M. 103197c. All plesiotypes from the Grayson formation on the west side of Mule Canyon near the southern end of the Quitman Mountains, Hudspeth County, Tex. (p. 32).

FIGURES 6, 7. *Pecten (Neithea) wrighti* (Shumard). (6) Interior of left valve, plesiotype U.S.N.M. 103236a; (7) right valve, slightly distorted and lacking posterior ear, plesiotype U.S.N.M. 103236b. Both specimens from the Georgetown limestone at Shoal Creek, Austin, Tex. (p. 46).

FIGURES 8, 9. *Pecten (Chlamys?) generosus* (Cragin). Left and right valves of holotype in the Texas State collection at Austin, Tex. From the Georgetown limestone on the San Gabriel River southeast of Georgetown, Tex. (p. 41).



COMANCHE PELECYPODS

PLATE 22

[All figures natural size.]

FIGURES 1, 2, 9, 10. *Exogyra drakei* Cragin. (1) Plesiotype U.S.N.M. 103348a, from the Grayson formation at the cut on the St. Louis and Southwestern Railroad, half a mile southwest of Smithfield, Tarrant County, Tex.; (2, 9) plesiotype U.S.N.M. 103347, from the Grayson formation one mile east of Burleson, Johnson County, Tex.; (10) interior of left valve, plesiotype U.S.N.M. 103348b, from same locality as specimen shown in figure 1 (p. 32).

FIGURES 3–8. *Exogyra plexa* Cragin. (3, 5) Exterior and interior of small right valve, plesiotype U.S.N.M. 103204a; (4) plesiotype U.S.N.M. 103203, from Duck Creek formation at Thompsons Ferry on the Red River near Preston, Tex.; (6, 7) typical left valve, plesiotype U.S.N.M. 103204b; (8) small, plicate left valve, plesiotype U.S.N.M. 103204c. Plesiotypes 103204a–c are from the Kiamichi formation on Duck Creek north of Denison, Tex. (p. 35).

COMANCHE PELECYPODS

PLATE 23

[All figures natural size.]

FIGURES 1, 4. *Exogyra clarki* Shattuck. Plesiotype U.S.N.M. 103201, from the Grayson formation near the initial monument of the United States-Mexican Boundary Survey, 4 miles west of El Paso, Tex. (p. 34).

FIGURES 2, 3, 5. *Exogyra drakei* Cragin. (2, 3) Exterior and interior of right valve, plesiotype U.S.N.M. 103195a; (5) right valve, plesiotype U.S.N.M. 103195b. Both specimens from the Main Street limestone member of the Denison formation at Denison, Tex. (p. 32).

COMANCHE PELECYPODS

PLATE 24

[Figures natural size unless otherwise indicated.]

FIGURES 1–5. *Pecten (Chlamys) stantoni* Hill. (1) Right valve, plesiotype U.S.N.M. 103219, from the Mural limestone 4 miles east of Naco near Boundary Monument 91 in the Mule Mountains, Arizona; (2, 3) left valve and enlargement (× 4) of surface of holotype in the R. T. Hill collection at Johns Hopkins University, from Glen Rose limestone near Glen Rose, Tex.; (4) left valve of plesiotype U.S.N.M. 103220, from the Glen Rose limestone of Travis County, Tex.; (5) right valve, plesiotype U.S.N.M. 103456, from the Glen Rose limestone about half a mile southwest of Albert, on north side of road, Gillespie County, Tex. (p. 41).

FIGURES 6, 9. *Pecten (Chlamys) stantoni quitmanensis* Stanton, n. var. (6) Right valve of holotype U.S.N.M. 103222, from the Quitman formation at the head of Red Bull Canyon, on trail from Quitman Arroyo to Hot Springs, Hudspeth County, Tex.; (9) right valve, paratype U.S.N.M. 103221, from the Trinity group near Boundary Monument 73 in southeastern Arizona (p. 42).

FIGURE 7. *Exogyra hilli* Cragin. Plesiotype 103200a, interior of large left valve, from the Trinity group at the Pedernales River bluff on the road crossing from Bee Caves to Corwin, Travis County, Tex. (p. 33).

FIGURE 8. *Exogyra clarki* Shattuck. Plesiotype U.S.N.M. 103201b, from the Grayson formation near initial monument of the United States-Mexican Boundary Survey, 4 miles west of El Paso, Tex. (p. 34).

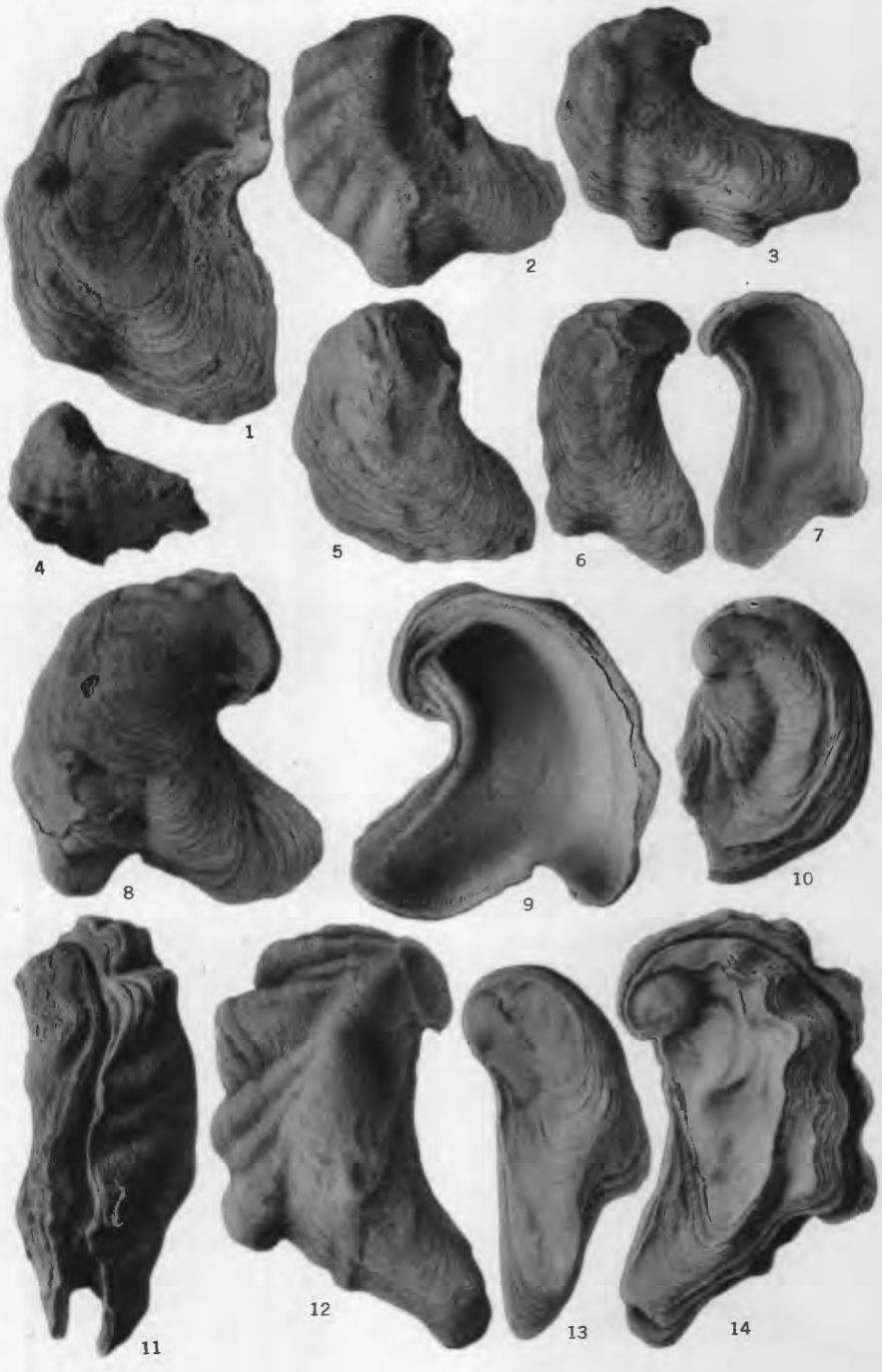
COMANCHE PELECYPODS

695463—47——12

PLATE 25

[All figures natural size.]

FIGURES 1–14. *Exogyra hilli* Cragin. (1) Broad, ovate left valve, plesiotype U.S.N.M. 103200b; (2) small, broad, falcate left valve, plesiotype U.S.N.M. 103200c; (3) small, falcate, left valve, plesiotype U.S.N.M. 103200d; (4) cotype in the Texas State collection at Austin, Texas; (5) nearly smooth left valve, plesiotype U.S.N.M. 103200e; (6, 7) slender left valve, plesiotype U.S.N.M. 103200f; (8, 9) broad, falcate left valve, plesiotype U.S.N.M. 103200g; (10) broad, ovate right valve, plesiotype U.S.N.M. 103200h; (11, 12, 14) large, plicate specimen showing both valves and profiles, plesiotype U.S.N.M. 103200i; (13) slender, right valve, plesiotype U.S.N.M. 103200j. The cotype represented by figure 4 is from the Travis peak formation at Camp Creek, Travis County, Tex. All the other specimens are from the Trinity group at the Pedernales River bluff near the road crossing from Bee Caves to Corwin, Travis County, Tex. (p. 33).



COMANCHE PELECYPODS

PLATE 26

[Figures 5/6 natural size.]

FIGURES 1, 2. *Exogyra quitmanensis* Cragin. Plesiotype U.S.N.M. 103205a, from the Quitman formation of Taff on the east bank of Mayfield Canyon, near its mouth, and about 3 miles east of Indian Hot Springs, Hudspeth County, Tex. (p. 36).

COMANCHE PELECYPODS

PLATE 27

[All figures natural size.]

FIGURES 1–4. *Pecten (Neithea) occidentalis* (Conrad). (1) Plesiotype U.S.N.M. 103228, from the Comanche Peak limestone near depot at Benbrook, 8 miles west of Fort Worth, Tex.; (2, 3) plesiotype U.S.N.M. 103227, from the Comanche Peak limestone at Wolf Creek, about 9 miles northeast of Kerrville on road to Fredericksburg, Tex.; (4) plesiotype U.S.N.M. 103229, from the Quitman formation of Taff at head of Red Bull Canyon, about 3¼ miles from Indian Hot Spring on trail from Quitman Arroyo, Hudspeth County, Tex. (p. 43).

FIGURE 5. *Exogyra quitmanensis* Cragin. Plesiotype U.S.N.M. 103205b, from the Quitman formation of Taff on east bank of Mayfield Canyon, near its mouth, about 3 miles east of Indian Hot Spring, Hudspeth County, Tex. (p. 36).

COMANCHE PELECYPODS

PLATE 28

[All figures natural size.]

FIGURES 1–5. *Exogyra texana* Roemer. (1) Plesiotype U.S.N.M. 103208a; right valve, plesiotype U.S.N.M. 103208b; (3) plesiotype U.S.N.M. 103210a; (4) plesiotype U.S.N.M. 103209; (5) plesiotype U.S.N.M. 103208c. Plesiotypes U.S.N.M. 103208a–c are from the Comanche Peak formation at Post Mountain, 1 mile west of Burnet, Tex. Plesiotype U.S.N.M. 103209 is from the Walnut clay, half a mile east of Greenwood and about 12 miles northeast of Decatur, Tex. Plesiotype U.S.N.M. 103210a is from the Walnut clay on road to Bee Caves, about 9 miles southwest of Austin, Tex. (p. 36).

FIGURE 6. *Exogyra quitmanensis* Cragin. Right valve, plesiotype U.S.N.M. 103206, from the Quitman formation of Taff at the A. L. Ranch on the Rio Grande in the southern Quitman Mountains, Hudspeth County, Tex. (p. 36).

COMANCHE PELECYPODS

PLATE 29

[All figures natural size.]

FIGURES 1–6. *Exogyra texana* Roemer. (1) Right valve, plesiotype U.S.N.M. 103210b; (2) left valve, plesiotype U.S.N.M. 103210c; (3) plesiotype U.S.N.M. 103207a; (4) plesiotype U.S.N.M. 103207b; (5) plesiotype U.S.N.M. 8299 from Bell County, Tex.; (6) plesiotype U.S.N.M. 103210d. Plesiotypes U.S.N.M. 103207a, b are from the Walnut clay on the west bluff of Black Creek, 7 miles northeast of Decatur, Tex. Plesiotypes U.S.N.M. 103210a–d are from the Walnut clay 9 miles southwest of Austin on road to Bee Caves, Travis County, Tex. (p. 36).

COMANCHE PELECYPODS

PLATE 30

[All figures natural size.]

FIGURES 1, 2. *Exogyra texana* Roemer. Exterior and interior of right valve, plesiotype U.S.N.M. 103188, from the Walnut clay, 1½ miles north of Fredericksburg, Tex. (p. 36).

FIGURES 3–12. *Exogyra texana weatherfordensis* Cragin. (3, 4, 10, 11) Interiors and exteriors of both right and left valves of plesiotype U.S.N.M. 103211a; (5) topotype U.S.N.M. 103212a; (6, 8) right and left valves of topotype U.S.N.M. 103212b; (7) right valve, topotype U.S.N.M. 103212c; (9, 12) left and right valves of plesiotype U.S.N.M. 103211b. Plesiotypes U.S.N.M. 103211a, b are from the Glen Rose limestone on Cowhouse Creek, Coryell County, Tex. Topotypes U.S.N.M. 103212a–c are from Glen Rose limestone at Toron Creek, a quarter of a mile west of depot at Weatherford, Parker County, Tex. (p. 38).

COMANCHE PELECYPODS

PLATE 31

[Figures 3/4 natural size.]

FIGURES 1, 2. *Exogyra walkeri* White. Exterior and interior of left valve of cotype U.S.N.M. 8039, from the Fort Worth limestone near Salado, Bell County, Tex. (p. 39).

COMANCHE PELECYPODS

PLATE 32

[Figures 4/5 natural size.]

FIGURES 1, 2. *Exogyra walkeri* White. (1) Interior of right valve of plesiotype U.S.N.M. 7068, from the Fort Worth limestone of Hays County, Tex.; (2) exterior of right valve of plesiotype U.S.N.M. 103213, from the Fort Worth limestone at the railroad cut north of the oil mill in northwest Denison, Tex. (p. 39).

COMANCHE PELECYPODS

695463—47——13

PLATE 33

[Figure slightly reduced.]

FIGURE 1. *Exogyra whitneyi* Böse. Interior of left valve of plesiotype U.S.N.M. 103199, from the Grayson formation near the initial monument of the United States-Mexican Boundary Survey, about 4 miles west of El Paso, Tex. (p. 33).

1

COMANCHE PELECYPODS

PLATE 34

[Figure slightly reduced.]

FIGURE 1. *Exogyra whitneyi* Böse. Exterior of left valve of plesiotype U.S.N.M. 103199, from the Grayson formation near the initial monument of the United States-Mexican Boundary Survey, about 4 miles west of El Paso, Tex. Interior view of same valve shown on plate 33 (p. 33).

1

COMANCHE PELECYPODS

PLATE 35

[Both figures natural size.]

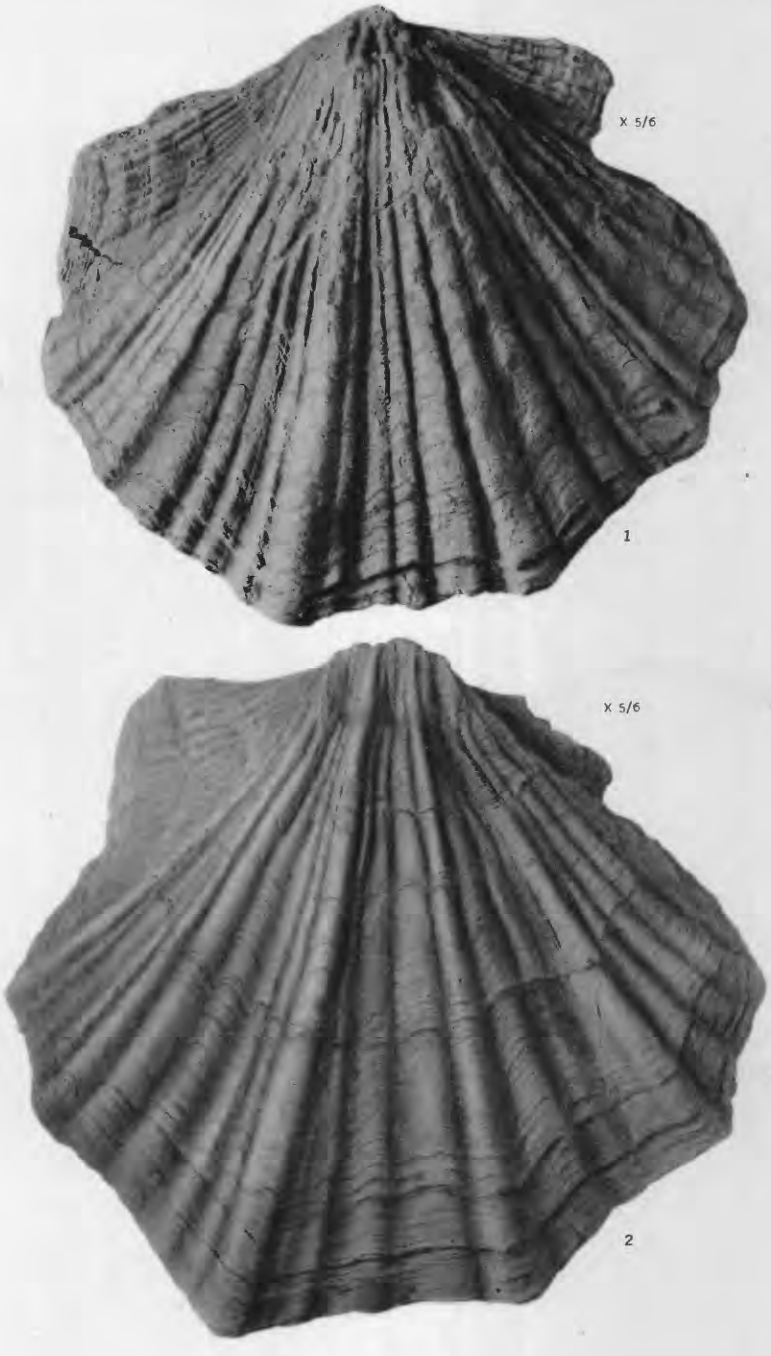
FIGURES 1, 2. *Pecten (Neithea?) roemeri* Hill. Profile view and left valve of paratype U.S.N.M. 19144a, from the Buda limestone at Shoal Creek, Austin, Tex. Right valve of same specimen shown on plate 36, figure 1 (p. 44).

COMANCHE PELECYPODS

PLATE 36

[Figures 5/6 natural size.]

FIGURES 1, 2. *Pecten (Neithea?) roemeri* Hill. (1) Right valve of paratype U.S.N.M. 19144a, from the Buda limestone at Shoal Creek, Austin, Tex.; other views of same specimen shown on plate 35, figures 1 and 2; (2) right valve of paratype U.S.N.M. 19144b, from same locality as specimen represented by figure 1 (p. 44).



COMANCHE PELECYPODS

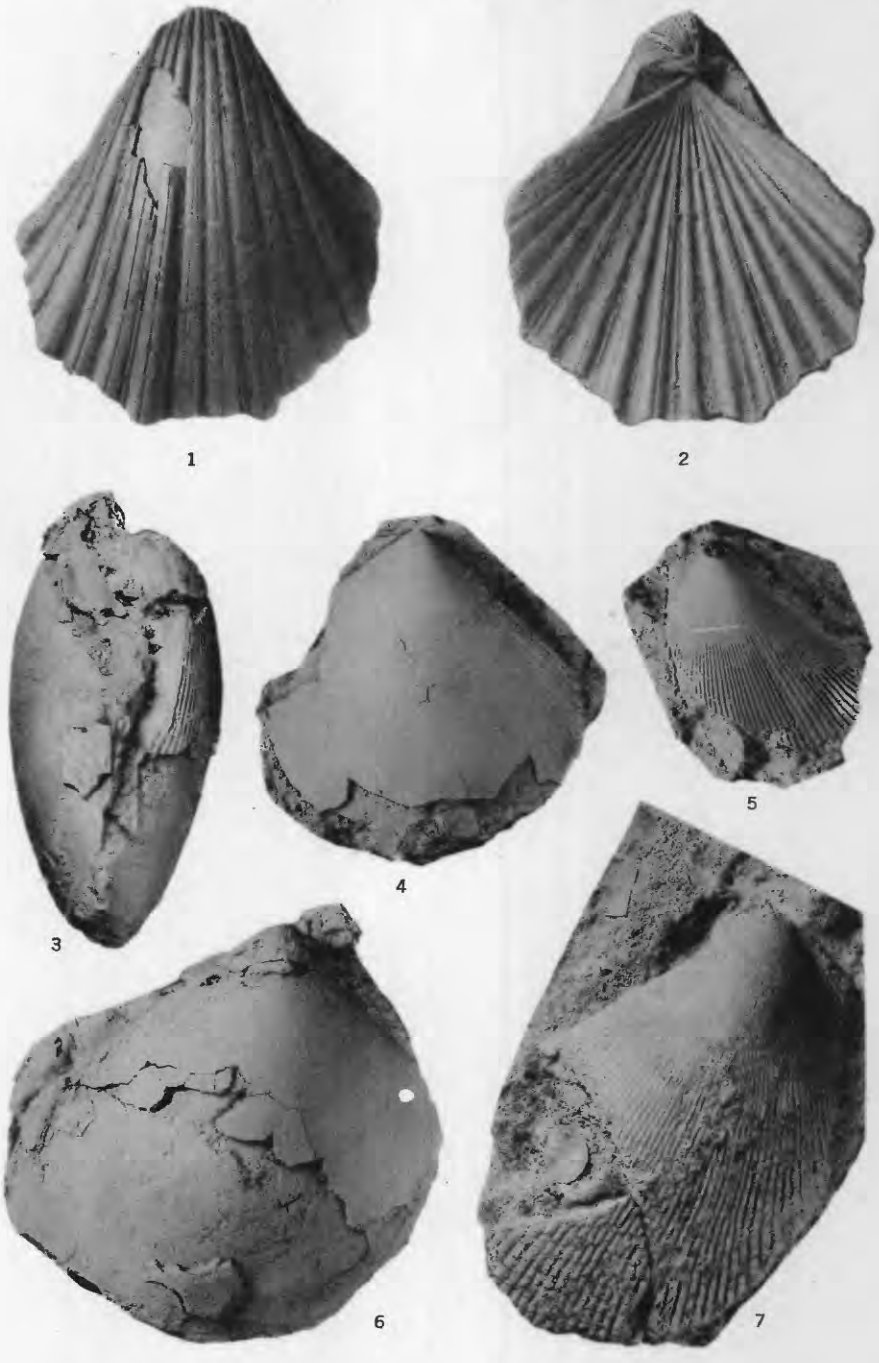
PLATE 37

[All figures natural size.]

FIGURES 1, 2. *Pecten (Neithea) georgetownensis* (Kniker). Plesiotype U.S.N.M. 103235a, from the Georgetown limestone at Georgetown, Tex. (p. 46).

FIGURES 3, 4, 6. *Lima (Plagiostoma) semilaevis* Cragin. (3, 6) Profile view and left valve of plesiotype U.S.N.M. 103243, from the Fort Worth limestone on Hog Creek, near Waco, Tex.; (4) right valve of cotype in the Texas State collection, from the Denton formation at Browns Ferry on the Red River, Cooke County, Tex. (p. 49).

FIGURES 5, 7. *Lima pecosensis* Stanton, n. sp. (5) Right valve of paratype U.S.N.M. 103242, from the upper part of the Devils River limestone at the high bridge across the Pecos River on the Galveston, Harrisburg & San Antonio Railroad, Texas; (7) left valve of holotype U.S.N.M. 103241, from the upper part of the Devils River limestone at the Painted Caves on the Rio Grande, 1 mile below the mouth of the Pecos River, Tex. (p. 48).



COMANCHE PELECYPODS

PLATE 38

[All figures natural size.]

FIGURES 1, 6. *Ctenostreon cumminsi* Stanton, n. sp. (1) Left valve, holotype U.S.N.M. 103237, from the Quitman formation of Taff on the Old Indian Trail in Mule Canyon, about 3 miles from Indian Hot Spring, Hudspeth County, Tex.; (6) left valve of paratype U.S.N.M. 103238 from the Quitman formation at same locality as specimen represented by figure 1 (p. 47).

FIGURES 2, 4, 5. *Pecten (Neithea) texanus* Roemer. (2) Left valve of plesiotype U.S.N.M. 103233, from the Georgetown limestone at "The Gap," Austin, Tex.; (4, 5) plesiotype U.S.N.M. 103231, from the top of the Fort Worth limestone, 2½ miles north of Denison, Tex. (p. 45).

FIGURE 3. *Pecten (Neithea) georgetownensis* (Kniker). Left valve of plesiotype U.S.N.M. 103235b, from Georgetown limestone at Georgtown, Tex. (p. 46).

COMANCHE PELECYPODS

PLATE 39

[All figures natural size.]

FIGURES 1, 2. *Pecten (Neithea) duplicicosta* Roemer. (1) Plesiotype U.S.N.M. 103225, from the upper part of the Edwards limestone, 1 mile south of Merrill's Ranch near head of Frio River, about 40 miles west of Kerrville, Tex.; (2) plesiotype U.S.N.M. 103226, from the Edwards formation(?), about a quarter of a mile east of south end of the Quitman Mountains, Hudspeth County, Tex. (p. 43).

FIGURES 3–5, 7. *Pecten (Neithea) texanus* Roemer. (3, 4) Plesiotype U.S.N.M. 103234, from the Grayson marl member of the Denison formation in the cut of the Bonham Railroad in the southeast edge of Denison, Tex.; (5) right valve of plesiotype U.S.N.M. 103232, from the Fort Worth limestone, 2½ miles north of Denison, Tex.; (7) left valve of plesiotype U.S.N.M. 103230, from a horizon just below the escarpment about a quarter of a mile southwest of Kent, Tex. (p. 45).

FIGURES 6, 8, 9. *Chondrodonta glabra* Stanton. (6) Cross section of lower part of hinge of a large specimen, cotype U.S.N.M. 30180a; (8, 9) exterior and interior of cotype U.S.N.M. 30180b; *pp*, pallial impression; *cl*, chondrophore of lower valve; *cu*, broken edge of chondrophore of the upper valve still adhering in the groove of the lower valve. Both specimens are from the Glen Rose limestone at a quarry 1 mile east of Kerrville, Tex. (p. 48).

COMANCHE PELECYPODS

PLATE 40

[Both figures natural size.]

FIGURES 1, 2. *Chondrodonta glabra* Stanton. Lower and upper valves of plesiotype U.S.N.M. 103239, from the Glen Rose limestone at a quarry 1 mile east of Kerrville, Tex. (p. 48).

2

1

COMANCHE PELECYPODS

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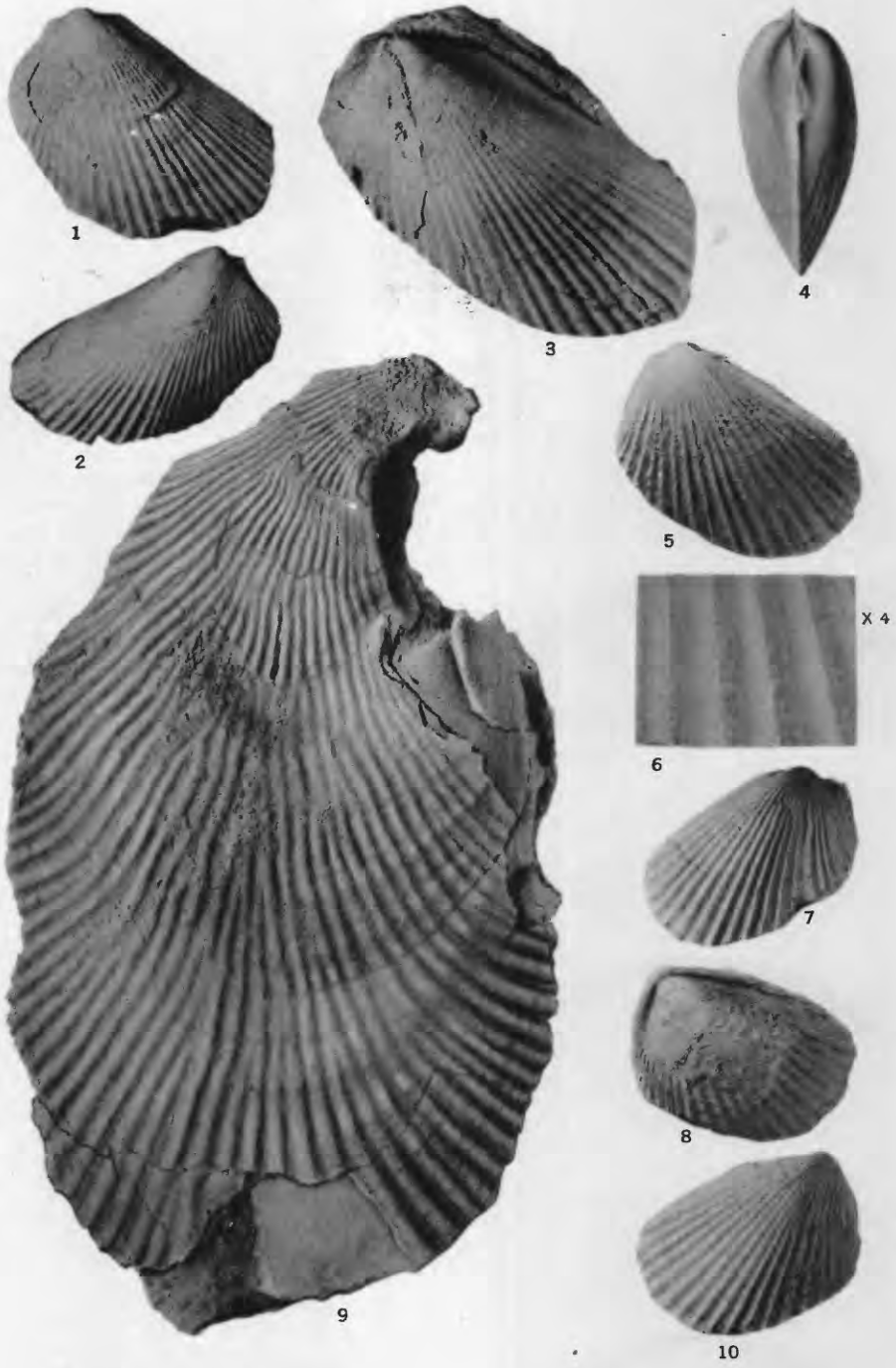
PLATE 41

[Figures natural size unless otherwise indicated.]

FIGURES 1–3. *Lima wacoensis quadrangularis* Stanton, n. var. (1) Right valve of paratype U.S.N.M. 103253a, from the Fort Worth limestone in Fort Worth, Tex.; (2) left valve of paratype U.S.N.M. 103253b, from the Fort Worth limestone in Fort Worth, Tex.; (3) right valve of holotype U.S.N.M. 103252, from the Washita group in the gap between the north and south peaks of Sierra Blanca, Tex. (p. 51).

FIGURES 4–8, 10. *Lima (Mantellum) wacoensis* Roemer. (4–6) Profile view, right valve, and part of enlarged surface (× 4) of plesiotype U.S.N.M. 103250, from Bluff Creek near Crawford in McLennan County, Tex.; (7) left valve of plesiotype U.S.N.M. 103251, from the Comanche Peak limestone at Seven Knobs, about 5 miles southeast of Glen Rose, Tex.; (8) right valve of plesiotype U.S.N.M. 9889a (holotype of *L. leonensis* Conrad), from Leon Springs near Fort Stockton; (10) left valve of plesiotype 9889b, from Leon Springs near Fort Stockton, Tex. (p. 50).

FIGURE 9. *Chondrodonta munsoni* (Hill). Lower valve of medium-sized specimen showing large area of attachment, plesiotype U.S.N.M. 103240a, from the Edwards limestone at the stone bridge across Bartons Creek, Austin, Tex. (p. 48).



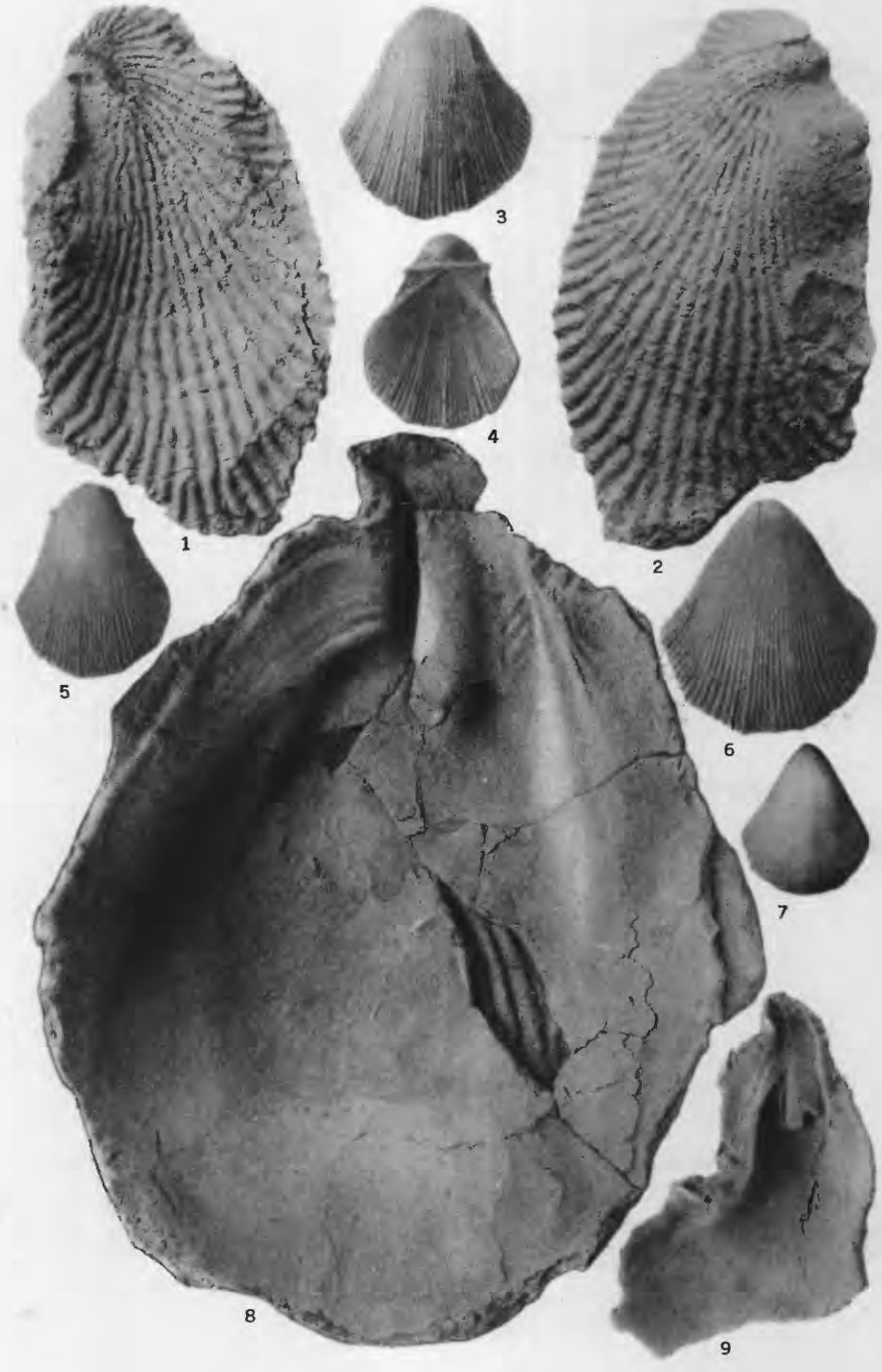
COMANCHE PELECYPODS

PLATE 42

[All figures natural size.]

FIGURES 1, 2, 8, 9. *Chondrodonta munsoni* (Hill). (1, 2) Upper and lower valves of a small specimen, plesiotype U.S.N.M. 30182, from Edwards limestone at Bartons Creek, Austin, Tex.; (8) interior of broadly ovate lower valve, plesiotype U.S.N.M. 103240b, from Edwards limestone at stone bridge across Bartons Creek, Austin, Tex.; (9) hinge and interior of small lower valve, plesiotype U.S.N.M. 103240c, from same locality as specimen represented by figure 8 (p. 48).

FIGURES 3–7. *Pecten (Neithea) bellulus* (Cragin). (3) Plesiotype U.S.N.M. 103224a, from Fort Worth limestone, 10 miles north of Fort Worth, Tex.; (4, 5) plesiotype U.S.N.M. 103223, from the Georgetown limestone near Bartons Springs, Austin, Tex.; (6) plesiotype U.S.N.M. 103224b, from the Fort Worth limestone, 10 miles north of Fort Worth, Tex.; (7) cotype in the Texas State collection at Austin, Tex., from the Fort Worth limestone, half a mile above the Texas and Pacific Railroad bridge across Sycamore Creek, near Fort Worth, Tex. (p. 42).



COMANCHE PELECYPODS

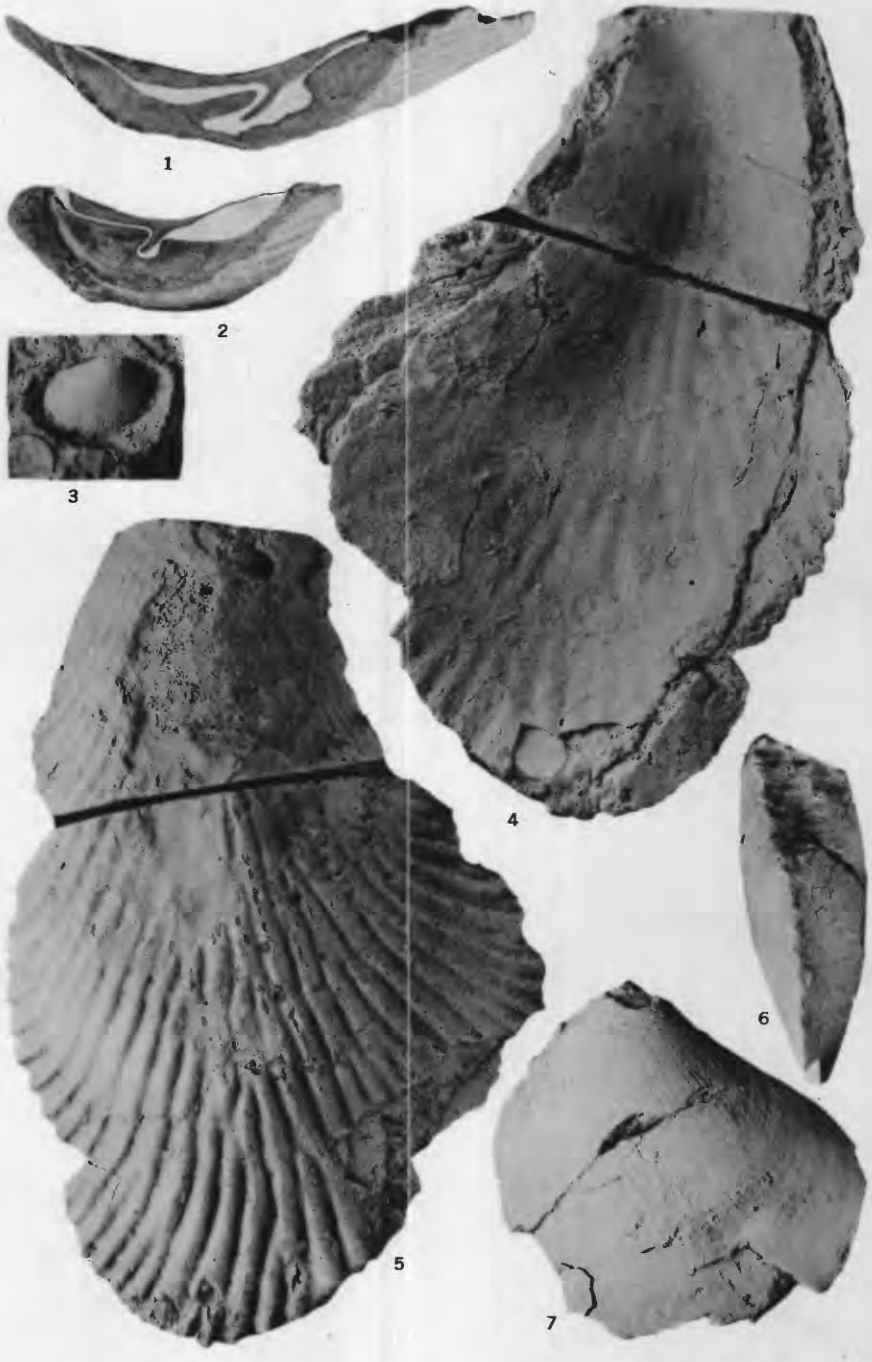
PLATE 43

[All figures natural size.]

FIGURES 1, 2, 4, 5. *Chondrodonta munsoni* (Hill). Plesiotype U.S.N.M. 30181, from the Edwards limestone on the Nolands River at Belton, Tex.; (5) elongate lower valve cut across lower part of hinge and lacking nearly an inch of the umbonal part; (4) upper valve; (2) polished upper end showing transverse section of the two valves and their chondrophores; (1) polished section across lower end of the hinge at cut place shown in figures 4 and 5 (p. 48).

FIGURE 3. *Lima* cf. *L. elpasensis* Stanton, n. sp. Specimen U.S.N.M. 103244, from the Comanche Peak limestone on Wolf Creek, about 9 miles northeast of Kerrville, Tex. (p. 49).

FIGURES 6, 7. *Lima (Plagiostoma) elpasensis* Stanton, n. sp. Profile and right valve of holotype U.S.N.M. 103249, from the Duck Creek (?) limestone on west side of the Rio Grande, about 4 miles northwest of El Paso, Tex. (p. 49).



COMANCHE PELECYPODS

PLATE 44

[All figures natural size.]

FIGURES 1, 2. *Lima (Mantellum) blancensis* Stanton, n. sp. Holotype U.S.N.M. 103245, from the Washita group in the pass betwen the north and south peaks of Sierra Blanca, Texas (p. 49).

FIGURES 3–6. *Chondrodonta munsoni* (Hill). (3, 4) Interior and exterior of small lower valve of plesiotype U.S.N.M. 103240d, pallial line distinct but hinge broken; (5, 6) moderately elongate lower valve and hinge of same; note large area of attachment; plesiotype U.S.N.M. 103240e. Both specimens from the Edwards limestone at the stone bridge across Bartons Creek, Austin, Tex. (p. 48).

FIGURES 7, 8. *Pecten (Neithea) subalpinus* (Böse). Plesiotype U.S.N.M. 8332, from Bell County, Tex. (p. 42).

COMANCHE PELECYPODS

PLATE 45

[Figure 5/6 natural size.]

FIGURE 1. *Pachymya austinensis* Shumard. Exterior of large right valve borrowed from Cragin's collection at Colorado College; plastotype 103254 in the U. S. National Museum. Interior view of same specimen shown on plate 46. Obtained from the upper part of the Washita group, 2 miles east of Gainesville, Cooke County, Tex. (p. 51).

COMANCHE PELECYPODS

PLATE 46

[Figure 5/6 natural size.]

FIGURE 1. *Pachymya austinensis* Shumard. Interior of large right valve shown on plate 45 (p. 51).

COMANCHE PELECYPODS

PLATE 47

[Figures natural size unless otherwise indicated.]

FIGURES 1–4. *Pleurotomaria macilenta* Cragin. (1, 3, 4) Apertural, apical, and basal view of an internal mold, U.S.N.M. 103093, from the Georgetown limestone on Bartons Creek, Austin, Tex.; (2) cotype in the Texas State collection at Austin, Tex., from Gillespie County, Tex. (p. 54).

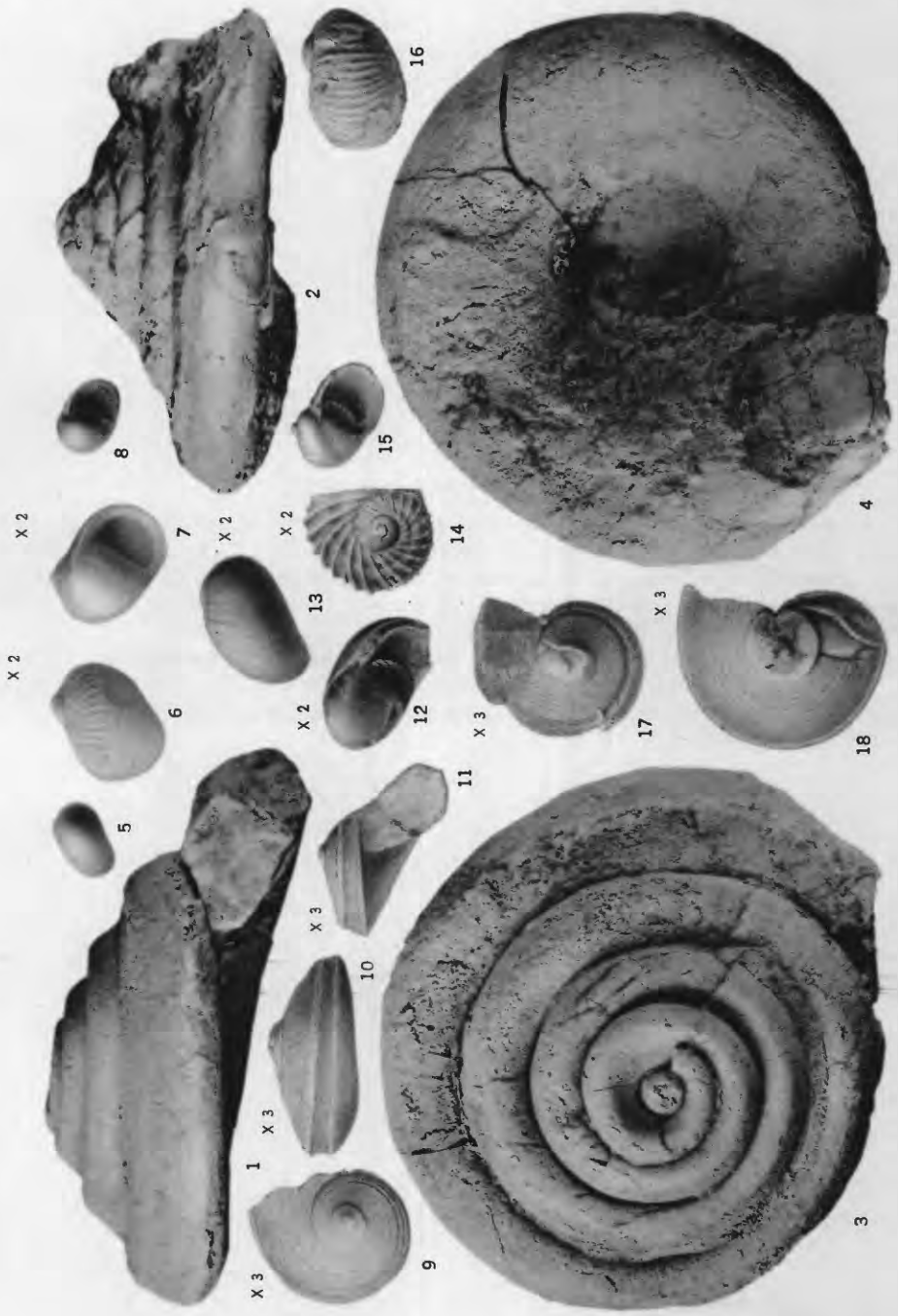
FIGURES 5–8. *Nerita? marcouana* (Cragin). (5, 8) Holotype U.S.N.M. 32674, from the Kiowa shale near Belvidere, Kans.; (6, 7) plesiotype U.S.N.M. 103084 (× 2), from the Kiowa shale, 20 to 40 feet above base, 1 mile south of Belvidere, Kans. (p. 61).

FIGURES 9–11, 17, 18. *Pleurotomaria* (s.l.) *increbescens* Stanton, n. sp. (9) Apical view of cotype U.S.N.M. 103091a (× 3); (11, 17) apertural, apical views of cotype U.S.N.M. 103091b (× 3); (10, 18) dorsal and apical views of cotype U.S.N.M. 103091c (× 3). All cotypes from the Edwards limestone on the west bank of the Colorado River above the mouth of Bartons Creek, near Austin, Tex. (p. 53).

FIGURES 12, 13. *Neritina? elpasensis* Stanton, n. sp. Apertural and dorsal views of holotype U.S.N.M. 103086 (× 2), from the Fredericksburg group in the lowest bed exposed just west of bridge in Southern Pacific Railway cut about 4 miles west of El Paso, Tex. (p. 62).

FIGURES 14, 15. *Nerita? apparata* (Cragin). (14) Apical view of plesiotype U.S.N.M. 103083 (× 2), from the Edwards limestone on the west bank of the Colorado River above mouth of Bartons Creek, near Austin, Tex.; (15) apertural view of plesiotype U.S.N.M. 22987, from the Edwards limestone near Austin, Tex. (p. 61).

FIGURE 16. *Nerita? pecosensis* Stanton, n. sp. Dorsal view of holotype U.S.N.M. 103085, from the Devils River limestone at the Rio Grande in Pecos County, Tex. (p. 62).



COMANCHE GASTROPODS

PLATE 48

[Figures natural size unless otherwise indicated.]

FIGURES 1, 7–10. *Pleurotomaria (Leptomaria) austinensis* Shumard. (1, 8) Apertural and apical views of plesiotype U.S.N.M. 21829, from the Fort Worth limestone, 8 miles north of Fort Worth, Tex. (7) dorsal view of plesiotype U.S.N.M. 19146, from the Georgetown limestone at Bull Creek, near Austin, Tex.; (9, 10) apical and basal view of a cotype of *P. robusta* Cragin in the Texas State collection, from the Fort Worth limestone, 2 miles southwest of Bosqueville in McLennan County, Tex. (p. 52).

FIGURES 2-6. *Trochus (Tectus) texanus* Roemer. (2, 5, 6) Basal and apertural views of plesiotype U.S.N.M. 22988 (figs. 2 and 6 are × 2) from the Edwards limestone near Austin, Tex.; (3, 4) drawing and photograph of plesiotype U.S.N.M. 103175 (× 2), from the Edwards limestone on the west bank of the Colorado River above the mouth of Bartons Creek, near Austin, Tex. (p. 57).

COMANCHE GASTROPODS

695463—47——15

PLATE 49

[Figures natural size unless otherwise indicated.]

FIGURES 1, 2. *Turbo? belviderensis* Stanton, n. sp. Apertural and basal views of holotype U.S.N.M. 103126, from the Kiowa shale near Belvidere, Kans. (p. 54).

FIGURES 3, 4. *Turbo? benbrookensis* Stanton, n. sp. Apertural and dorsal views of holotype U.S.N.M. 103131, from the Comanche Peak limestone near depot at Benbrook, 8 miles west of Fort Worth, Tex. (p. 55).

FIGURES 5, 6. *Turbo? newberryi* (Cragin). (5) Holotype (probably lost) from Champion shell bed at base of Kiowa shale near Belvidere, Kans.; (6) plesiotype U.S.N.M. 103134, from the Purgatoire formation at Mesa Tucumcari, N. Mex. (p. 56).

FIGURES 7, 8. *Turbo? gainesvillensis* Stanton, n. sp. (7) Apertural view of squeeze of holotype U.S.N.M. 103128; (8) lower part of dorsal view of squeeze of paratype U.S.N.M. 103129. Both specimens from the Pawpaw sandy member of the Denison formation, 4½ miles northeast of Gainesville, Cooke County, Tex. (p. 55).

FIGURE 9. *Turbo? gouldi* Stanton, n. sp. Dorsal view of holotype U.S.N.M. 103130, from the Mentor formation, 4½ miles southeast of Marquette, Kans. (p. 55).

FIGURE 10. *Turbo? revueltensis* Stanton, n. sp. Apertural view of holotype U.S.N.M. 103136, from the Purgatoire formation at Monte Revuelto in northeastern New Mexico (p. 56).

FIGURES 11, 12. *Turbo? weatherfordensis* Stanton, n. sp. Holotype U.S.N.M. 103138, from the Comanche Peak limestone, 4 miles south of Weatherford, Parker County, Tex. (p. 56).

FIGURE 13. *Turbo? cookensis* Stanton, n. sp. Holotype U.S.N.M. 103127, from the Pawpaw sandy member of the Denison formation, 4½ miles northeast of Gainesville, Cooke County, Tex. (p. 55).

FIGURES 14, 15. *Amberleya mudgeana* (Meek). (14) Plesiotype U.S.N.M. 77640, from the Kiowa shale, 1 mile south of Belvidere, Kans.; (15) holotype U.S.N.M. 7903, from the Mentor beds, 12 miles southwest of Salina, Kans. (p. 57).

FIGURES 16–19. *Calliostoma (Eutrochus) serratum* Stanton, n. sp. (16–18) Apertural, basal, and dorsal views of cotype U.S.N.M. 77596a; (19) cotype U.S.N.M. 77596b. Both specimens from the Fredericksburg group a quarter of a mile east of south end of Quitman Mountains, Hudspeth County, Tex. (p. 60).

FIGURES 20, 21. *Margarites? brownii* (Cragin). Apertural and basal views of plesiotype U.S.N.M. 77635 (× 2), from the Edwards limestone on the west bank of the Colorado River above Bartons Creek, near Austin, Tex. (p. 59).

FIGURES 22, 23. *Calliostoma cragini* Stanton, n. sp. Holotype U.S.N.M. 77594 (× 3), from the Kiowa shale at Black Hill, 6 miles southeast of Belvidere, Kans. (p. 60).

FIGURES 24–26, 30–32. *Margarites bartonensis* Stanton, n. sp. Photographs (24–26) and drawings (30–32) of a cotype U.S.N.M. 77636 (× 2), from the Edwards limestone on the west bank of the Colorado River above mouth of Bartons Creek, near Austin, Tex. (p. 59).

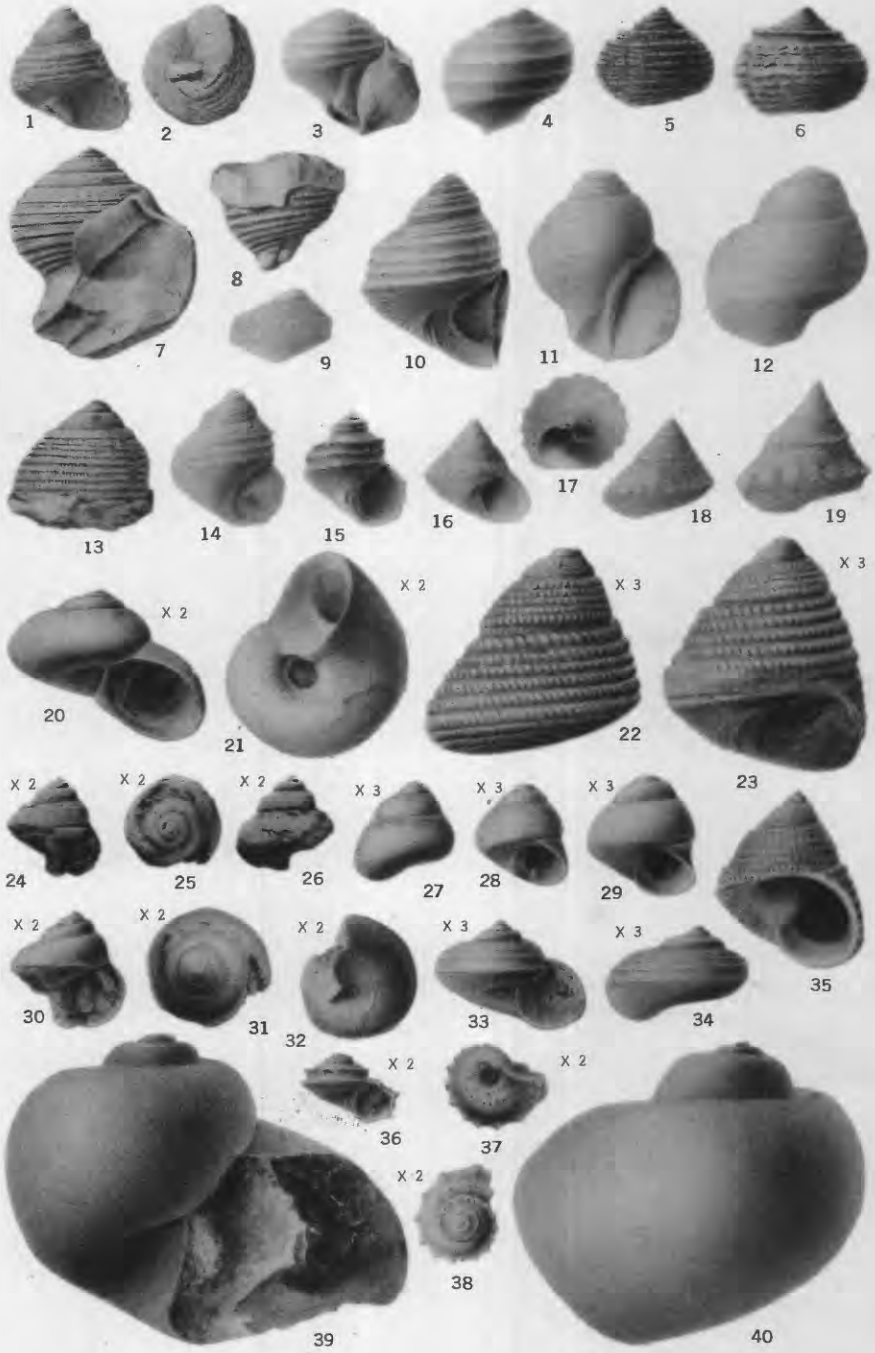
FIGURES 27–29. *Monodonta (Osilinus?) minuta* Stanton, n. sp. (27, 28) Cotype U.S.N.M. 77641a (× 3); (29) cotype U.S.N.M. 77641b (× 3). Both specimens from the Edwards limestone on the west bank of the Colorado River above mouth of Bartons Creek near Austin, Tex. (p. 58).

FIGURES 33, 34. *Margarites bartonensis vaughani* Stanton, n. var. Holotype U.S.N.M. 77638 (× 3), from the Edwards limestone on the west bank of the Colorado River above the mouth of Bartons Creek, near Austin, Tex. (p. 59).

FIGURE 35. *Monodonta bartonensis* Stanton, n. sp. Cotypes U.S.N.M. 103124a–b (figured as one), from the Edwards limestone on the west bank of the Colorado River above the mouth of Bartons Creek, near Austin, Tex. (p. 58).

FIGURES 36–38. *Solariella serrata* Stanton, n. sp. Apertural, basal, and apical view of holotype U.S.N.M. 103112 (× 2), from the Edwards limestone on the west bank of the Colorado River above the mouth of Bartons Creek, near Austin, Tex. (p. 59).

FIGURES 39, 40. *Gyrodes biangulata* (Shumard). Plesiotype in the former collection of F. W. Cragin. From the Duck Creek formation near Marietta, Love County, Okla. (p. 67).



COMANCHE GASTROPODS

PLATE 50

[Figures 4/5 natural size.]

FIGURES 1, 2. *Lunatia? pedernalis* (Roemer). Plesiotype U.S.N.M. 77634, from the Glen Rose limestone between Bee Creek and Pedernales River, near Corwin road to Bee Caves, Hays County, Tex. (p. 66).

COMANCHE GASTROPODS

PLATE 51

[Figures 4/5 natural size.]

FIGURES 1, 2. *Lunatia? praegrandis* (Roemer). Plesiotype U.S.N.M. 7131, from the Glen Rose limestone (?), Coryell County, Tex. (p. 65).

COMANCHE GASTROPODS

PLATE 52

[Figures natural size unless otherwise indicated.]

FIGURES 1–3. *Lunatia cragini* Stanton, n. sp. (1, 3) Cotype U.S.N.M. 77633a; (2) cotype 77633b. Both specimens from the Kiowa shale three-quarters of a mile south of depot at Belvidere, Kans. (p. 65).

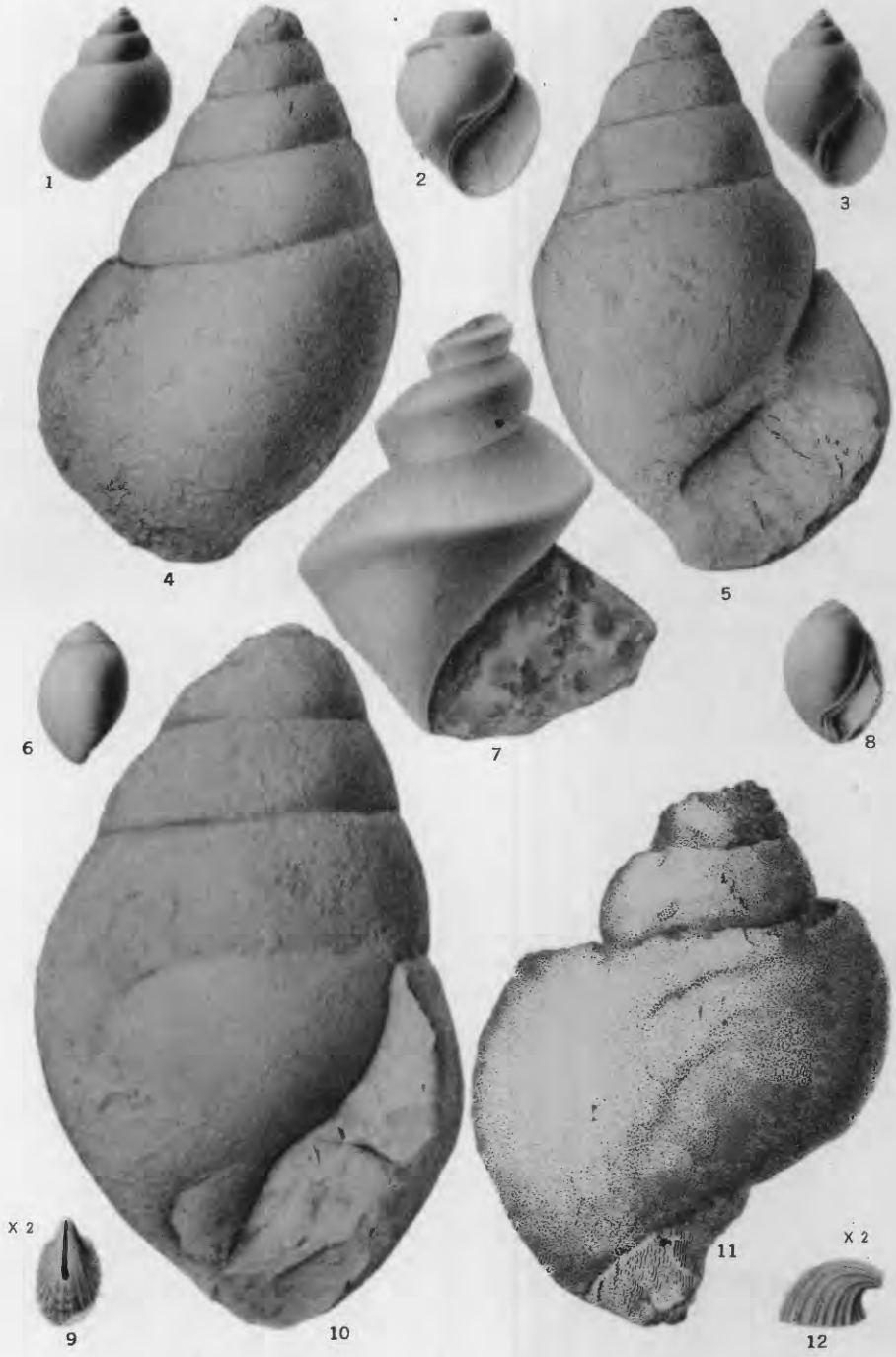
FIGURES 4, 5, 10. *Tylostoma kentense* Stanton, n. sp. (4, 5) Holotype U.S.N.M. 103157, from Washita group, 5 miles west of Kent, Tex.; (10) paratype U.S.N.M. 103156, from Washita group, 1 mile south of Kent, Tex. (p. 69).

FIGURES 6, 8. *Tylostoma? formosum* (Cragin). Holotype in Texas State collection at Austin, Tex. From the Comanche Peak limestone on the Texas and Pacific Railway, 2½ miles east of Benbrook, Tarrant County, Tex. (p. 68).

FIGURE 7. *Trichotropis shumardi* Cragin. Plesiotype U.S.N.M. 32695, from the Comanche Peak limestone, 7½ miles west of Fort Worth on road to Weatherford, Tex. (p. 79).

FIGURES 9, 12. *Rimula vaughani* Stanton, n. sp. (9) Cotype U.S.N.M. 103106a (× 2); (12) cotype U.S.N.M. 103106b (× 2). Both specimens from the Edwards limestone on the west bank of the Colorado River above the mouth of Bartons Creek, near Austin, Tex. (p. 54).

FIGURE 11. *Natica? conradi* (Hill). Dorsal view of holotype, which is probably lost. From the Trinity group at Gypsum Bluff on the Little Missouri River, Pike County, Ark. (p. 64).



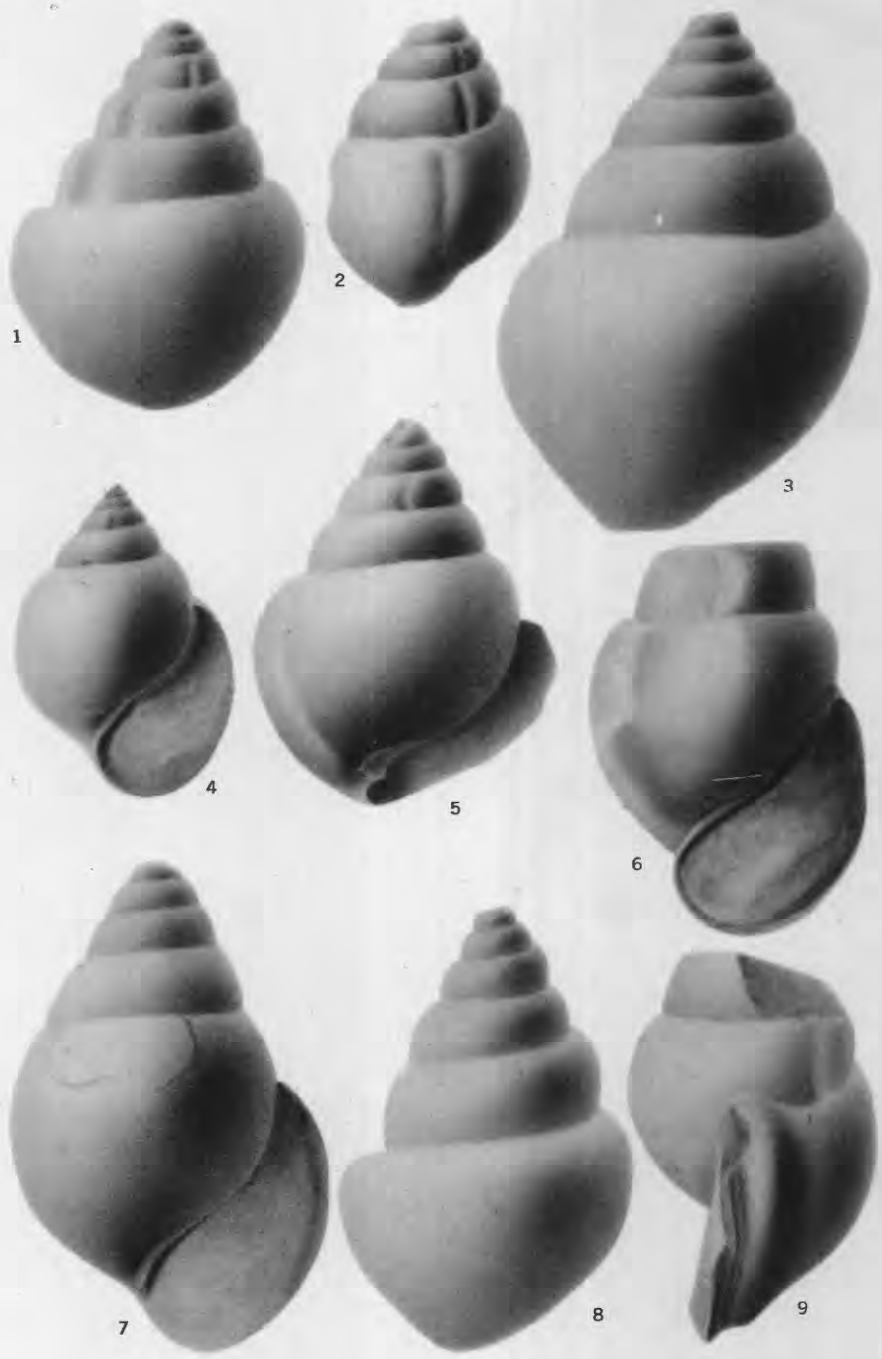
COMANCHE GASTROPODS

PLATE 53

[All figures natural size.]

FIGURES 1–5. *Tylostoma elevatum* (Shumard). (1, 5) Plesiotype U.S.N.M. 103161, from the Comanche Peak limestone near depot at Benbrook, 8 miles west of Fort Worth, Tex.; (2) plesiotype U.S.N.M. 103163, from the Comanche Peak limestone at Chalk Mountain, 12 miles southwest of Glen Rose, Tex.; (3) plesiotype U.S.N.M. 103162, from the Comanche Peak limestone at Seven Knobs, 5 miles southeast of Glen Rose, Tex.; (4) plesiotype U.S.N.M. 103168, from the vicinity of Austin, Tex. (p. 68).

FIGURES 6–9. *Tylostoma tumidum* Shumard. (6, 9) Plesiotype U.S.N.M. 103166a, from the Comanche Peak limestone at Seven Knobs, 5 miles southeast of Glen Rose, Tex.; (7) plesiotype U.S.N.M. 103166b, from the same locality as specimen shown in figures 6 and 9; (8) plesiotype U.S.N.M. 103167, from the Comanche Peak limestone at Chalk Mountain, 12 miles southwest of Glen Rose, Tex. (p. 70).

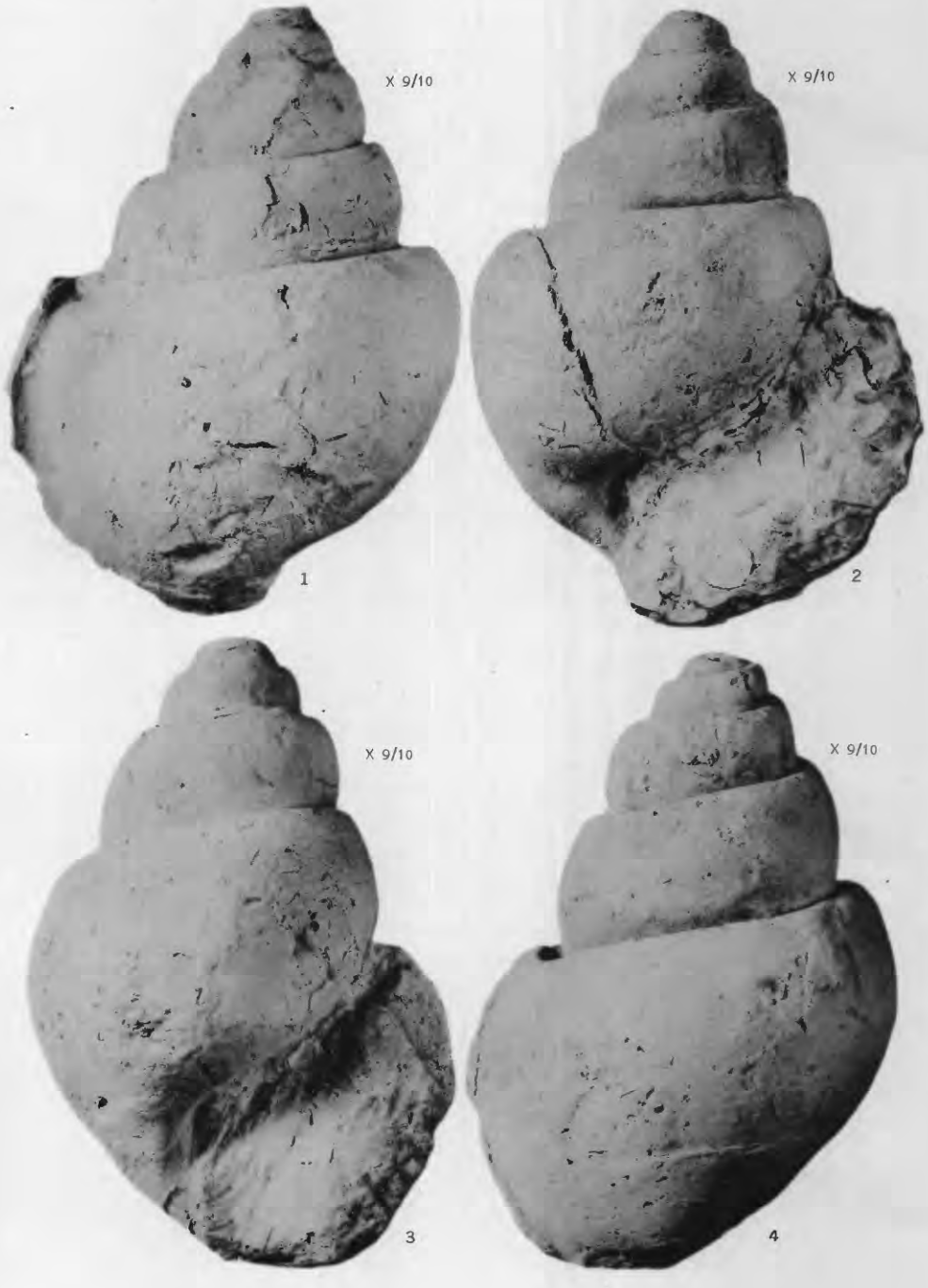


COMANCHE GASTROPODS

PLATE 54

[Figures 9/10 natural size.]

FIGURES 1–4. *Tylostoma regina* (Cragin). (1, 2) Plesiotype U.S.N.M. 103164, from the Fredericksburg group just west of Southern Pacific Railway bridge, about 4 miles west of El Paso, Tex.; (3, 4) plesiotype U.S.N.M. 103165, from the Glen Rose limestone on the right bank of the Paluxy River, 5 miles above Glen Rose, Tex. (p. 69).



COMANCHE GASTROPODS

PLATE 55

[Figures natural size unless otherwise indicated.]

FIGURES 1–3, 10, 11. *Turritella leonensis* Conrad. Holotype U.S.N.M. 9834, from the lower part of the Washita group at Leon Springs, about 9 miles west of Fort Stockton, Tex.; (3) plesiotype U.S.N.M. 19158a, from the Buda limestone near Austin, Tex.; (10, 11) plesiotype U.S.N.M. 19158b (fig. 10 is × 2), from the Buda limestone near Austin, Tex. (p. 73).

FIGURES 4–9. *Pileolus septangularis* Stanton, n. sp. (4, 5) Basal and apical views of cotype U.S.N.M. 103089a (× 3); (6–8) basal, apical and profile views of cotype U.S.N.M. 103089b (× 2); (9) apical view of cotype U.S.N.M. 103089c (× 3). All specimens from the Edwards limestone on the west bank of the Colorado River, above the mouth of Bartons Creek, near Austin, Tex. (p. 62).

FIGURES 12, 14. *Turritella irrorata* Conrad. Holotype U.S.N.M. 9845, last whorl (× 3) and apertural view, from the Del Rio formation "between El Paso and Frontera", Mexico or Texas (p. 72).

FIGURES 13, 22. *Turritella irrorata* Conrad? Last whorl (× 3) and apertural view of specimen U.S.N.M. 103140, from the Grayson formation on the west side of the Rio Grande, about 4 miles northwest of El Paso, Tex. (p. 73).

FIGURES 15, 16. *Cancellaria? medicinensis* (Cragin). Apertural and dorsal views of a cotype formerly in Cragin's collection but probably now lost. From the Kiowa shale, 1½ miles south of depot at Belvidere, Kans. (p. 109).

FIGURES 17, 18. *Triforis? antiquus* Stanton, n. sp. (17) Dorsal view of cotype U.S.N.M. 103117a (× 2); (18) apertural view of cotype U.S.N.M. 103117b (× 2). Both specimens from the Edwards limestone on the west bank of the Colorado River, above the mouth of Bartons Creek, near Austin, Tex. (p. 102).

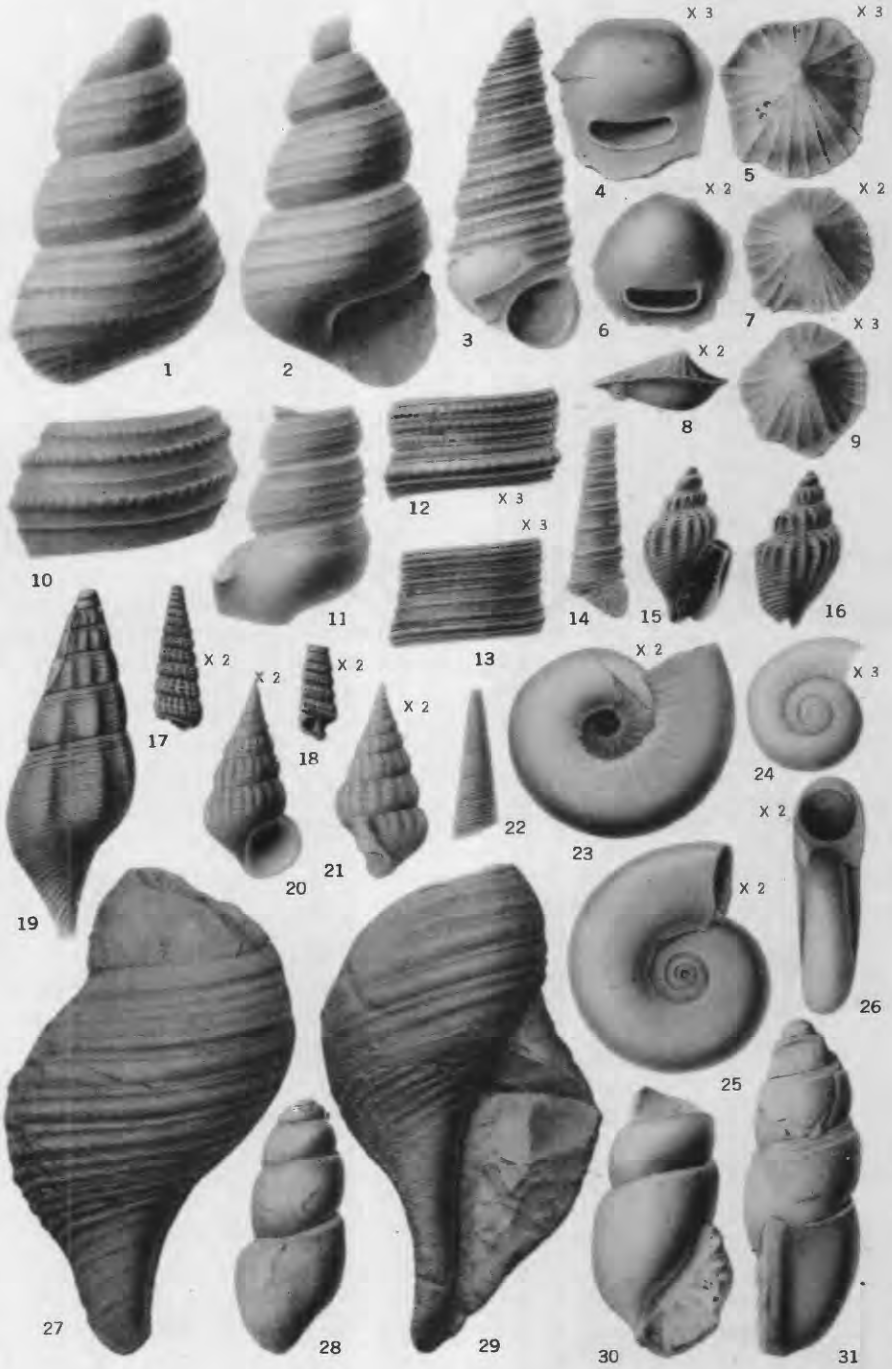
FIGURE 19. *Falsifusus? gainesvillensis* Stanton, n. sp. Squeeze of holotype U.S.N.M. 77625, from the Pawpaw sandy member of the Denison formation, 4½ miles northeast of Gainesville, Cooke County, Tex. (p. 109).

FIGURES 20, 21. *Rissoa? texana* Stanton, n. sp. Apertural and dorsal views of holotype U.S.N.M. 103108 (× 2), from the Fredericksburg group in the eastern foothills of the Quitman Mountains, about 16 miles south of the town of Sierra Blanca, Hudspeth County, Tex. (p. 71).

FIGURES 23–26. *"Solarium" planorbis* Roemer. (23, 25, 26) Basal, apical, and apertural views of plesiotype U.S.N.M. 22989 (× 2); (24) apical view of plesiotype, U.S.N.M. 103114 (× 3). Both specimens from the Edwards limestone on the west bank of the Colorado River, above the mouth of Bartons Creek, near Austin, Tex. (p. 64).

FIGURES 27, 29. *Falsifusus? blancensis* Stanton, n. sp. Dorsal and apertural views of holotype U.S.N.M. 77624, from the Washita group in the gap between the north and south peaks of Sierra Blanca, Tex. (p. 108).

FIGURES 28, 30, 31. *Pseudomelania? pupoides* (Cragin). (28, 31) Cotypes in the Texas State collection at Austin, from the Glen Rose limestone on the Blanco River above Blanco City, Tex.; (30) plesiotype U.S.N.M. 103095, from the Glen Rose limestone in Travis County, Tex. (p. 63).



COMANCHE GASTROPODS

PLATE 56

[Figures natural size unless otherwise indicated.]

FIGURES 1, 2. *Turritella pecosensis* Stanton, n. sp. (1) Dorsal view of cotype U.S.N.M. 103145a (× 2); (2) apertural view of cotype U.S.N.M. 103145b (× 2). Both specimens from the Devils River limestone at the high bridge across the Pecos River on the Galveston, Harrisburg & San Antonio Railway, 3 miles east of Shumla, Tex. (p. 74).

FIGURE 3. *Turritella ventrivoluta* Cragin. Dorsal view of a cotype in the Texas State collection at Austin. Obtained from float on the Texas and Pacific Railway, 3½ miles east of Fort Worth, Tex. (p. 77).

FIGURES 4–6. *Turritella seriatim-granulata gainesvillensis* Stanton, n. var. (4) Paratype U.S.N.M. 103154, retaining shell, from the Pawpaw sandy member of the Denison formation half a mile north of depot at Denison, Tex.; (5) holotype U.S.N.M. 103151, from the Pawpaw sandy member of the Denison formation three quarters of a mile northeast of depot at Denison, Tex.; (6) paratype U.S.N.M. 103152, from the Pawpaw sandy member of the Denison formation, 4½ miles northeast of Gainesville, Tex. (p. 76).

FIGURES 7, 11, 17–24. *Turritella seriatim-granulata* Roemer. (7) Squeeze of holotype (× 2), sculpture slightly exaggerated, from Fredericksburg group near Fredericksburg, Tex.; (11, 20) penultimate whorl (× 2) and apertural view of plesiotype U.S.N.M. 103150a; (17, 24) penultimate whorl (× 3) and dorsal view of a specimen in Gabb's collection from a locality near Arivechi, Sonora, Mex.; (18, 23) penultimate whorl (× 3) and apertural view of a specimen in Gabb's collection from a locality near Arivechi, Sonora, Mex.; (19) plesiotype U.S.N.M. 103149a; (21) plesiotype U.S.N.M. 103149b; (22) plesiotype U.S.N.M. 103150b. Plesiotypes U.S.N.M. 103150a, b, are from the Goodland limestone about 10 miles northwest of Denison on road to Preston, Tex.; plesiotypes U.S.N.M. 103149a, b, are from the Purgatoire formation at Mesa Tucumcari, N. Mex. (p. 75).

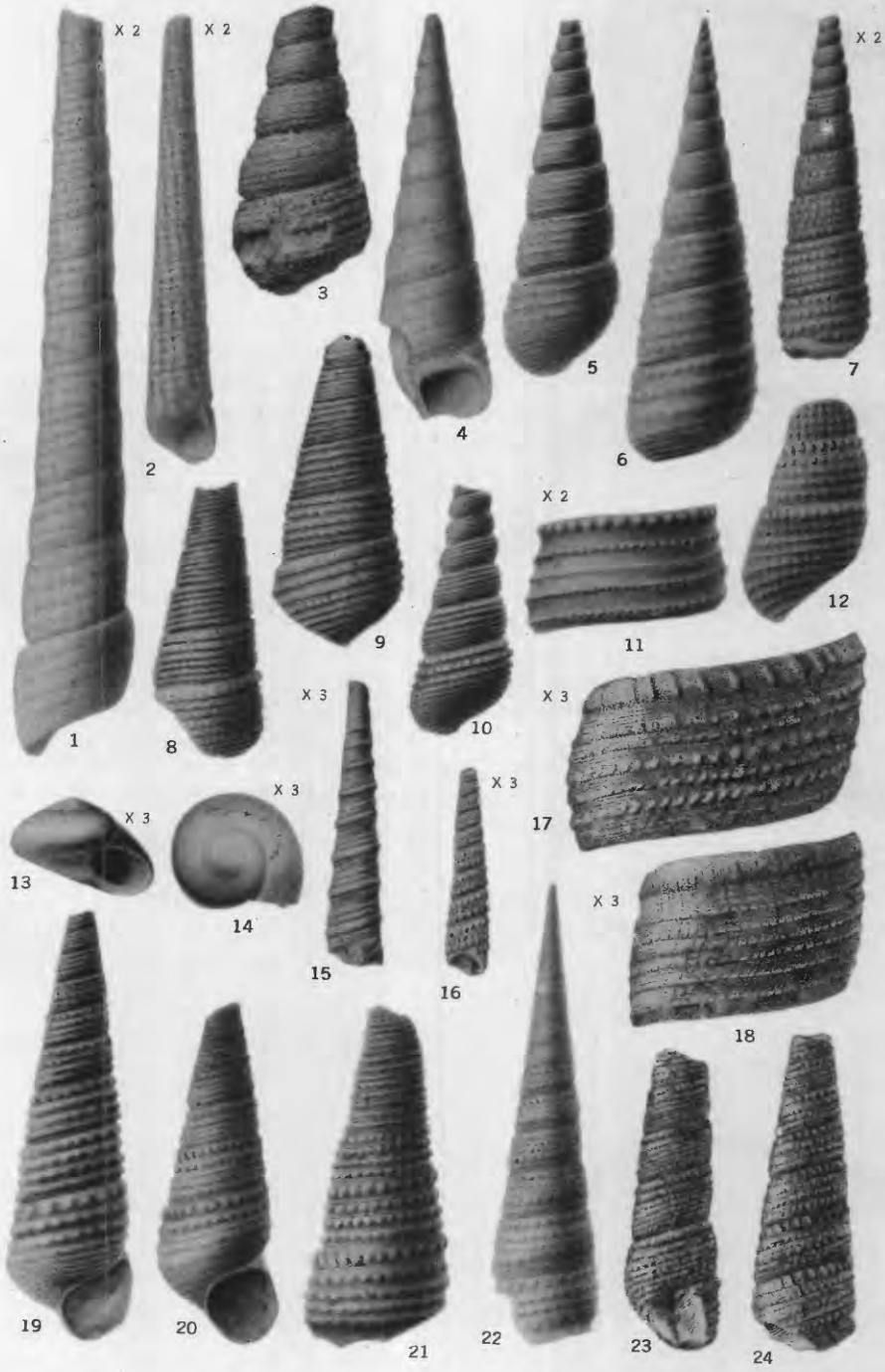
FIGURES 8–10. *Turritella belviderei* Cragin. (8) Plesiotype U.S.N.M. 103139a, somewhat distorted; (9) plesiotype U.S.N.M. 103139b, rather robust; (10) plesiotype U.S.N.M. 103139c, showing ribs more nearly equal than typical of species. All specimens from the Kiowa shale at Black Hill, 6 miles southeast of Belvidere, Kans. (p. 71).

FIGURE 12. *Turritella marnochi* White. Holotype U.S.N.M. 8055, from the Fredericksburg group(?) near Helotes, Bexar County, Tex. (p. 74).

FIGURES 13, 14. *Teinostoma? austinense* Stanton, n. sp. Holotype U.S.N.M. 103115 (×3) from the Edwards limestone on the west bank of the Colorado River, above the mouth of Bartons Creek, near Austin, Tex. (p. 61).

FIGURE 15. *Turritella delriensis* Stanton, n. sp. Holotype U.S.N.M. 103143 (× 3), from the Denton formation, 2 to 3 miles west of Denison, Tex. (p. 74).

FIGURE 16. *Turritella kerrvillensis* Stanton, n. sp. Holotype U.S.N.M. 103141 (× 3), from the Edwards limestone, 6 miles northeast of Kerrville, Tex. (p. 73).



COMANCHE GASTROPODS

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PLATE 57

[Figures natural size unless otherwise indicated.]

FIGURES 1–6. *Cassiope branneri* (Hill). Plesiotype U.S.N.M. 77627a, from the Glen Rose limestone on the right bank of the Paluxy River, 2½ miles North of Glen Rose, Tex.; (3) plesiotype U.S.N.M. 77627b, from same locality as specimen shown on figures 1 and 2; (4) plesiotype U.S.N.M. 77628a, showing nontuberculate ribs and only one strong carina on each whorl, from the Glen Rose limestone 8 miles west of Weatherford, Tex.; (5) plesiotype U.S.N.M. 77628b, showing nontuberculate ribs, from the Glen Rose limestone 8 miles west of Weatherford, Texas; (6) plesiotype U.S.N.M. 77626, from the Glen Rose limestone 18 miles southwest of Decatur, Wise County, Tex. (p. 77).

FIGURES 7, 8. *Cassiope zebra* (Gabb). Cotypes in the Philadelphia Academy of Natural Sciences. From the Fredericksburg group near Arivechi, Sonora, Mex. (p. 79).

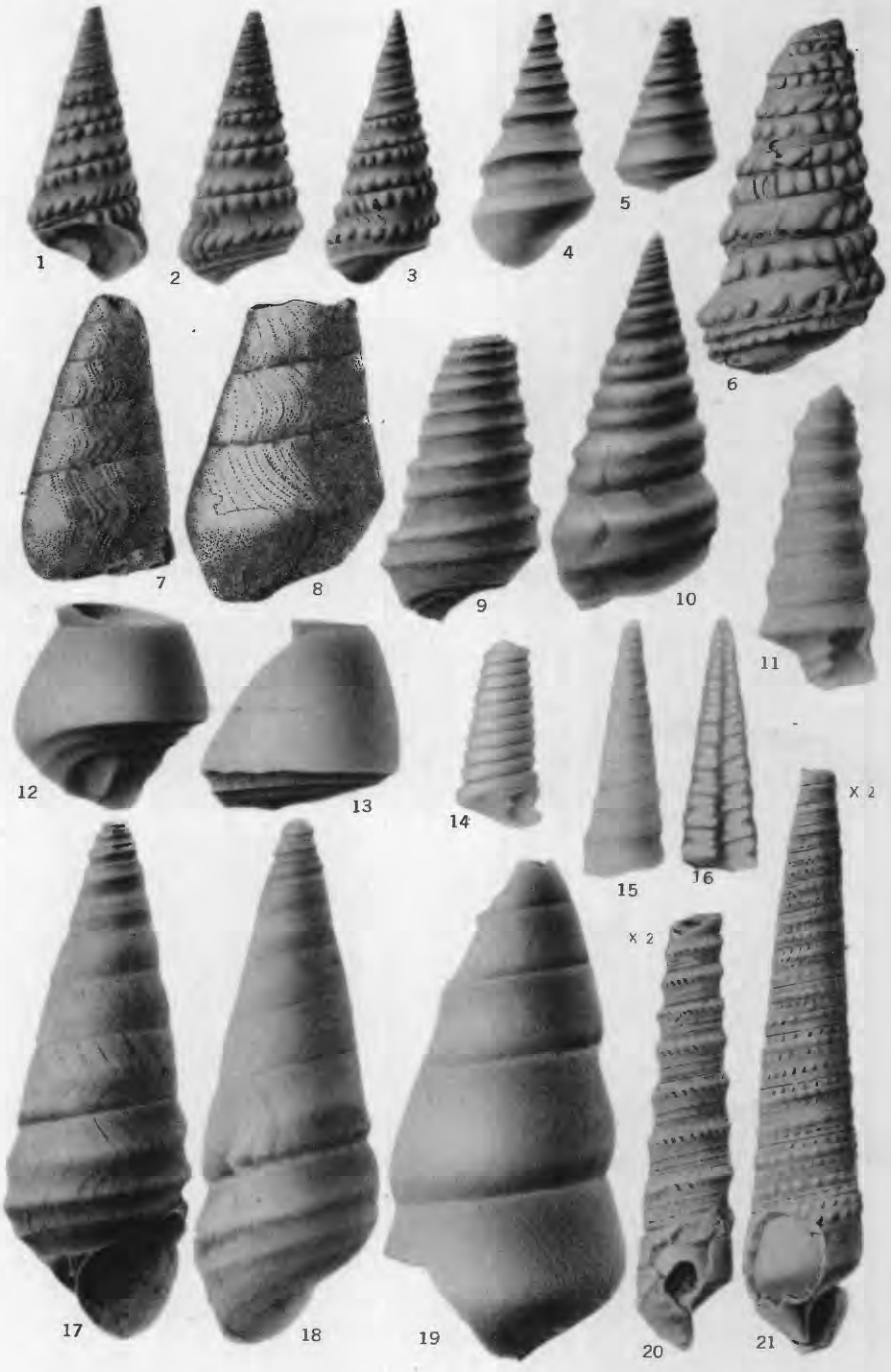
FIGURES 9, 10. *Cassiope burnsi* Stanton, n. sp. Cotypes U.S.N.M. 77629a, b, from the Glen Rose limestone 18 miles southwest of Decatur, Wise County, Tex. (p. 78).

FIGURES 12, 13, 19. *Cassiope hyatti* Stanton, n. sp. Cotypes U.S.N.M. 77630a, b, c, figures 12 and 13 showing spiral ribs on basal part of whorl; from the Purgatoire formation at Mesa Tucumcari, N. Mex. (p. 78).

FIGURES 11, 14–16. *Nerinea pecosensis* Stanton, n. sp. (11) Apertural view of medium-sized specimen, cotype U.S.N.M. 77670a; (14) internal mold, cotype U.S.N.M. 77670b; (15, 16) dorsal view and axial section of cotype U.S.N.M. 77670c, showing gradual change in sculpture. All specimens from the upper part of the Devils River limestone at the high bridge across the Pecos River on the Galveston, Harrisburg & San Antonio Railway, 3 miles east of Shumla, Tex. (p. 86).

FIGURES 17, 18. *Cassiope paluxiensis* Stanton, n. sp. Holotype U.S.N.M. 77631, from the Glen Rose limestone on the right bank of the Paluxy River, 2½ miles north of Glen Rose, Tex. (p. 78).

FIGURES 20, 21. *Nerinea (Aptyxiella) supracostata* Stanton, n. sp. Cotypes U.S.N.M. 77689a, b (× 2), from the Edwards limestone 6 miles northeast of Kerrville, Tex. (p. 92).



COMANCHE GASTROPODS

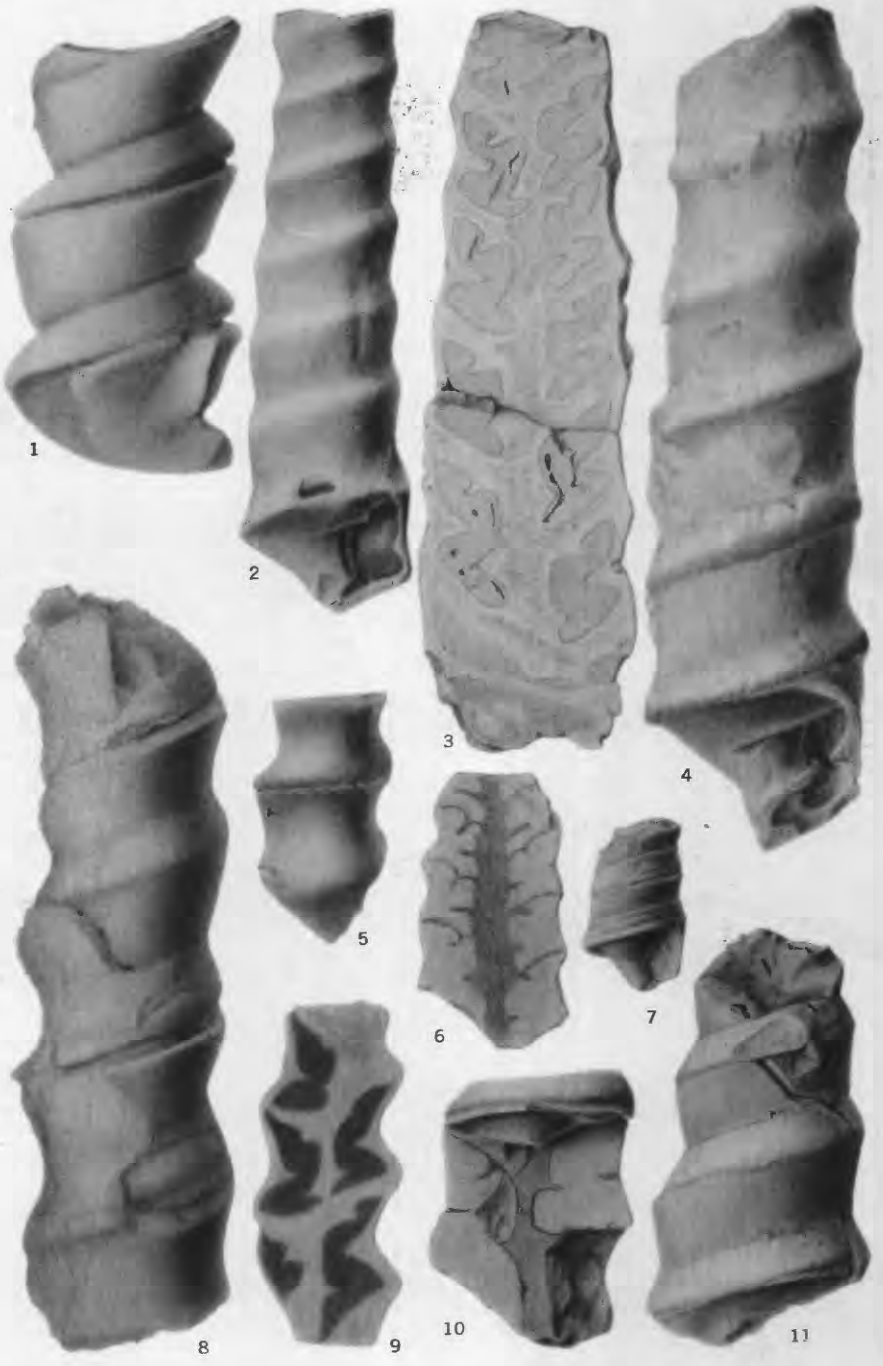
PLATE 58

[All figures natural size.]

FIGURES 1, 5, 8, 9. *Nerinea aquilina* Stanton, n. sp. (1) Apertural view of internal mold, cotype U.S.N.M. 77644a; (5) small specimen retaining shell, cotype U.S.N.M. 77644b; (8) dorsal view of large internal mold retaining part of the shell, cotype U.S.N.M. 77644c; (9) axial view of cotype U.S.N.M. 77644d. All specimens from the Trinity group a little south of old stage road at end of a limestone ridge trending northwest from Eagle Mountain, about 13 miles southeast of town of Sierra Blanca, Hudspeth County, Tex. (p. 80).

FIGURES 2–4. *Nerinea hicoriensis* Cragin. Apertural views and axial section of plesiotypes 77662a, b, c, from the Travis Peak formation in the bed of Cow Creek, about 2 miles below Travis Peak Post Office, Travis County, Tex. (p. 83).

FIGURES 6, 7, 10, 11. *Nerinea incisa* Giebel. (6) Axial section showing second small fold on columella, plesiotype U.S.N.M. 77663a; (7) apertural view showing sculpture, plesiotype U.S.N.M. 77663b; (10, 11) axial section and dorsal view of an internal mold, plesiotype U.S.N.M. 77664 from the Fredericksburg group (?) on the Rio Grande, near crossing of the 103d meridian, Tex. Plesiotypes U.S.N.M. 77663a, b, are from the Comanche Peak limestone at Seven Knobs, 5 miles southeast of Glen Rose, Tex. (p. 84).



COMANCHE GASTROPODS

PLATE 59

[Figures natural size unless otherwise indicated.]

FIGURES 1, 2. *Nerinea colligata* Stanton, n. sp. Axial section and dorsal view of cotypes U.S.N.M. 77646a, b, from the lower part of the Trinity group on Spanish Oak Creek, about 39 miles northwest of Austin, Burnet County, Tex. (p. 81).

FIGURE 3. *Nerinea? acus* Roemer? Squeeze of external mold of specimen U.S.N.M. 77643 (× 2) from the Edwards limestone 150 feet above base, on north bluff of Bluff Creek, half a mile above mouth, near Kickapoo Springs, Tex. (p. 80).

FIGURES 4–6, 11. *Nerinea (Ptygmatis) ponsaltensis* Stanton, n. sp. (4) Apertural view of paratype U.S.N.M. 103174, from the Devils River limestone on the Rio Grande, Pecos County, Tex.; (5, 6) axial section and apertural view of cotypes U.S.N.M. 77674a–b, from the upper part of the Devils River limestone at the high bridge across the Pecos River on the Galveston, Harrisburg & San Antonio Railway, 3 miles east of Shumla, Tex.; (11) dorsal view of paratype U.S.N.M. 77637 (× 2), from the upper part of the Devils River limestone on the Rio Grande, Terrell County, Tex. (p. 87).

FIGURES 7–10, 12–16. *Nerinea riograndensis* Stanton, n. sp. (7) Holotype U.S.N.M. 77681; (8) young specimen with strong sculpture, paratype U.S.N.M. 77682a (× 2); (9, 10) axial section and dorsal view of paratype U.S.N.M. 77682b; (12) medium-sized specimen lacking most of the shell, paratype U.S.N.M. 77683a; (13) dorsal view of internal mold, paratype U.S.N.M. 77683b; (14) small specimen showing change of sculpture, paratype U.S.N.M. 77682c; (15) axial section of paratype U.S.N.M. 103172, from the Devils River limestone on the Rio Grande, Pecos County, Tex.; (16) medium-sized specimen retaining shell, paratype U.S.N.M. 103171, from the Devils River limestone at Painted Caves on the Rio Grande 1 mile below mouth of Pecos River, Tex. Holotype U.S.N.M. 77681 and paratypes 77682a, b, c, are from the upper part of the Devils River limestone at the high bridge across the Pecos River on the Galveston, Harrisburg & San Antonio Railway, 3 miles east of Shumla, Tex. Paratypes U.S.N.M. 77683a, b, are from the upper part of the Devils River limestone near the Rio Grande, Terrell County, Tex. (p. 89).

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PLATE 60

[Figures natural size unless otherwise indicated.]

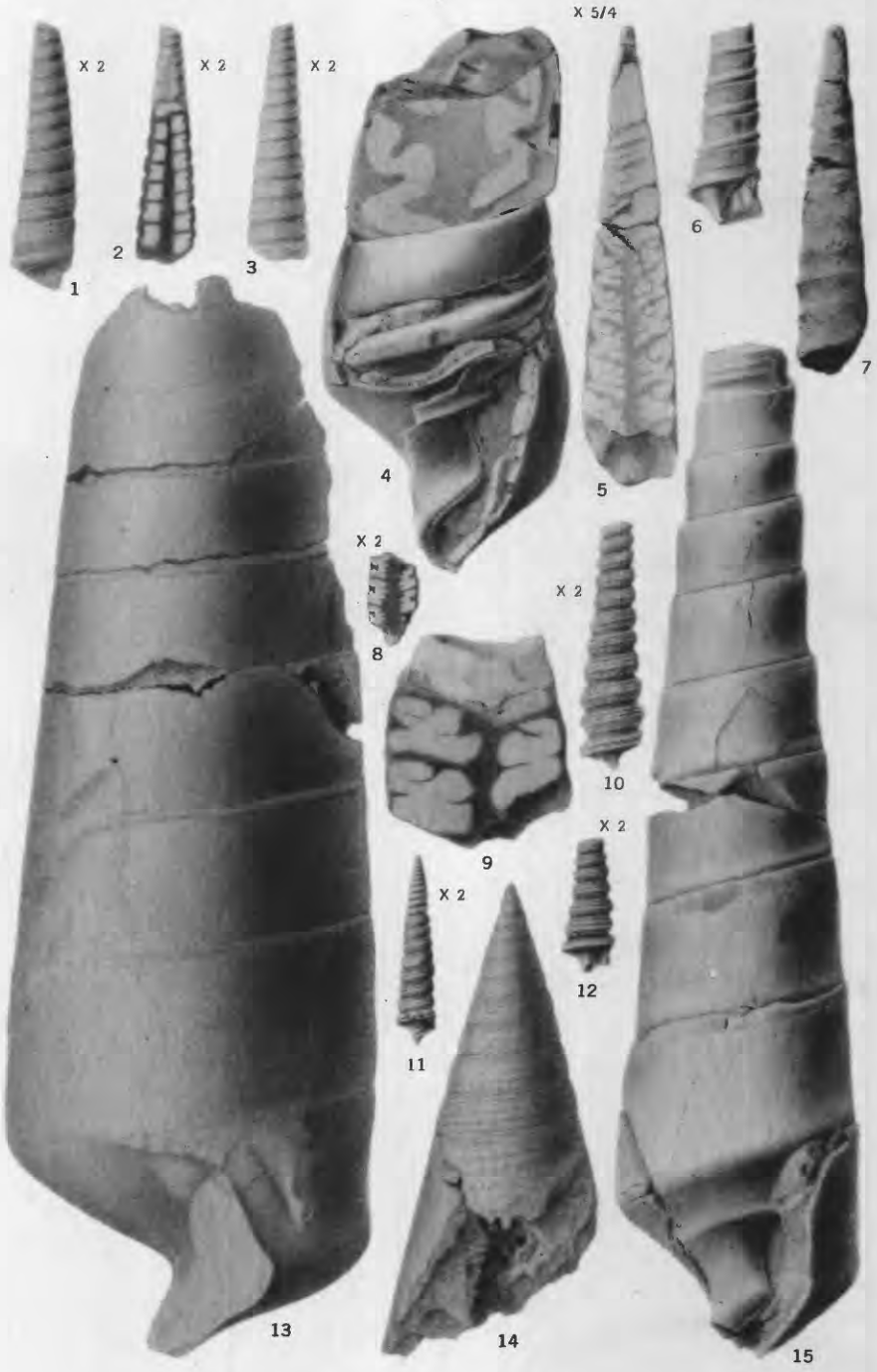
FIGURES 1–3. *Nerinea (Nerinella?) decipiens* Stanton, n. sp. (1) Dorsal view of paratype U.S.N.M. 77649 (× 2), from the upper part of the Devils River limestone at the Painted Caves on the Rio Grande just below the mouth of the Pecos River, Tex.; (2, 3) axial section and dorsal view of holotype U.S.N.M. 77648 (× 2), from the upper part of the Devils River limestone at the high bridge across the Pecos River on the Galveston, Harrisburg & San Antonio Railway, 3 miles east of Shumla, Tex. (p. 82).

FIGURES 4, 15. *Nerinea schottii* Conrad. (4) Apertural view showing axial section of one whorl, cotype U.S.N.M. 9873a; (15) apertural view of cotype U.S.N.M. 9873b. Both specimens from the Devils River limestone on "Oak Creek, near mouth of Puercos [Pecos] River," Terrell County, Tex. (p. 90).

FIGURES 5–7. *Nerinea texana* Roemer. (5–7) Axial section (× 5/4) and dorsal view of specimen U.S.N.M. 103170, from the Goodland limestone 20 miles southwest of Gainesville, Tex.; (6) apertural view of an internal mold, specimen U.S.N.M. 103169, from the Comanche Peak limestone of Bexar County, Tex. (p. 93).

FIGURES 8, 10–12. *Nerinea pseudoconvexa* Stanton, n. sp. (8, 10, 11) Axial section and dorsal views of cotypes U.S.N.M. 77676a, b, c (×2), from the Edwards limestone about 6 miles northeast of Kerrville on road to Fredericksburg, Tex.; (12) apertural view of specimen showing strong sculpture, paratype U.S.N.M. 77678 (× 2), from the Edwards limestone on the west bank of the Colorado River above the mouth of Bartons Creek, near Austin, Tex. (p. 87).

FIGURES 9, 13, 14. *Nerinea sanmartinensis* Stanton, n. sp. (9) Axial section of paratype U.S.N.M. 77685; (13, 14) holotype U.S.N.M. 77684, consisting of two pieces. Both specimens from the Buda limestone at the San Martine water tank on the Texas and Pacific Railway, 8 miles east of Kent, Tex. (p. 90).



COMANCHE GASTROPODS

PLATE 61

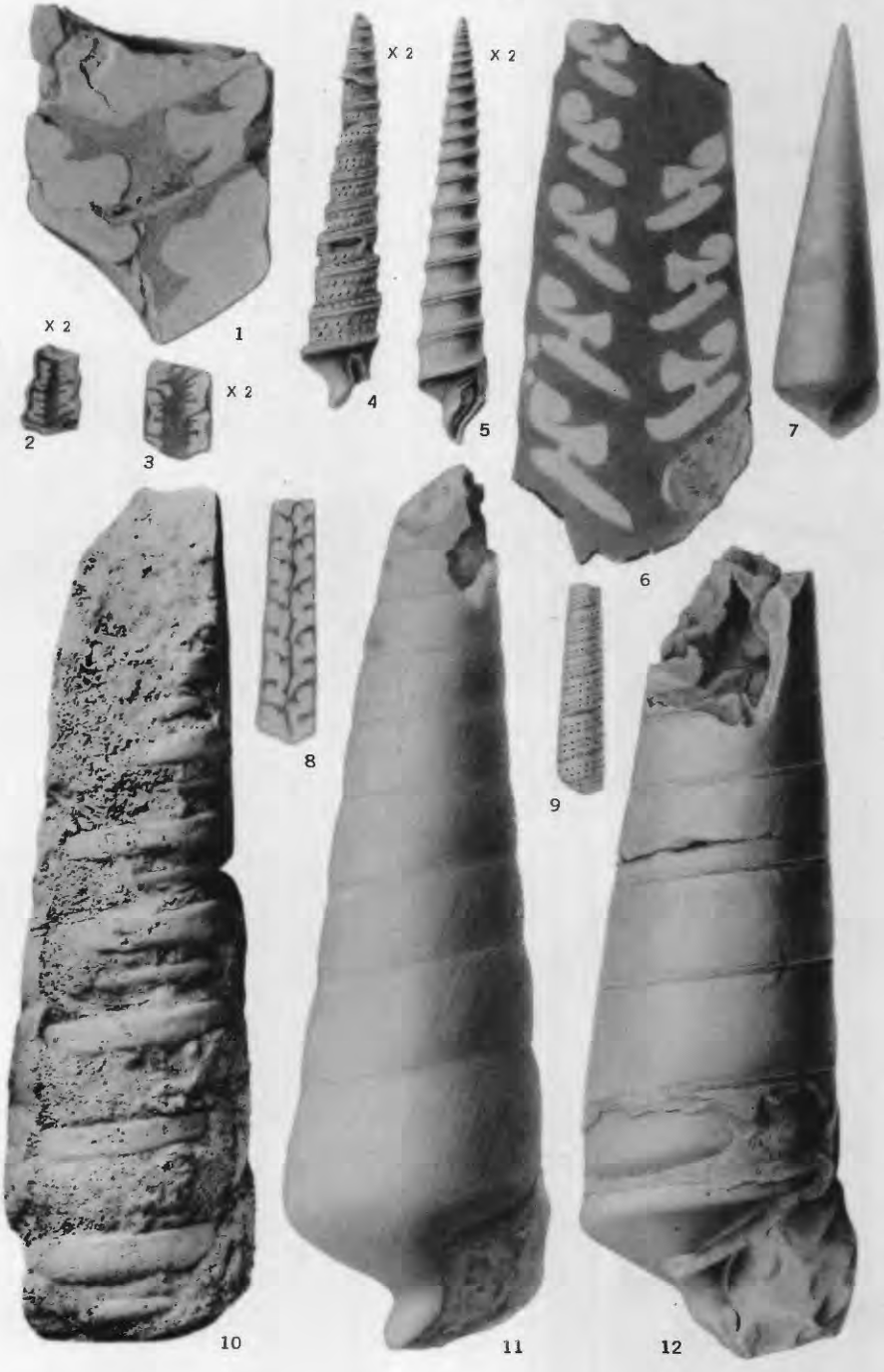
[Figures natural size unless otherwise indicated.]

FIGURES 1, 6, 7, 10–12. *Nerinea volana* Cragin. (1) Axial section of plesiotype U.S.N.M.103082a, from the Buda limestone, about 6 miles west of Kent, Tex.; (6, 7, 11) axial section and apertural views of plesiotypes U.S.N.M. 103081a, b, c, from the Buda limestone, 4½ miles west of Kent, Tex.; (10) cotype in the Texas State collection at Austin, from the San Gabriel River, 6 miles below Georgetown, Tex.; (12) apertural view of plesiotype U.S.N.M. 103082b, from the Buda limestone, about 6 miles west of Kent, Tex. (p. 93).

FIGURES 2, 4. *Nerinea geminata* Stanton, n. sp. (2) Axial section of paratype U.S.N.M. 77653 (× 2); (4) apertural view of holotype U.S.N.M. 77652 (× 2). Both specimens from the Edwards limestone, about 6 miles northeast of Kerrville on road to Fredericksburg, Tex. (p. 82).

FIGURES 3, 5. *Nerinea geminata glabra* Stanton, n. var. (3) Axial section of paratype U.S.N.M. 77657 (× 2); (5) apertural view of holotype U.S.N.M. 77656 (× 2). Both specimens from the Edwards limestone, about 6 miles northeast of Kerrville on road to Fredericksburg, Tex. (p. 83).

FIGURES 8, 9. *Nerinea shumlensis* Stanton, n. sp. Axial section and dorsal view of cotypes U.S.N.M. 77687a, b, from the upper part of the Devils River limestone at the high bridge across the Pecos River on the Galveston, Harrisburg & San Antonio Railway, 3 miles east of Shumla, Tex. (p. 91).



COMANCHE GASTROPODS

PLATE 62

[Figures natural size unless otherwise indicated.]

FIGURES 1, 2. *Nerinea quadrilineata* Stanton, n. sp. (1) Holotype U.S.N.M. 4534a, from the Fredericksburg group at "San Lucas Springs" (probably San Marcos), Tex.; (2) axial section of paratype U.S.N.M. 77680 (× 2) from the upper part of the Glen Rose limestone in the bed of the Paluxy River at Glen Rose, Tex. (p. 88).

FIGURES 3, 4. *Nerinea (Aptyxiella) subula* Roemer. Plesiotypes U.S.N.M. 77688a, b (×2), from the Edwards limestone, about 6 miles northeast of Kerrville on road to Fredericksburg, Tex. (p. 92).

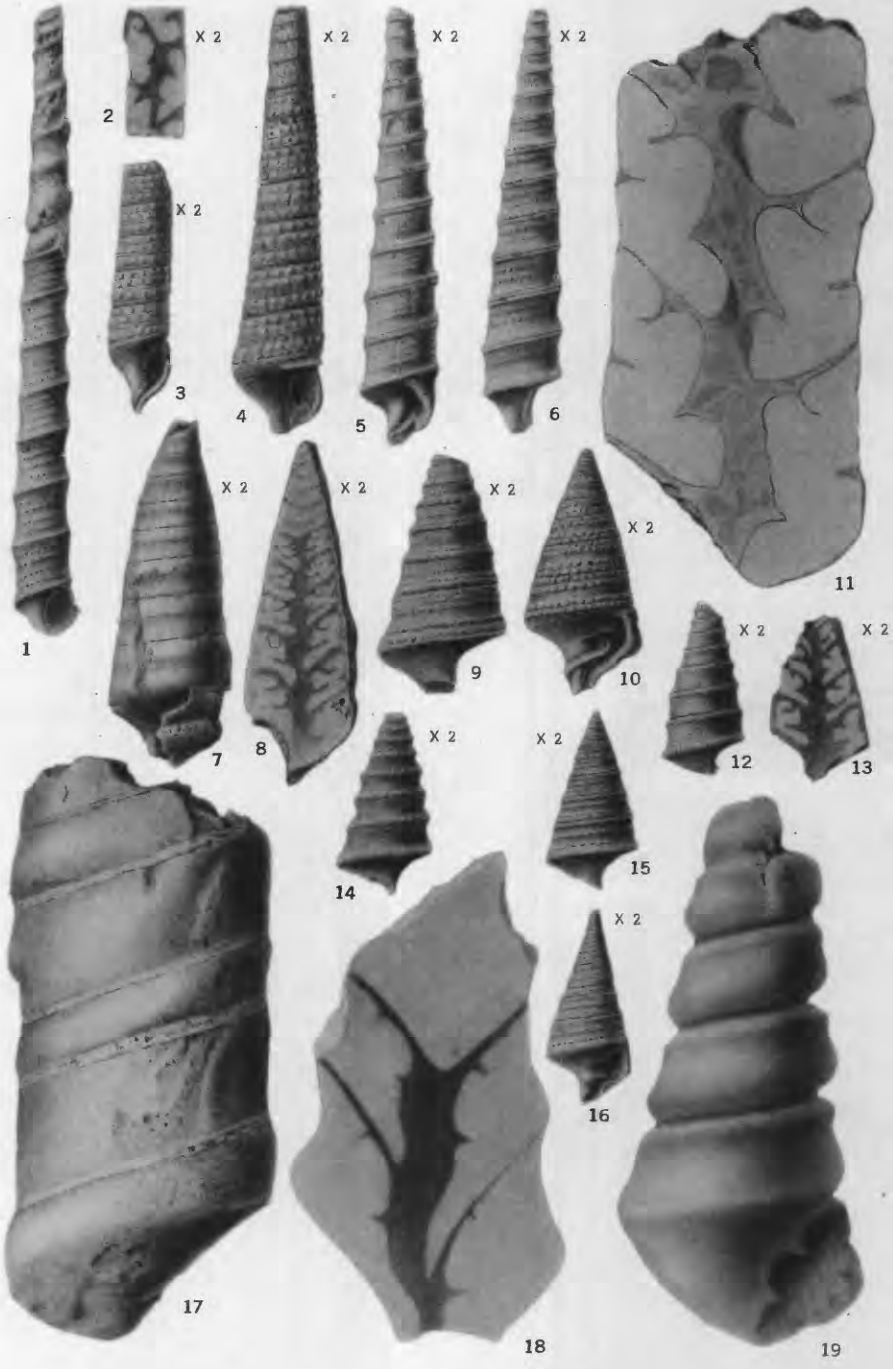
FIGURES 5, 6. *Nerinea geminata parvilineata* Stanton, n. var. Cotypes U.S.N.M. 77659a, b (× 2), from the Edwards limestone, about 6 miles northeast of Kerrville on the road to Fredericksburg, Tex. (p. 83).

FIGURES 7, 8. *Nerinea kerrvillensis* Stanton, n. sp. Dorsal view and axial section of cotypes U.S.N.M. 77666a, b (×2), from the Edwards limestone, 6 miles northeast of Kerrville on road to Fredericksburg, Tex. (p. 85).

FIGURES 9, 10, 12–16. *Nerinea pellucida* Cragin. Plesiotypes U.S.N.M. 77672a-g (× 2), from the Edwards limestone on the Colorado River near Austin, Tex. (p. 86).

FIGURES 11, 17. *Nerinea occidentalis* Stanton, n. sp. Axial section and dorsal view of holotype U.S.N.M. 77668, from the Washita group(?) near the Rio Grande, at the crossing of the 103d meridian, Tex. (p. 86).

FIGURES 18, 19. *Nerinea kentensis* Stanton, n. sp. Axial section and apertural view of internal molds of cotypes U.S.N.M. 77665a, b, from the Buda limestone near the San Martin water tank on the Texas and Pacific Railway, 8 miles east of Kent, Tex. (p. 85).



COMANCHE GASTROPODS

PLATE 63

[Figures natural size unless otherwise indicated.]

FIGURES 1, 2. *Trochactaeon parvus* Stanton, n. sp. Apertural and dorsal views of cotypes U.S.N.M. 103123a, b (×2), from the Edwards limestone on the bank of the Colorado River above the mouth of Bartons Creek, near Austin, Tex. (p. 112).

FIGURES 3–6, 13. *Trochactaeon cumminsi* Stanton, n. sp. (3) Apertural view of large, slender specimen, cotype U.S.N.M. 103121a; (4) apertural view of a stout specimen, paratype U.S.N.M. 103119, from the Devils River limestone at Painted Caves on the Rio Grande, 1 mile below mouth of the Pecos River, Tex.; (5) dorsal view showing distinct growth lines, cotype U.S.N.M. 103121b; (6) internal mold of cotype U.S.N.M. 103121c; (13) apertural view of a small, stout specimen, cotype U.S.N.M. 103121d. All cotypes are from the Devils River limestone at the high bridge across the Pecos River on the Galveston, Harrisburg & San Antonio Railway, 3 miles east of Shumla, Tex. (p. 111).

FIGURES 7, 8. *Avellana hilli* Stanton, n. sp. Cotypes U.S.N.M. 77591a, b (×2) from the Weno formation, 8 miles north of Fort Worth, Tex. (p. 112).

FIGURES 9, 10. *Pseudonerinea? arkansensis* Stanton, n. sp. Holotype U.S.N.M. 22598; (10) axial section of paratype U.S.N.M. 103098 (× 3/2). Both types from the Trinity group in T. 7 S., R. 27 W., Ark. (p. 95).

FIGURES 11, 12. *Avellana chispensis* Stanton, n. sp. Holotype U.S.N.M. 77590, from the Washita group in the ridge west of the abandoned railroad, about 7 miles southwest of Chispa, Tex. (p. 112).

FIGURES 14–20. *Pseudonerinea multiformis* Stanton, n. sp. Cotypes U.S.N.M. 103096a-g, from the Fredericksburg group (?), 12 miles south of Weatherford, Tex. (p. 94).

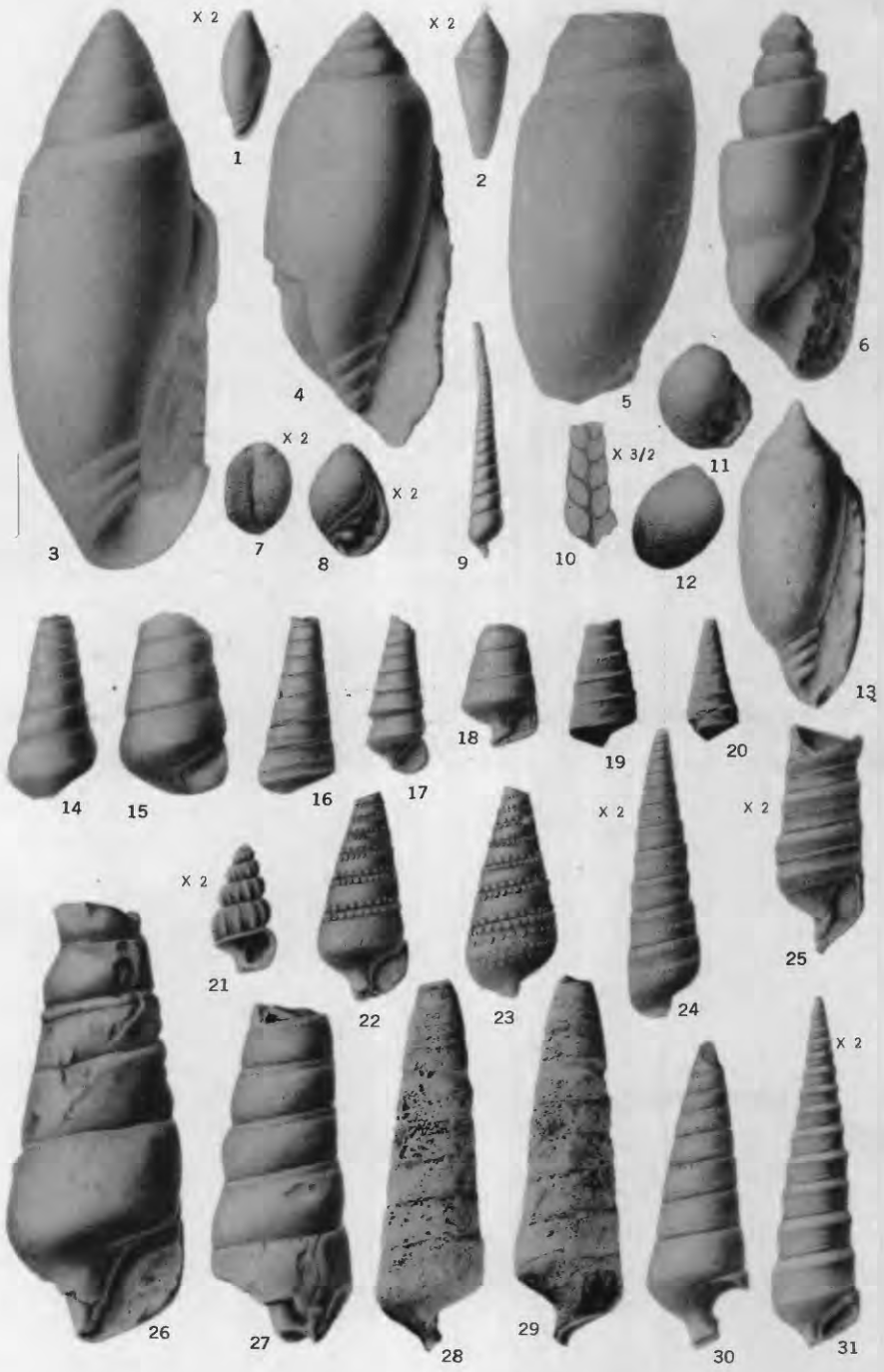
FIGURE 21. *Epitonium? austinense* Stanton, n. sp. Holotype U.S.N.M. 103110 (× 2) from the Edwards limestone on the west bank of the Colorado River above the mouth of Bartons Creek, near Austin, Tex. (p. 63).

FIGURES 22, 23, 28–30. *Pseudonerinea proctori* (Cragin). (22, 23) Plesiotype in the R. T. Hill collection at Johns Hopkins University, spiral sculpture slightly exaggerated, from the Edwards limestone near Austin; (28, 29) cotype U.S.N.M. 32697, from the Edwards limestone northwest of Austin, Tex.; (30) plesiotype U.S.N.M. 103101, from the Edwards limestone near Austin, Tex. (p. 95).

FIGURES 24, 25. *Pseudonerinea terebroides* Stanton, n. sp. Cotypes U.S.N.M. 103102 a, b (× 2), from the Edwards limestone, 6 miles northeast of Kerrville on road to Fredericksburg, Tex. (p. 96).

FIGURES 26, 27. *Pseudonerinea? presidiensis* Stanton, n. sp. Cotypes U.S.N.M. 103099a, b, from the Fredericksburg group (?) on the west side of the mountain on the south side of the Rio Grande opposite Presidio, Tex. (p. 95).

FIGURE 31. *Pseudonerinea terebroides glabra* Stanton, n. var. Holotype U.S.N.M. 103104 (× 2) from the Edwards limestone, 6 miles northeast of Kerrville on road to Fredericksburg, Tex. (p. 96).



COMANCHE GASTROPODS

PLATE 64

[Figures natural size unless otherwise indicated.]

FIGURES 1–4. *Cerithium? bartonense* Stanton, n. sp. (1, 2) Cotypes U.S.N.M. 77600a (× 2); (3) cotype U.S.N.M. 77600b (×2); (4) cotype U.S.N.M. 77600c (× 2). All types from the Edwards limestone on the west bank of the Colorado River above the mouth of Bartons Creek, near Austin, Tex. (p. 97).

FIGURES 5, 6. *Cerithium kansasense* Stanton, n. sp. Holotype U.S.N.M. 77606 (× 2), from the Kiowa shale on the west branch of Bear Creek, about 11 miles northwest of Ashland in Clark County, Kans. (p. 99).

FIGURES 7, 8, 26. *Cerithium diversecingulatum* Stanton, n. sp. Cotypes U.S.N.M. 77604a, b, c (figure 8 is × 2); from the Fredericksburg group in the eastern foothills of the Quitman Mountains, about 16 miles south of the town of Sierra Blanca, Hudspeth County, Tex. (p. 98).

FIGURES 9–11. *Cerithium kickapooense* Stanton, n. sp. Cotypes U.S.N.M. 77611a-c (× 2), from the Edwards limestone on the west bank of the Colorado River above the mouth of Bartons Creek, near Austin, Tex. (p. 100).

FIGURES 12, 17. *Cerithium quitmanense* Stanton, n. sp. Cotypes U.S.N.M. 77616a, b (× 2), from the Fredericksburg group in the eastern foothills of the Quitman Mountains, about 16 miles south of the town of Sierra Blanca, Hudspeth County, Tex. (p. 100).

FIGURES 13, 14. *Cerithium? shattucki* Stanton, n. sp. Cotypes U.S.N.M. 77621a, b (× 2), from the Edwards limestone on the west bank of the Colorado River above mouth of Bartons Creek, near Austin, Tex. (p. 101).

FIGURES 15, 20. *Cerithium riograndense* Stanton, n. sp. (15) Cotype U.S.N.M. 77619, from the Washita group on the ridge east of Mule Canyon near the Rio Grande, 25 miles south of the town of Sierra Blanca, Hudspeth County, Tex.; (20) cotype U.S.N.M. 77617, from the Washita group in the pass between the north and south peaks of Sierra Blanca, Hudspeth County, Tex. (p. 101).

FIGURES 16, 25. *Cerithium? obliterato-granosum* Roemer. Plesiotypes U.S.N.M. 77608a, b, from the Edwards limestone on the Colorado River near Austin, Tex. (p. 99).

FIGURES 18, 19. *Cerithium pecosense* Stanton, n. sp. Holotype U.S.N.M. 4552, from the Fredericksburg group at "Pecos Shoals," Tex. (p. 99).

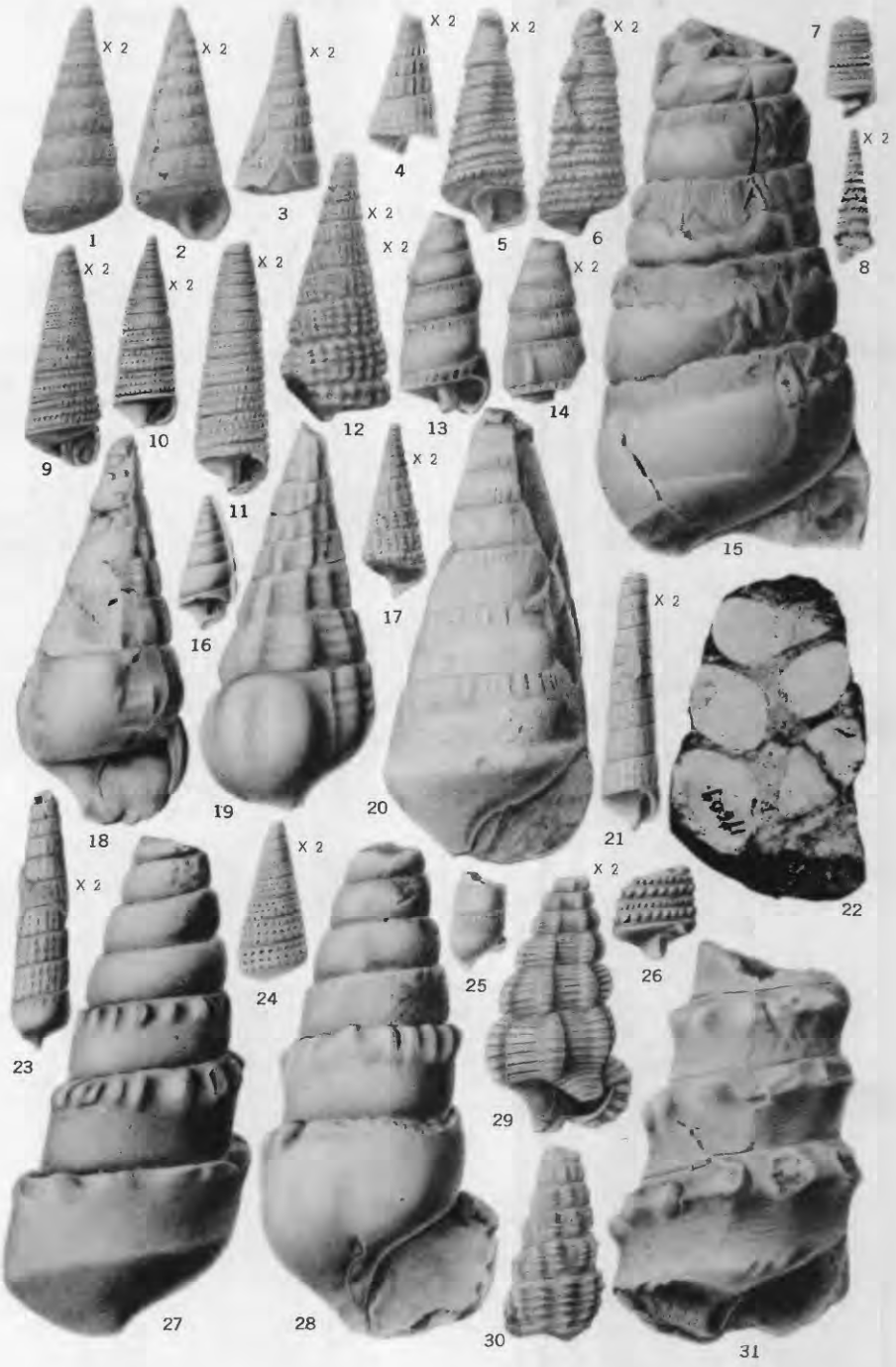
FIGURES 21, 23. *Cerithium coloradense* Stanton, n. sp. Holotype U.S.N.M. 77622 (× 2), from the Edwards limestone on the Colorado River near Austin, Tex. (p. 101).

FIGURE 24. *Cerithium kickapooense valverdense* Stanton, n. var. Holotype U.S.N.M. 77613 (× 2) from the upper part of the Devils River limestone at the high bridge across the Pecos River on the Galveston, Harrisburg & San Antonio Railway, 3 miles east of Shumla, Tex. (p. 100).

FIGURES 22, 27, 28, 31. *Cerithium bosquense* Shumard. (22) Axial section of plesiotype figured by Cragin (1893, pl. 42, fig. 10), locality unknown; (27, 28) plesiotype U.S.N.M. 77603, from the Goodland limestone, 6 miles west of Fort Worth, Tex; (31) plesiotype U.S.N.M. 77602, from the Comanche Peak formation near depot at Benbrook, 8 miles west of Fort Worth, Tex. (p. 97).

FIGURE 29. *Cerithium austinense* Roemer. Plesiotype U.S.N.M. 77599 (× 2) from the Edwards limestone on the west bank of the Colorado River above the mouth of Bartons Creek, near Austin, Tex. (p. 96).

FIGURE 30. *Cerithium pecosense* Stanton, n. sp.(?). Specimens U.S.N.M. 77609, from the Fredericksburg group in the eastern foothills of the Quitman Mountains, 16 miles south of town of Sierra Blanca, Hudspeth County, Tex. (p. 100).



COMANCHE GASTROPODS

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PLATE 65

[All figures natural size.]

FIGURES 1–4. *Anchura (Drepanocheilus) mudgeana* White. (1) Squeeze of plesiotype U.S.N.M. 77565, from the Pawpaw sandy member of the Denison formation, 1 mile west of Denison, Tex.; (2) plesiotype U.S.N.M. 77567, from the Pawpaw member half a mile north of depot at Denison, Tex.; (3) plesiotype U.S.N.M. 77566, from the Pawpaw member three-quarters of a mile northeast of depot at Denison, Tex.; (4) cotype U.S.N.M. 8086, from the Pawpaw member near Denison, Tex. (p. 103).

FIGURES 5, 11. *Anchura (Drepanocheilus) kiowana marquettensis* Stanton, n. var. Cotypes U.S.N.M. 77564a, b, from the Mentor formation, 4½ miles southeast of Marquette, Kans. (p. 103).

FIGURES 6–10. *Anchura (Drepanocheilus) kiowana* Cragin. (6, 7) Cotypes U.S.N.M. 32673, from the Kiowa shale, No. 3 of Cragin's section south of Belvidere, Kans.; (8, 9) plesiotypes U.S.N.M. 77563a, b, from the Kiowa shale at Black Hill, 6 miles southeast of Belvidere, Kans.; (10) plesiotype U.S.N.M. 77562, from the Kiowa shale, 1 mile south of Belvidere, Kans. (p. 102).

FIGURES 12, 13, 16. *Aporrhais travisensis* Stanton, n. sp. (12) Holotype U.S.N.M. 77587a, from the Travis Peak formation in the bed of Cow Creek, 1 mile below Travis Peak Post Office, Travis County, Tex; (13) paratype U.S.N.M. 77586, from the Travis Peak formation in the bed of Cow Creek, 2 miles below Travis Peak Post Office, Travis County, Texas; (16) paratype U.S.N.M. 77587b, from the same locality as the holotype (p. 108).

FIGURES 14, 15. *Anchura quitmanensis* Stanton, n. sp. Cotypes U.S.N.M. 77568a, b, from a horizon near base of the Quitman formation of Taff, 1 mile south of Quitman Canyon, Hudspeth County, Tex. (p. 104).

FIGURES 17–19. *Aporrhais? kentensis* Stanton, n. sp. (17, 18) Cotype U.S.N.M. 77574a; (19) cotype U.S.N.M. 77574b. Both types from the lower part of the Washita group on the hill 1 mile south of depot at Kent, Tex. (p. 105).

FIGURES 20, 21. *Aporrhais? subfusiformis* (Shumard). (20) Plesiotype U.S.N.M. 77581, from the Comanche Peak limestone at Chalk Mountain, 12 miles southwest of Glen Rose, Tex.; plesiotype U.S.N.M. 77582, from the Comanche Peak limestone near depot at Benbrook, 8 miles west of Fort Worth, Tex. (p. 106).

FIGURES 22, 23. *Aporrhais brittsi* Stanton, n. sp. Holotype U.S.N.M. 77571, from the Edwards limestone near Austin, Tex. (p. 104).

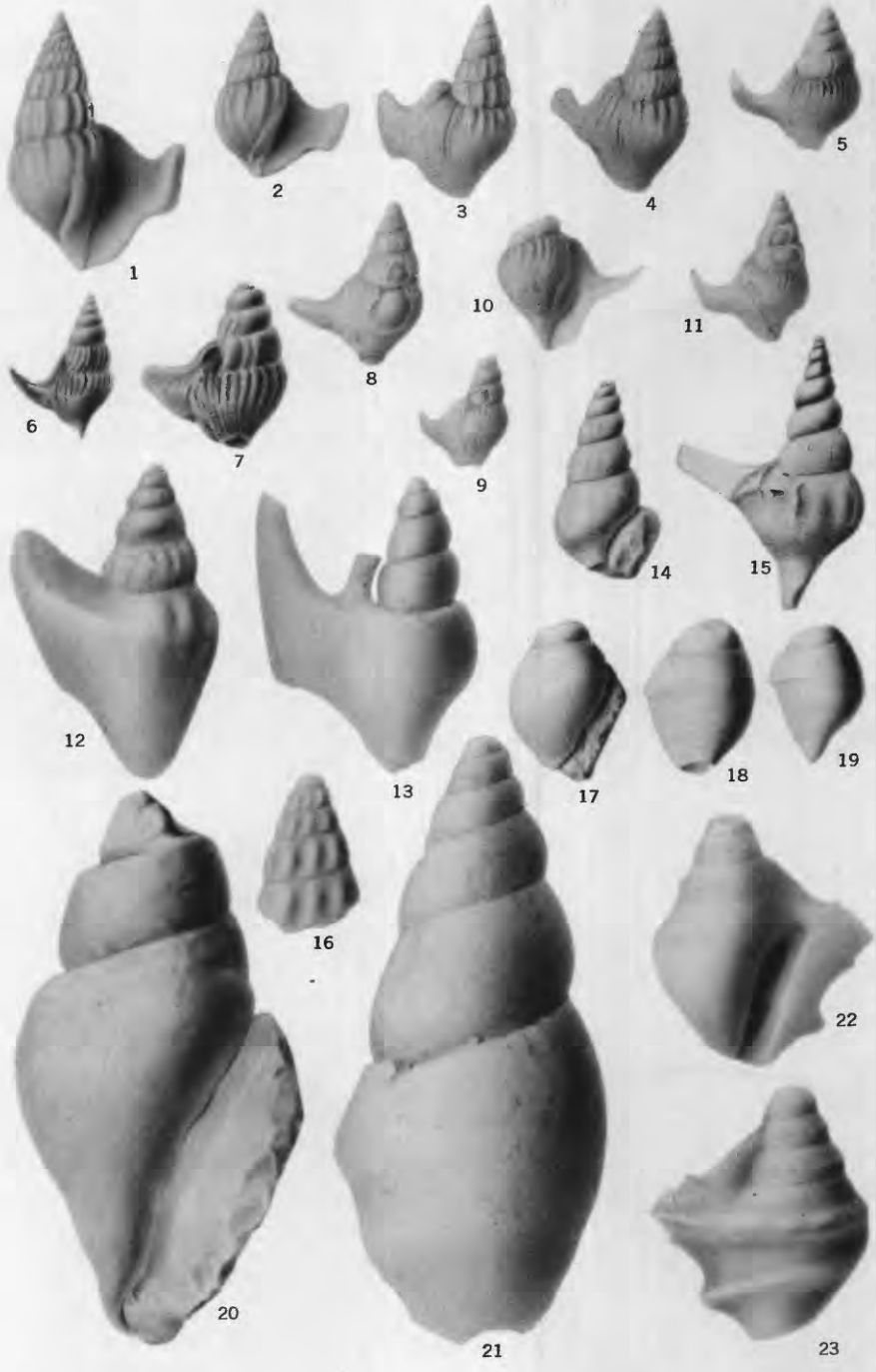

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PLATE 66

[All figures natural size.]

FIGURES 1–3, 11. *Aporrhais singleyi* Stanton, n. sp. (1, 2) Paratype U.S.N.M. 77579a; (3) paratype U.S.N.M. 77579b; (11) holotype U.S.N.M. 22985, from the Edwards limestone near Austin, Tex. Both paratypes from the Edwards limestone on the west bank of the Colorado River above the mouth of Bartons Creek, near Austin, Tex. (p. 106).

FIGURES 4–6, 8. *Aporrhais tarrantensis* Stanton, n. sp. (4, 5) Holotype U.S.N.M. 77583, from the Goodland limestone, about 10 miles northwest of Denison, Tex.; (6) paratype U.S.N.M. 77584, from the Comanche Peak limestone near depot at Benbrook, 8 miles west of Fort Worth, Tex.; (8) paratype U.S.N.M. 77585, from the Comanche Peak limestone at Chalk Mountain, 12 miles southwest of Glen Rose, Tex. (p. 107).

FIGURES 7, 9. *Aporrhais nuecensis* Stanton, n. sp. (7) Paratype U.S.N.M. 77576, from the Comanche Peak limestone in the bed of west fork of the Nueces River, opposite mouth of Bluff Creek, and 1 mile below Kickapoo Springs, Tex.; (9) holotype U.S.N.M. 77575, from the Comanche Peak limestone in the bed of the west fork of the Nueces River near Kickapoo Springs, Tex. (p. 105).

FIGURES 10, 12. *Aporrhais? elpasensis* Stanton, n. sp. Holotype U.S.N.M. 77572, from the Buda limestone on the Rio Grande, 4 miles northwest of El Paso, Tex. (p. 105).

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FIGURES 1, 3, 4, 7, 10–12. *Actaeonella dolium* Roemer. (1, 4) Plesiotypes U.S.N.M. 8306a, b, from the Fredericksburg group(?) of Bell County, Tex.; (3, 7, 10–12) plesiotypes U.S.N.M. 77559a-e, from the Fredericksburg group at Flat Mesa, 4 miles north of Sierra Blanca, Hudspeth County, Tex. Figures 1 and 10 represent internal molds. The other figures represent specimens with considerable shell material (p. 109).

FIGURES 2, 5, 6, 8, 9. *Actaeonella pecosensis* Stanton, n. sp. (2, 5) Paratype U.S.N.M. 77561a, from the Devils River limestone at the Rio Grande, Pecos County, Tex.; (6, 8) holotype U.S.N.M. 77560, from the upper part of the Devils River limestone at the high bridge across the Pecos River on the Galveston, Harrisburg & San Antonio Railway, 3 miles east of Shumla, Tex.; (9) paratype U.S.N.M. 77561b, from the Devils River limestone at the Rio Grande, Pecos County, Tex. (p. 110).

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