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STATE GEOLOGICAL SURVEY OF KANSAS

RAYMOND C. MOORE, State Geologist and Director Kenneth K. Landes, State Geologist and Assistant Director

Volume 10

LATE PALEOZOIC PELECYPODS: PECTINACEA

NORMAN D. NEWELL

PLATES



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STATE GEOLOGICAL SURVEY OF KANSAS

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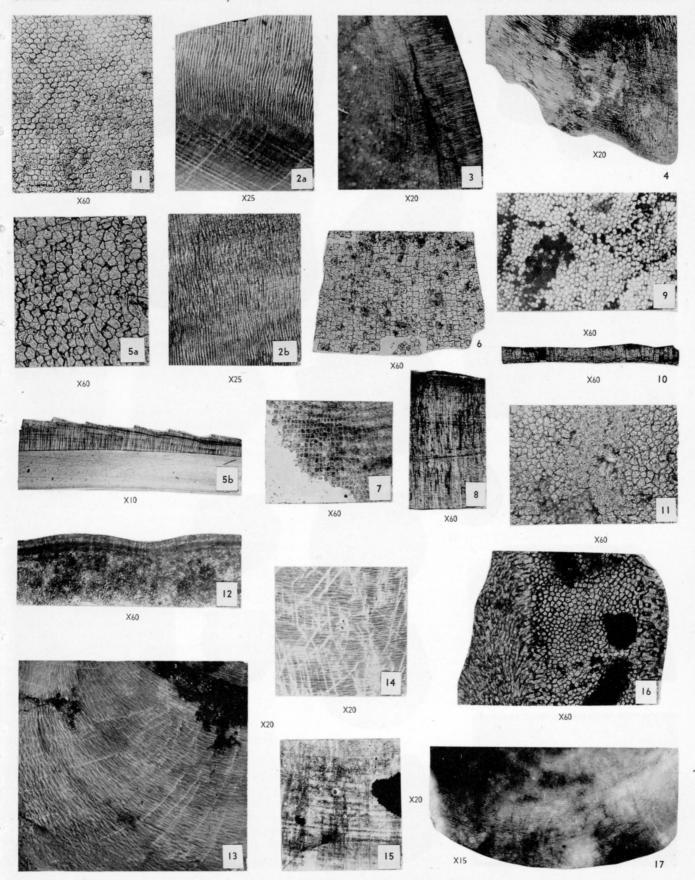
9-11—Dunbarella wbitei (Meek). Shell microstructure

of the outer ostracum. Upper Carboniferous (Pier-

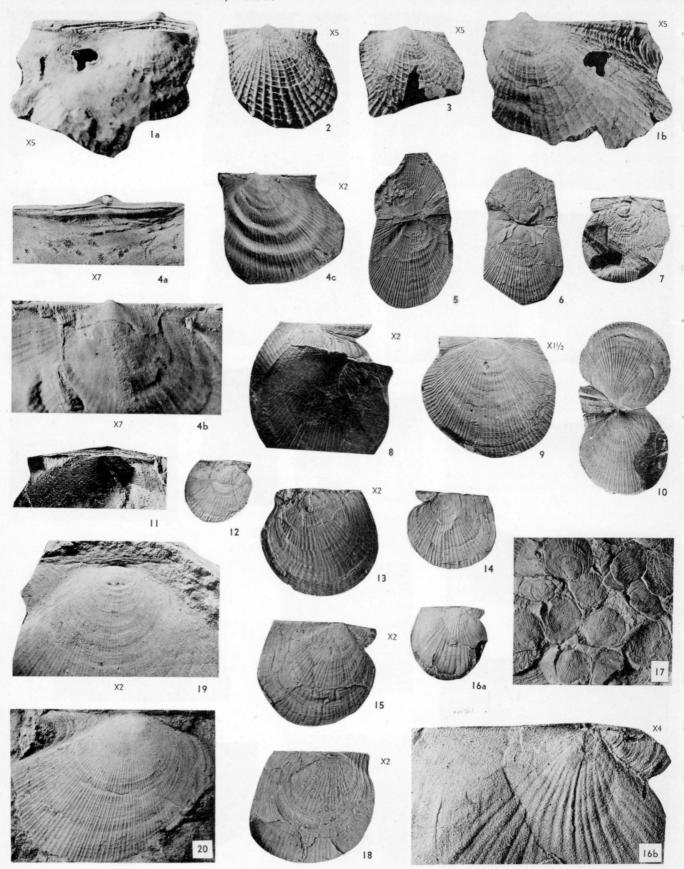
(Bonner Springs shale, Missouri subseries, middle

Pennsylvanian), Kansas Univ. Paleont. Coll., no.

233.13 p. 49



Newell, Shell Structure in Pectinids and Other Pelecypods



Newell, Devonian and Carboniferous Pterinopectinidae

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(2 2000000)	,
1-3—Pseudaviculopecten exacutus (Hall), Middle Devonian (Hamilton group), Lake Canandaigua, New York	zon and locality Coll., no. 237.3.
 1a, b,—Views of ligament area and external surface of a left valve, x 5; Yale Univ., Peabody Mus., no. 14,487. 2—A left valve showing the particularly upright and aviculo pectinoid form of the species, bearing a homeomorphic resemblance to Aviculopecten, x 5; Yale Univ., Peabody Mus., no. 14,487. 3—A less complete specimen, x 5; Yale Univ., Peabody Mus., no. 14,487. 	ing typical chevro of interior of the nopectinidae. Up at a quarry 1 mi U.S. Nat. Mus., 1
4a-c—Pterinopecten undosus Hall, genotype of Pterinopecten, Middle Devonian (Hamilton group), Moscow, N.Y.; U.S. Nat. Mus., no. 80,962p. 36 4a—Left valve, a hypotype, hinge view, showing ligament grooves, x 7. 4b—Umbonal view of the same specimen, showing the relatively acute beak and filose ornamentation, x 7. 4c—Same, side view, x 2.	barella, Upper C Virgil subseries, ern Nebraska 12—A right valve, h Pony Creek bri Yale Univ., Peal 13—A normal left selected as lector's shaft," at
5-7—Dunbarella rectalaterarea (Cox), x 1, Upper Carboniferous, (shale 8 feet above a 4-foot coal, lower Pennsylvanian) at Oakland City, Ind.; hypotypes, Yale Univ., Peabody Mus., no. 14,463 p. 40	no. 6,983. 14—External mold (traces of outer polygonal calcite horizon, and loc
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- -A characteristic left valve, showing the high subquadrate form and costate auricles.
- 8-10—Dunbarella knighti Newell, n. sp., Upper Carboniferous, (lower Pennsylvanian), Missouri and

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9—A fine left valve, showing the suborbicular form, and the

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10—A specimen retaining both valves, showing the characteristic form and ornamentation, a topoparatype, x 1, same horiy as fig. 9, Kansas Univ. Paleont. Type

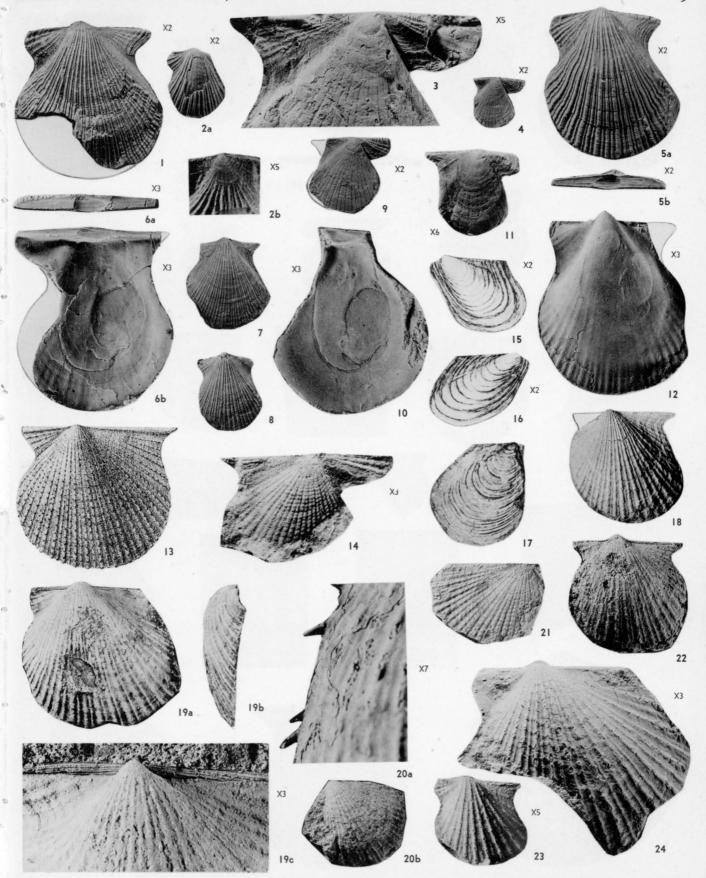
- wax cast of a left valve, x 1, showon ligament furrows and excavation e beak, characteristic of the Pteripper Devonian (Chemung group), ile southwest of Southport, N.Y.; no. 89,746p. 38
- bitei (Meek), genotype of Dun-Carboniferous (Wabaunsee group, upper Pennsylvanian), southeast
 - nypotype, x 1. Pierson Point shale, under dge, 1 mile south of Falls City, Nebr.; body Mus., no. 14,462.
 - valve, one of Meek's figured types, here otype, x 2; probably Willard shale. "Mor-Nebraska Čity, Nebr.; U. S. Nat. Mus.,
 - (concave impression) of a right valve with ostracum adhering to it as a thin film of e prisms, a hypotype, x 1; same collection, cality as fig. 12.
 - showing the characteristic form and ornaof Meek's figured paratypes, x 2; same col-, and locality as fig. 13.
 - ght valve, a hypotype, x 1 and x 4; same on, and locality as fig. 12.
 - 17-A typical slab of young specimens in shale, paratypes, x 1; same collection, horizon, and locality as fig. 13.
 - 18-A left valve, external mold (concave impression), one of Meek's paratypes, x 2; same collection, horizon, and locality as fig. 13.
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PLATE 3.—CARBONIFEROUS PTERINOPECTINIDAE (Pterinopectinella, Posidonia) AND AVICULOPECTINIDAE (Aviculopecten).

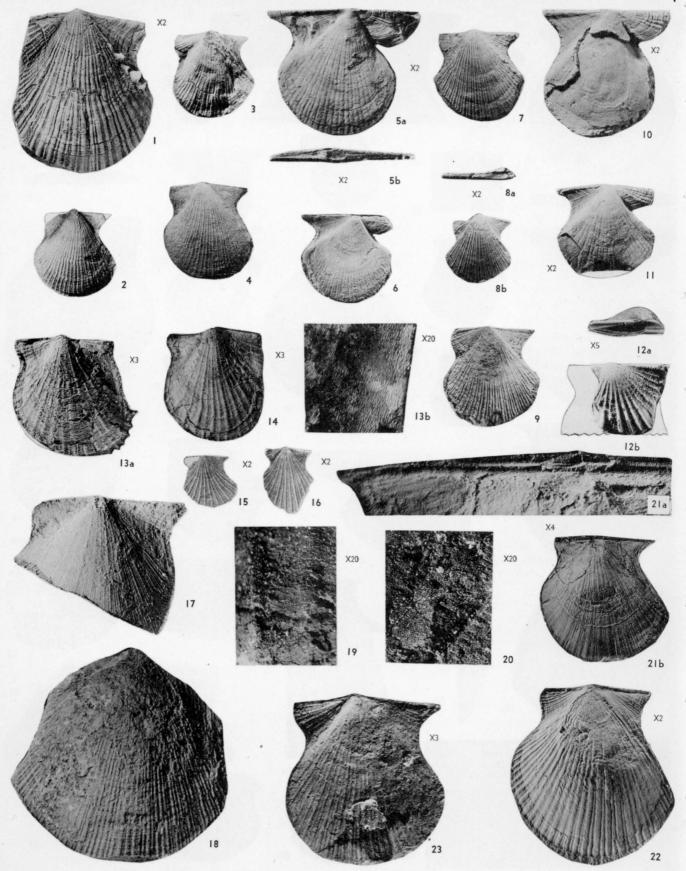
Figure			
1-12—Aviculopecten	exem plarius	Newe	ll,
Carboniferous			

- n. sp.; Upper Carboniferous (Bonner Springs shale, Missouri subseries, Pennsylvanian), near Bonner Springs, Kans.; type specimens, Kansas Univ. Paleont. Type Coll., no. 233. p. 49
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 - 2a-Left valve, topoparatype, x 2, no. 233.7; 2b-Part of 2a, showing smooth yet unworn beak, x 5.
 - 3—Right valve, topoparatype, x 5, no. 233.16.
 - 4-Small right valve, showing the characteristic flat, bifurcate costae of the genus, topoparatype, x 2, no. 233.9.
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 - 7,8—Left valves, topoparatypes, x 1.
 - 9-Small right valve showing characteristic flat, bifurcate costae of the genus, topoparatype, x 2, no. 233.6.
 - 10-Inner view of fragmentary right valve, a topoparatype, x 3, no. 233.3.
 - 11-Right valve, a topoparatype, x 6, no. 233.10.
 - 12—Internal mold of left valve, showing part of musculature, a topoparatype, x 3, no. 233.5.
- 13—Pterinopectinella nodulosa (De Koninck), after De Koninck, x 1; Lower Carboniferous, Visean, Etage II, Belgium; introduced for comparison.
- 14, 18-24—Pterinopectinella welleri Newell, n. sp., genotype of Pterinopectinella; (Upper Carboniferous (middle and upper Pennsylvanian), Kansas, Missouri, Texas. p. 41
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- Kansas City, Mo.
- 18-A left valve, showing clearly forward obliquity that is characteristic of the genus, a paratype, x 1; Virgil subseries (supposedly from Oread limestone), upper Pennsylvanian, Melvern, Kans.; Kansas Univ. Paleont. Type Coll., no.
- 19a, b-Side and posterior views of the internal mold of a left valve, holotype, x 1; Stanton limestone, Missouri subseries, middle Pennsylvanian, cement plant quarry, Fredonia, Kans.; Kansas Univ. Paleont. Type Coll., no. 358.
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- 22—Side veiw of a left valve, topoparatype, x 1; Kansas Univ. Paleont. Type Coll., no. 359.
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- 24-A well-preserved but fragmentary left valve, paratype, x 3; Argentine limestone, Missouri subseries, Middle Pennsylvanian, Kansas City, Mo.; Kansas Univ. Paleont. Type Coll., no. 361.
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Newell, Carboniferous Pterinopectinidae and Aviculopectinidae



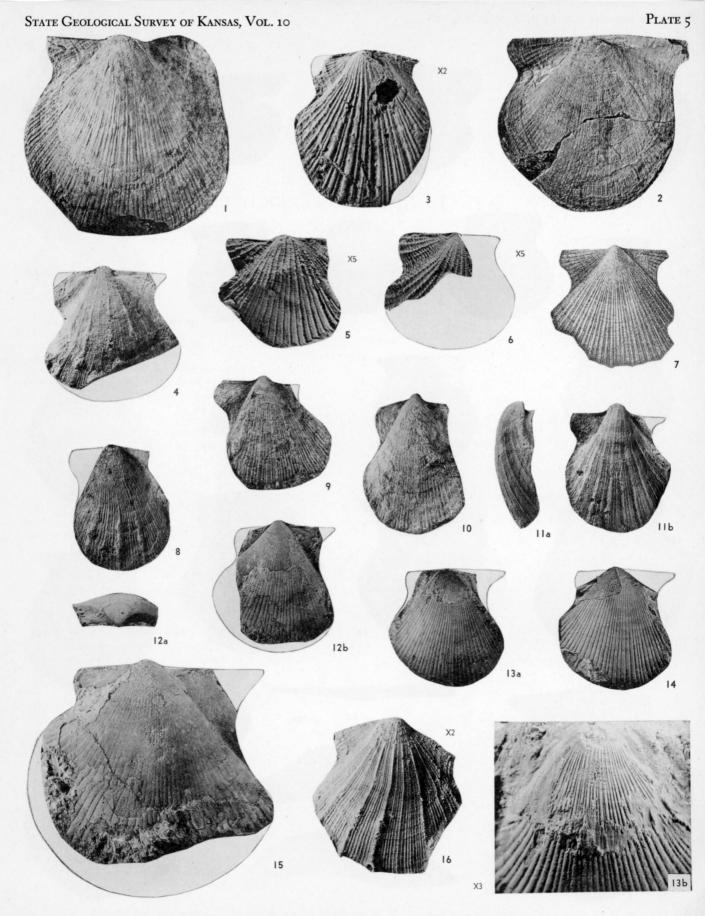
Newell, Carboniferous and Permian Aviculopectinidae

PLATE 4.—CARBONIFEROUS AND PERMIAN AVICULOPECTINIDAE (Aviculopecten).

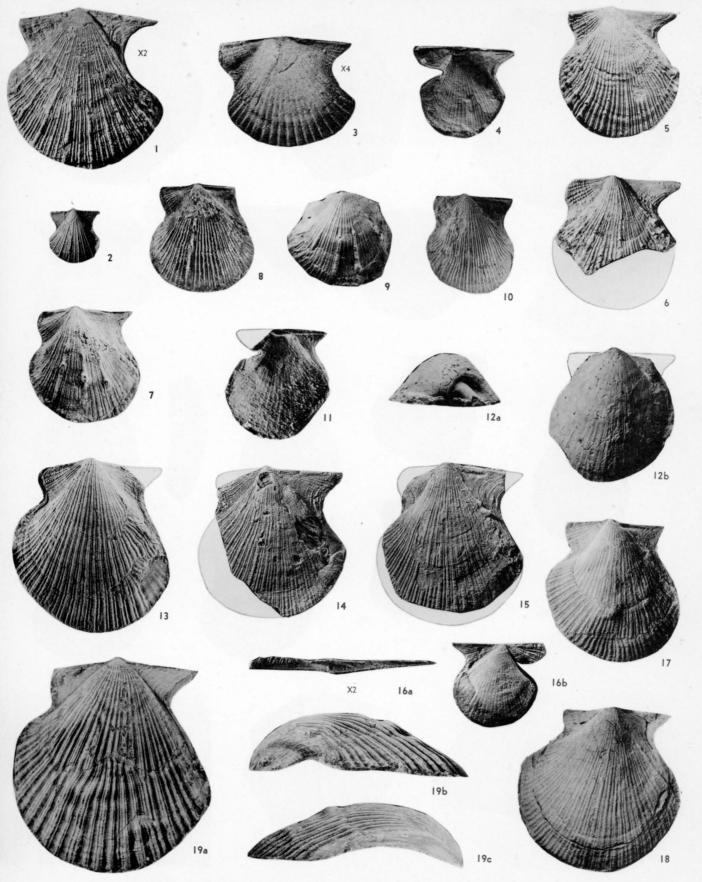
Figure 1-3—Aviculopecten arctisulcatus Newell, n. sp., Upper Carboniferous (Brownville limestone, uppermost Virgil subseries, upper Pennsylvanian), 1 mile north of Reece, Kans.; Kansas Univ. Paleont. Type Coll., no. 235	 14—A topoparatype, x 3, having a less oblique form than the lectotype, Chicago Univ., Walker Mus., no. 8,779. 15, 16—Aviculopecten eaglensis (Price), Upper Carboniferous (Eagle limestone, Pottsville, lower Pennsylvanian), left valves, syntypes, x 2, after Price. These specimens have not been located. P. 54
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PLATE 5.—AVICULOPECTINIDAE FROM CARBONIFEROUS AND PERMIAN ROCKS.

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p. 58 Word ., no.
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f wax
f reg- e, x 2; e the Can- 364. p. 61



Newell, Aviculopectinidae from Carboniferous and Permian Rocks



Newell, Aviculopectinidae from Carboniferous and Permian Rocks

PLATE 6.—AVICULOPECTINIDAE FROM CARBONIFEROUS AND PERMIAN ROCKS.

Figure
1,2—Aviculo pecten gradicosta Newell, n. spp. 53 1—Left valve, holotype, x 2; Upper Carboniferous (Westerville oolitic limestone, middle Pennsylvanian); Kansas Univ. Paleont. Type Coll., no. 365.
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6—A well-preserved fragmentary left valve, topoparatype, x 1.
7-10—Aviculopecten nodocosta Newell, n. spp. 53 7—Left valve, holotype, x 1; Lower Permian (Burr limestone),
Nebraska; Yale Univ., Peabody Mus., no. 14,453.
8, 10—Two left valves, topoparatypes, x 1; Lower Permian (Burr limestone), Nebraska; Yale Univ., Peabody Mus., no. 14,453.
9—A paratype, x 1; Lower Permian (Florena shale), Kansas; Kansas Univ. Paleont. Type Coll., no. 267.

11-12b—Aviculopecten peculiaris Newell, n. sp. Type

specimens, x 1; Lower Permian (Fort Riley lime-

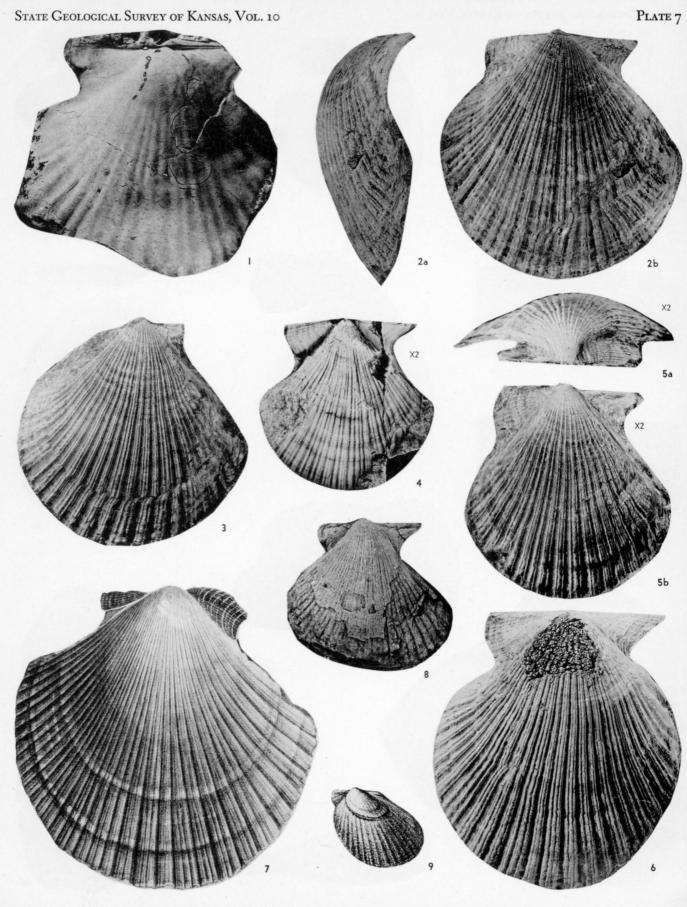
stone) 1 mile east of Marysville, Kans.....p. 62

11-Interior view of a right valve, showing unique convexity

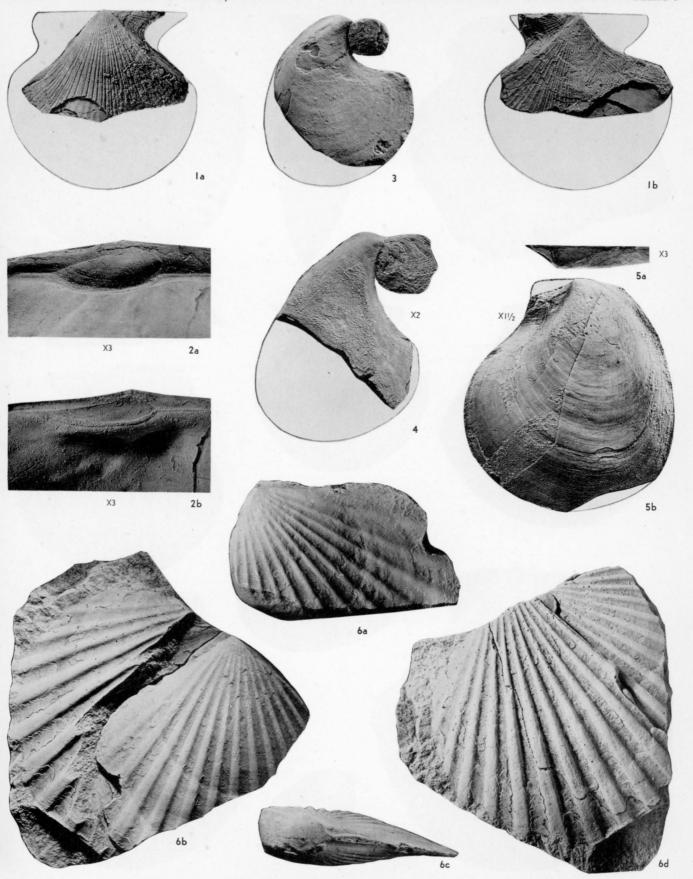
- as seen internally; this valve is concave from front to back as viewed externally, being unlike typical Aviculopecten in which the right valve is slightly convex; wax cast made from a paratype in Kansas Univ. Paleont. Type Coll., no. 368.2.
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 - 14, 15—Paratypes, x 1; Upper Carboniferous (Graham shale upper Pennsylvanian), Texas; Yale Univ., Peabody Mus., no. 14,451.
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- - 17—Side view of a wax cast of the left valve, showing broadly flaring umbonal slopes and relatively coarse costae, holotype; Lower Permian (basal Herington limestone), 3 miles northwest of Hanover, Kans.; original in Kansas Univ. Paleont. Type Coll., no. 371.1.
 - 18—A topoparatype in which the orbicular form and wide umbonal angle are typically developed; Kansas Univ. Paleont. Type Coll., no. 371.2.
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 - 19a—A nearly complete left valve, a topoparatype, x 1. U. S. Nat. Mus., no. 46,377.
 - 19b, c—Front and rear views, showing extraordinary convexity characteristic of the species, x 1.

PLATE 7.—AVICULOPECTINIDAE FROM CARBONIFEROUS ROCKS.

Figure 1-3, 5, 6—Fasciculiconcha knighti Newell, n. sp.; Upper Carboniferous (Westerville limestone, middle Pennsylvanian), Kansas City, Mop. 65 1—Internal mold of a left valve, showing musculature and hinge characters, a topoparatype, x 1; U. S. Nat. Mus., no. 46,377. 2a, b—Rear and side views of a fine left valve, a topoparatype, x 1; Kansas Univ. Paleont. Type Coll., no. 372.2. 3—A well-preserved but fragmentary left valve, a topoparatype, x 1; U. S. Nat. Mus., no. 46,377. 5a—Hinge view of a small, well-preserved left valve, a topoparatype, x 2; Kansas Univ. Paleont. Type Coll., no. 372.3. 5b—The same, side view, x 2. 6—A robust, nearly complete left valve, lacking a small part of the posterior margin, holotype, x 1; Kansas Univ. Paleont. Type Coll., no. 372.1.	the genus, holotype, x 2; Upper Carboniferous (lower Mercer limestone, lower Pennsylvanian), Bald Hill, near Newark, Ohio; U.S. Nat. Mus. p. 66 7, 8—Fasciculiconcha providencensis (Cox); Upper Carboniferous (lower Pennsylvanian)
4—Fasciculiconcha scalaris (Herrick). A left valve, showing characteristic irregular intercalation of costae at a comparatively mature stage of growth; convexity is markedly less than in other species of	9—Limatulina radula De Koninck, after De Koninck, designated here the genolectotype of Limatulina; left valve, x 1; Lower Carboniferous, Viséan, Etage III, Belgiump. 62



Newell, Aviculopectinidae from Carboniferous Rocks



Newell, Aviculopectinidae from Carboniferous and Permian Rocks

PLATE 8.—AVICULOPECTINIDAE FROM CARBONIFEROUS AND PERMIAN ROCKS.

1b—View of right valve, same individual, showing intercalate costellae.

- margin, a paratype, x 1; Sedgwick Mus., Cambridge Univ., no. A5,983.
- 4—A relatively large, incomplete right valve having an unusually broad byssal notch, and a proportionally greater height than ordinary, a paratype, x 2; Sedgwick Mus., Cambridge Univ., no. A5,087.
- 5a, b—View of ligament area, showing oblique resilifer, x 3, and side view, x 1½, a left valve, designated here as lectotype; Sedgwick Mus., Cambridge Univ., no. A5,985.
- 6a-d—Deltopecten illawarensis (Morris), genotype species of Deltopecten. Plastotypes of lectotype and paratype, x 1, from Permian of Illawara, New South Wales, now in the British Mus. of Nat. History, no. 96,893.p. 63
 - 6a—Left (?) valve of lectotype.
 - 6b—Portion of paratype (right [?] valve) broken away to show right (?) valve of lectotype.
 - 6c—Hinge aspect of lectotype; lower valve (left?) appears to be slightly flatter than the opposite valve but the lower convexity might possibly be the result of distortion.
 - 6d—Right (?) valve of paratype with small area of lectotype visible.

PLATE 9.—AVICULOPECTINIDAE FROM CARBONIFEROUS ROCKS

rigure
1a, b—Limipecten grandicostatus Girty, left and right views, holotype, x 1; Upper Carboniferous (Wayland shale, upper Pennsylvanian), near Graham,

2-6—Limipecten texanus Girty. 2-4, 6 from Upper Carboniferous (Wayland shale, upper Pennsylvanian), near Graham, Tex.; 5 from Jacksboro formation, near Jacksboro, Tex......p. 68

Tex.; U.S. Nat. Mus., no. 27,103.p. 69

2a, b—Side and cardinal views of left valve, a topoparatype, x 1; U.S. Nat. Mus., no. 27,102.

3a—Part of lower (right) valve shown in 3b, showing differentiation of an exceedingly thin film of prismatic outer ostracum (a), and a well-defined fibrous hypostracum (b), x 5; U. S. Nat. Mus., no. 27,102.

3b—Dorso-ventral section of same specimen, normal to the hinge through shell; the lower (right) valve has slipped Figure

to the left (dorsally) a short distance in respect to the upper one.

3c-Postero-dorsal view of same.

3d-Postero-dorsal part of right valve of same specimen, x 1.

4a—Left valve, holotype, x 1, U. S. Nat. Mus., no. 27,102.

4b-Posterior view of the same specimen, x 1.

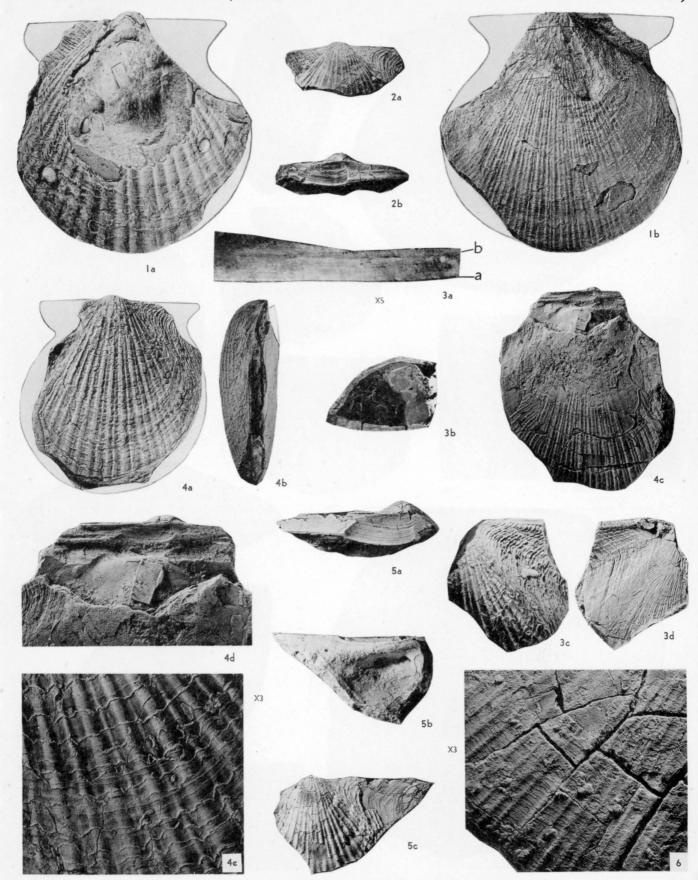
4c-Right valve of same, x 1.

4d—Right valve, showing slight mutilation of the ligament area and giving the erroneous impression of a posterior hinge tooth, x 2.

4e—Enlarged portion of left valve, holotype, x 3; U.S. Nat. Mus., no. 27,102.

5a-c—Cardinal, interior and side views of a hypotype, x 1, from the Jacksboro formation (middle Pennsylvanian), Texas; Yale Univ., Peabody Mus., no. 14,470.

6—Enlarged portion of middle of ventral margin, a right valve, a topoparatype, x 3 (shown also in pl. 10, fig. 2e); U. S. Nat. Mus., no. 27,102.



Newell, Aviculopectinidae from Carboniferous Rocks

Newell, Aviculopectinidae from Carboniferous and Permian Rocks

7b

PLATE 10.—AVICULOPECTINIDAE FROM CARBONIFEROUS AND PER-MIAN ROCKS

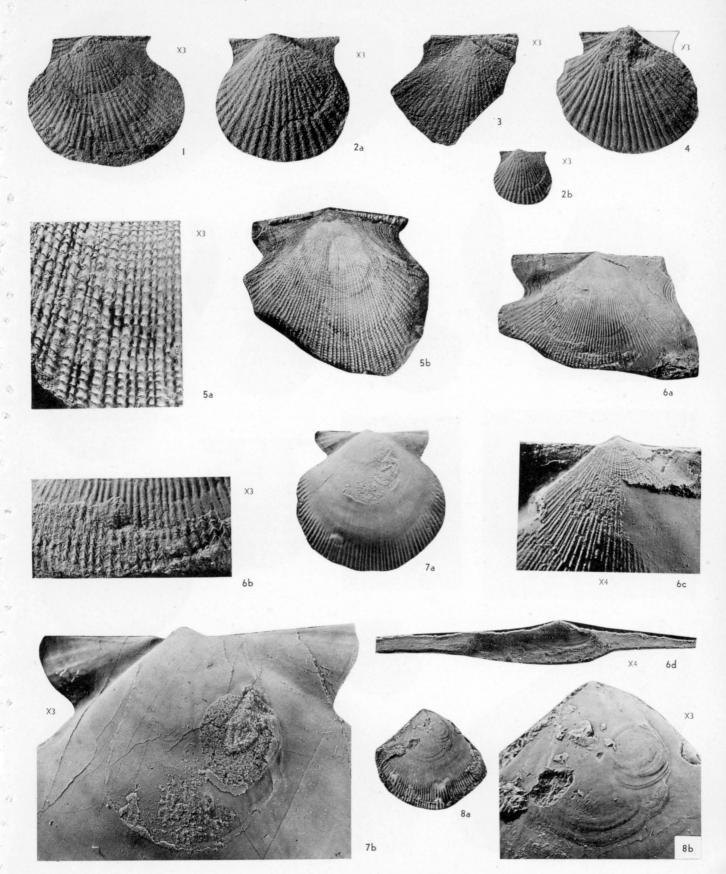
Figure
1—Limipecten koninckii (Meek and Worthen). Right
valve, x 1, retaining chiefly the nacreous part of the
shell, with only a small area of prismatic outer
ostracum near the front margin. Upper Carbonif-
erous (Des Moines beds, lower Pennsylvanian),
Alpine, Iowa, holotype; Illinois Univ., no. 12,877.
p. 69.
Cinta and the state of Time
2a-c—Limipecten texanus Girty, genotype of Limipec-
ten. Cardinal, left and right views, topoparatype,
x 1. Upper Carboniferous (Wayland shale, upper
Pennsylvanian), near Graham, Tex.; U.S. Nat.
Mus., no. 27,102p. 68
<u> </u>
3, 4—Limipecten latiformis (Shimer). Plastotypes,
x 1.5, of specimens from the Lake Minnewanka
section (Permian), Albertap. 70
3—Right valve, topoparatype, Victoria Mem. Mus., Ottawa,
no. 4863C.
4-Right valve, holotype, Victoria Mem. Mus., Ottawa, no.
4863A.

- - 5—Hinge view showing resilifers, topoparatype, x 1; Yale Univ., Peabody Mus., no. 8,146.
 - 6a-7b—Views of the holotype from Cow Creek, Floyd County, Ky., in the paleontological collections of Mississippi State College.
 - 6a—View of the surface on the ventral area of the left valve, showing spiny processes of intercostal furrows, characteristic in left valves of the genus, x 3.
 - 6b—Enlarged view of the scaly surface along the posterior umbonal slope of the same specimen, x 3.
 - 6c—Left valve, retaining the thin outer ostracum, which has been pulled off in places exposing the massive nacreous layer, holotype, x 1, Upper Carboniferous (Kendrick, lower Pennsylvanian), Cow Creek, Floyd County, Ky.
 - 7a—Enlargement of surface of right valve of same individual showing the way in which the ornamentation is largely developed on the outer prismatic ostracum where the outer film of ostracum is peeled off there is only an obscure reflection of the surface ornamentation on the massive nacreous layer, x 3.
 - 7b—Fragment of the right valve of holotype showing marked reticulose ornamentation, x 1.

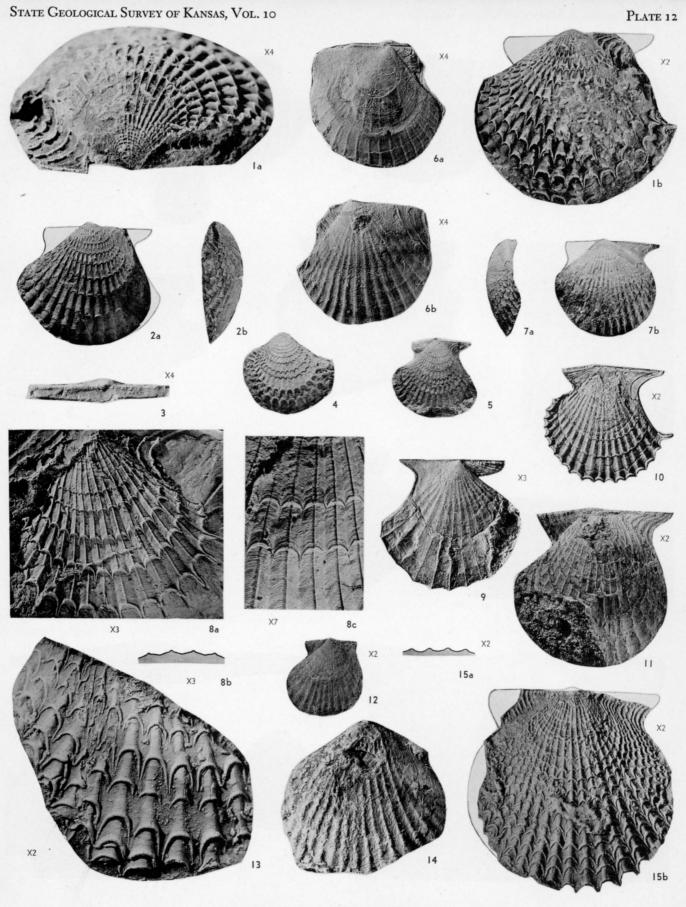
PLATE 11.—CARBONIFEROUS AVICULOPECTINIDAE.

- 1—A left valve, normal except in having a somewhat exceptional quadrate front auricle, lectotype, x 3; West Virginia Geol. Survey, no. 507. (Price's Loc. 76).
- 2a—A left valve, juvenile, a topoparatype, x 7; West Virginia Geol. Survey, no. 507.
- 2b-Same, x 3.
- 3—Fragmentary right valve, a paratype, showing bifurcating costae characteristic in right valves of the genus, a paratype, x 3; West Virginia Geol. Survey, no. 638.
- 4—A left valve, lacking the rear auricle, a paratype, x 3; West Virginia Geol. Survey, no. 507.
- 5a, b—Limipecten wewokanus Newell, n. sp. Holotype, Upper Carboniferous (top of middle Wewoka shale, lower Pennsylvanian), 5 1-2 miles west of Okmulgee, Okla. p. 71
 - 5a—Enlarged portion of shell surface of the holotype showing distinctive ornamentation, x 3; Kansas Univ. Paleont. Type Coll., no. 374.
 - 5b-The same, a left valve, x 1.

- - 6a-d—A well-preserved but incomplete left valve, showing a ligament area and resilifer, originally thought to be lacking in the species; Sedgwick Mus., Cambridge Univ., no. A5,679. 6a—Side view, x 1; 6b—A detail of ornamentation, x 3; 6c—Umbonal view showing intercalate addition of costae during shell growth, x 4; 6d—Ligament area, x 4, showing typical resilifer of the Aviculopectinidae, originally covered by matrix and not observed by McCoy.
 - 7a, b—A nearly perfect internal mold of a left valve, showing musculature and plicated periphery, x 1 and x 3; Sedgwick Mus., Cambridge Univ., no. A5,678.
 - 8a, b—A well-preserved but fragmentary internal mold of a left valve, showing musculature, x1 and x3; Sedgwick Mus., Cambridge Univ., no. A5,68o.



Newell, Carboniferous Aviculopectinidae



Newell, Carboniferous and Permian Aviculopectinidae

PLATE 12.—CARBONIFEROUS AND PERMIAN AVICULOPECTINIDAE.

Figure

- 1a-5—Acanthopecten meeki Newell, n. sp.p. 73
 - 1a, b—Paratype, from an unknown horizon, possibly Stanton formation, in Douglas County, Kans.; Kansas Univ. Paleont. Type Coll., no. 375. 1a—Umbonal view, showing reticulate ornamentation and prosocline shape of juvenile stages; the hinge line to the left of the beak, although offset by a fracture, is complete, x 4. 1b—Side view of same shell, showing peculiarly elevated and broad vaulted lamellae, which ordinarily are broken away in rock matrix, x 2.
 - 2a—Side view of left valve showing the relatively broad and rounded costae characteristic of the species, holotype, x 1. This specimen illustrates the usual appearance of specimens broken out of limestone; compare with the more perfect specimen shown in 1b.
 - 2b—Front view, holotype; Upper Carboniferous (Westerville oolitic limestone, middle Pennsylvanian), Kansas City, Mo.; Yale Univ., Peabody Mus., no. 8,148.
 - 3—Cardinal view of part of a left valve, showing the oblique resilifer typical of many Aviculopectinidae; Acanthopecten has erroneously been considered to lack such resilifers, but Meek pointed out long ago that the inner ostracum of pelecypods, including the hinge, is commonly dissolved in fossils; a topoparatype, x 4; Upper Carboniferous, (Westerville limestone, middle Pennsylvanian), Turner, Kans.; Kansas Univ. Paleont. Type Coll., no. 376.1.
 - 4—Left valve retaining prominent peripheral spines, but in other respects imperfect, a topoparatype, x 1; Kansas Univ. Paleont. Type Coll., no. 376.2.
 - 5—A left valve, showing symmetrically flaring umbonal slopes characteristic of the species, a topoparatype, x1; Upper Carboniferous (Westerville limestone, middle Pennsylvanian), Turner, Kans.; Kansas Univ. Paleont. Type Coll., no. 376.3.
- 6a, b—Acanthopecten sp., juvenile x 4. Upper Carboniferous (Strawn group, lower Pennsylvanian), Mineral Wells, Tex.; Yale Univ., Peabody Mus., no. 14,489.
 - 6a-View of right valve; 6b, View of left valve.
- 7a, b, 13-15b—Acanthopecten coloradoensis (Newberry). p. 75
 - 7a—Posterior view of an imperfect and somewhat defaced specimen, x 1; 7b—side view of same, x 1. Permian (Word formation), West Texas; Texas Bur. Econ. Geology, no. 12,312.
 - 13—Wax cast of a small fragment of a large left valve, the lectotype, x 2; Permian (Kaibab limestone), near the

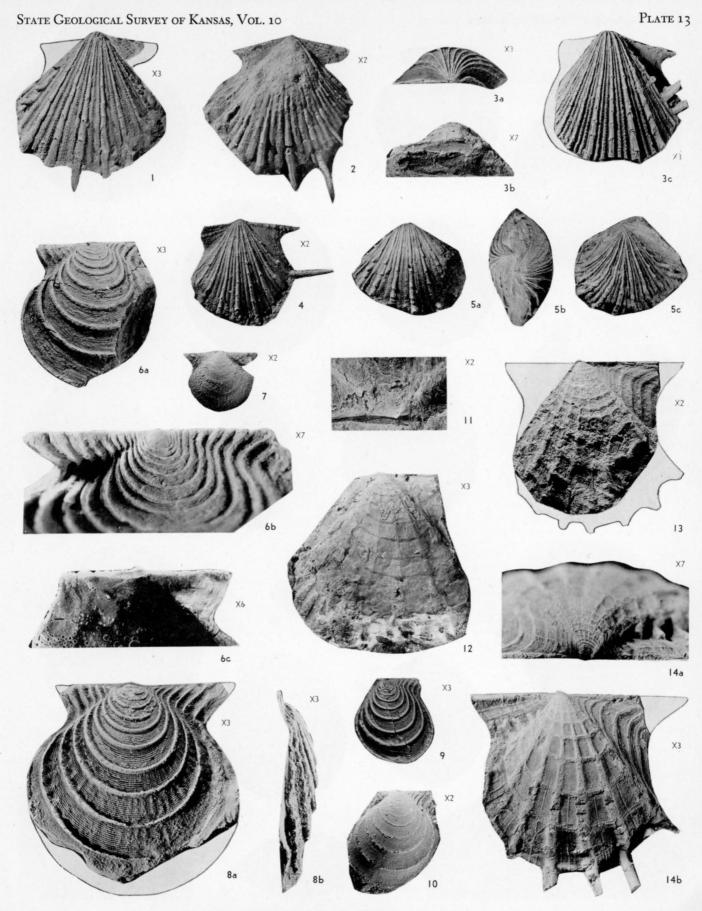
- mouth of the little Colorado River, Ariz.; Columbia Univ., no. 14,203.
- 14—A poorly preserved subinternal mold of a left valve, on which compaction has impressed a trace of external ornamentation, a paratype, x 1; Permian (Kaibab limestone), at the mouth of the Little Colorado River, Ariz.; Columbia Univ., Geol. Mus., no. 6,392G.
- 15a-b—Profile and wax cast, made from a nearby perfect silicified mold, showing well the orbicular form and peculiar ornamentation of the species, x 2; Permian (Kaibab limestone), near Grand Canyon, Ariz.; Yale Univ., Peabody Mus.
- 8a-10—Acanthopecten carboniferus (Stevens).p. 72
 - 8a-c—A topotype of Acanthopecten carboniferus (Stevens); Upper Carboniferous (Centralia formation, middle Pennsylvanian), Crooked Creek, Marion County, Ill.; Illinois Geol. Survey. 8a—A wax cast of a natural mold showing a narrow costa at the crest of each plication; this feature is inconspicuous in most specimens so that it may not be an invariable characteristic of the species carboniferus, x 3. 8b—Profile of the shell surface taken near the ventral margin, x 3. 8c—Part of a natural external mold from which the wax cast in 8a was made, x 7.
 - 9—A rare right valve showing ornamentation and form, one of Meek's hypotypes, x 3; Upper Carboniferous (Willard shale, upper Pennsylvanian), Rockford, Nebraska City, Nebr.; U.S. Nat. Mus., no. 6,508.
 - 10—A left valve illustrative of the shell to which Geinitz applied the name Pecten hawni, placed here tentatively in the synonomy of Acanthopecten carboniferus (Stevens), one of Meek's hypotypes, x 2; Upper Carboniferous (Willard shale), Rockford, Nebraska City, Nebr.; U.S. Nat. Mus., no. 6,508.
- 12—Acanthopecten delawarensis (Girty). A poorly preserved left valve, showing the simple costate ornamentation of Acanthopecten, holotype, x 2; Permian (Delaware Mountain formation), West Texas; U.S. Geol. Survey, no. 417.p. 75

PLATE 13.—CARBONIFEROUS AND PERMIAN AVICULOPECTINIDAE.

Figure

- - 1—A characteristic right valve, a paratype, x 3; Upper Carboniferous (Oread limestone, upper Pennsylvanian, Condra's zone B), quarry at Snyderville, Neb.; Yale Univ., Peabody Mus.
 - 2—A somewhat worn right valve tentatively referred to the species, a paratype, x 2; Upper Carboniferous (just above the Howard limestone, upper Pennsylvanian), Barroum Ranch, near Foraker, Osage County, Okla.; Kansas Univ. Paleont. Type Coll., no. 377.
 - 3a-c—Umbonal view, x 3; view of the ligament area with oblique resilifer, x 7; and side view x 3; of a characteristic left valve; Upper Carboniferous ("South Bend" limestone, middle Pennsylvanian), 2 miles northeast of South Bend, Tex.; Yale Univ., Peabody Mus., no. 14,484.
 - 4—A left valve, referred somewhat doubtfully to the species because of the nearly smooth intercalate second order costae, a paratype, x 2; Lower Permian (Americus limestone), Elmdale, Kans.; Yale Univ., Peabody Mus., no. 14,483.
 - 5a-c—Right, cardinal, and left views of a fragmentary specimen, holotype, x 1; Lower Permian (lower Eiss limestone), west of cemetery northwest of Strong City, Kans.; Yale Univ., Peabody Mus., no. 14,480.
- 6a-10—Annuliconcha interlineata (Meek and Worthen).p. 76
 - 6a—A well-preserved left valve, topotype, x 3; Upper Carboniferous (Lasalle limestone, middle Pennsylvanian), Lasalle, Ill.; U.S. Nat. Mus., no. 80,348. 6b—The same specimen, showing the growth changes and ornamentation at the beak, x 7. 6c—Cardinal view of the same showing the resilifer, x 6.

- 7—A very rare right valve, x 2; Upper Carboniferous (unknown horizon in the Kansas City or Bronson group), Kansas City, Mo.; Kansas Univ. Paleont. Type Coll., no. 379.
- 8a—A very fine left valve, the holotype, x 3; Upper Carboniferous (Lasalle limestone), Lasalle, Ill.; Illinois Univ., no. 10,922. 8b—Anterior view of the same, showing that the margin of the valve does not lie in a plane.
- 9—An imperfect left valve, holotype of *Posidonomya lasallensis* Miller and Gurley, here placed in the synonomy of *A. interlineata*, x 3; Upper Carboniferous (Lasalle limestone), Lasalle, Ill.; Chicago Univ., Walker Mus., no. 6,612.
- 10—A relatively large and exfoliated left valve, x 2; Upper Carboniferous (an unknown horizon in the Kansas City or Bronson group), Kansas City, Mo.; Kansas Univ. Paleont. Type Coll., no. 378.
- - 11—Hinge view of an internal mold of a left valve, showing a resilifer like that found in other Aviculopectinidae, x 2; Middle Permian (Word formation), 1.5 miles N., 55 degrees W. of the old "Hess Ranch House;" Texas. Bur. Econ. Geology, no. 12,313.
 - 12—A poorly preserved left valve, the holotype, x 3; Upper Permian (Capitan formation), Guadalupe Mountains, West Texas; U.S. Geol. Survey, no. 1,211.
 - 13—Another characteristic specimen, x 2, from the Word formation, same locality as fig. 11; Texas Bur. Econ. Geol.
 - 14a-b—Beak view, x 7, and side view, x 3, of an extraordinarily well-preserved left valve; Middle Permian (Word formation, "second limestone"), one-half mile north of "hill 5611" of the King brothers, Hess Canyon, West Texas; Yale Univ., Peabody Mus.



Newell, Carboniferous and Permian Aviculopectinidae



Newell, Permian Aviculopectinidae

PLATE 14.—PERMIAN AND CARBONIFEROUS AVICULOPECTINIDAE.

igure				_	
1—Camt	otonectes?	sculptilis	Girty.	Fragment	t of a right
valve	showing	peculiar	ornam	entation,	holotype,
x 4;	Upper Pe	rmian (C	Capitan	limeston	e), Guad-
alupe	Mountair	ns, West	Texas;	U.S. Geo	ol. Survey,
					p. 91

- 4, 5—Camptonectes? papillatus Girty. Left valves, holotype and a topotype, respectively, possibly conspecific with C.? asperatus, x 4; Upper Permian (Capitan limestone), Guadalupe Mountains, West Texas; U.S. Geol. Survey.......p. 90
- 6, 7—Streblochondria? montpelierensis (Girty), Middle Permian, Idaho; classed tentatively with Streblochondria because of the obvious relationship to S.? tenuilineata (Meek and Worthen)..........p. 83
 6—An incomplete left valve, a topoparatype, x 2, Middle Permian (Phosphoria formation), Montpelier, Idaho; U.S. Geol. Survey, Type Coll., no. 1,713.
 - 7-View of right valve, showing details of configuration,

holotype, x 4; Middle Permian (Phosphoria formation), Montpelier, Idaho; U.S. Geol. Survey, Type Coll., no.

- 8a-12—Streblopteria oklahomensis Newell, n. sp....p. 88
 - 8a,b—Side and cardinal views of a characteristic right valve, a topoparatype, x 2; Upper Carboniferous (Eudora shale member, Stanton limestone, middle Pennsylvanian), 2.5 miles west of Wann, Okla.; Kansas Univ. Paleont. Type Coll., no. 380.2.
 - 9a-c—Right, anterior, and left views of a topoparatype, x 2; Upper Carboniferous (Eudora shale member, Stanton limestone, middle Pennsylvanian), 2.5 miles west of Wann, Okla.; Kansas Univ. Paleont. Type Coll., no. 380.3.
 - 10a-d—Holotype, Upper Carboniferous (Eudora shale member, Stanton formation, middle Pennsylvanian), 2.5 miles west of Wann, Okla.; Kansas Univ. Paleont. Type Coll., no. 380.1. 10a—Right valve, x 3; 10b—left valve, x 3; 10c—hinge view, x 3; 10d—enlargement of left umbo, x 8, showing form of growth lines.
 - 11a,b—A well-preserved internal mold tentatively referred to the species, right side view showing impression of resilifer, a paratype, x 2 and x 7, respectively; Upper Carboniferous (Boggy shale, lower Pennsylvanian), sec. 18, T. 3 S., R. 7 E., Okla., Kansas Univ. Paleont. Type Coll., no. 381.
 - 12—A fragmentary right valve, a topoparatype, x 2; Upper Carboniferous (Eudora shale member, Stanton limestone, middle Pennsylvanian), 5 miles northeast of Copan, Okla.: Yale Univ., Peabody Mus., no. 14,477.

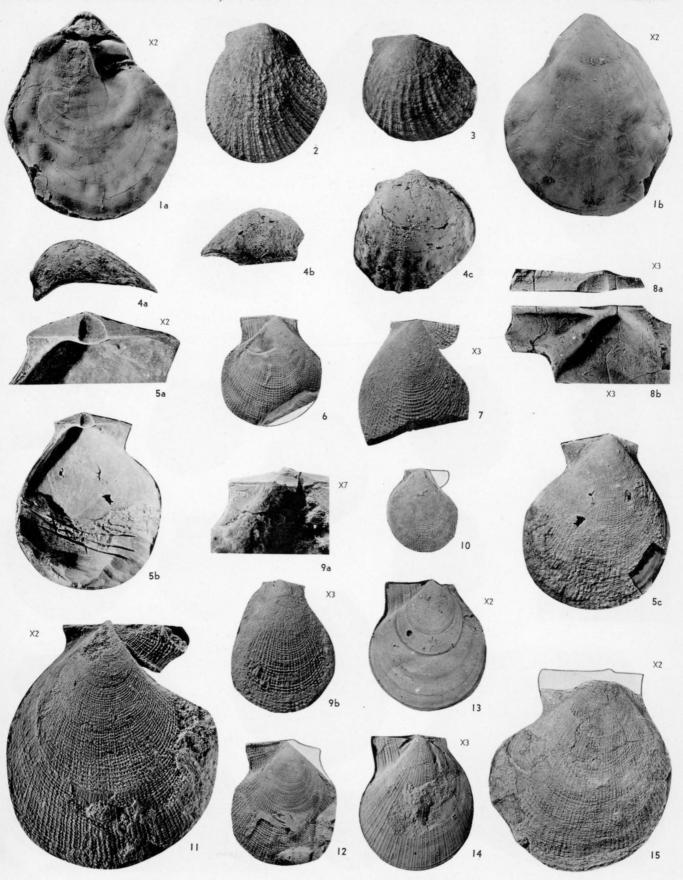
PLATE 15.—CARBONIFEROUS AND PERMIAN AVICULOPECTINIDAE.

1a, b, 3, 4—Streblochondria stantonensis Newell, n. sp.

- 1a, b—Side and front views, respectively, of a robust left valve, a topoparatype, x 1; Upper Carboniferous (uppermost part of Stanton limestone, middle Pennsylvanian), at cement plant quarry, Fredonia, Kans.; Kansas Univ. Paleont. Type Coll., no. 381.2.
- 3—Another topoparatype, a left valve, x 1, from the same locality as above; Kansas Univ. Paleont. Type Coll., no. 381.2.
- 4—Holotype, a left valve, showing well the slender proportions and upright form of the species, x 1, Kansas Univ. Paleont. Type Coll., no. 381.1.
- 2—Streblochondria subequivalva (Beede). Fragmentary left valve, after Beede, holotype, apparently lost, x 1; Upper Carboniferous, "thin limestone in Upper Coal Measures" (upper Pennsylvanian), south of Dover, Kans.p. 87
- 5—Streblochondria sp. A wax cast of a fine right valve showing the extraordinary backward obliquity and obsolescent posterior costae, a metatype, x 1; Upper Carboniferous (Avant limestone horizon?, middle Pennsylvanian), butte west of Bartlesville, Okla.; Kansas Univ. Paleont. Type Coll., no. 382.p. 87
- - 6—An incomplete right valve, showing the extraordinary split-rib ornamentation, a topotype, x 2; U.S. Geol. Survey, Type Coll., no. 425.7.
 - 7—A very imperfect left valve showing intercalate costae, holotype, x 2; U.S. Geol. Survey, Type Coll., no. 424.
- - 8—A damaged left valve, showing the relatively coarse ornamentation and distinctive upright configuration, holotype, x 2; Kansas Univ. Paleont. Type Coll., no. 383.1.
 - 9—An incomplete right valve, with somewhat finer ornamentation than the holotype, although found on the

- same rock slab with it, a topoparatype, x 2; Kansas Univ. Paleont. Type Coll., no. 383.2.
- - 10—An internal mold of a right valve, showing the type of resilifer possessed by Streblochondria, a hypotype, x 2; Upper Carboniferous (lower Mercer limestone, lower Pennsylvanian), Flint Ridge, Licking County, Ohio; Kansas Univ. Paleont. Type Coll., no. 384.1.
 - 11, 12—Right valves, x 2, topotypes of Crenipecten foerstii Herrick, which is here placed in the synonymy of Streblochondria? tenuilineata (Meek and Worthen); Upper Carboniferous (lower Mercer limestone), Flint Ridge, Ohio; Kansas Univ. Paleont. Type Coll., nos. 384.2, 384.3.
 - 13—A somewhat squeezed and distorted left valve, also a topotype of Crenipecten foerstii Herrick, placed here in the synonymy of Streblocbondria? tenuilineata (Meek and Worthen), x 2; Upper Carboniferous (lower Mercer limestone, lower Pennsylvanian), Flint Ridge, Licking County, Ohio; U.S. Nat. Mus., no. 89,789.
 - 14a-c—Views of left valve showing shell form and ornamentation of the umbo, a topoparatype, found on the same slab with the holotype, x 38, x 3, and x 7, respectively; Upper Carboniferous (middle Pennsylvanian), Clinton County, Ill.; Illinois Univ. Type Coll., no. 12,880.
 - 15a-c—Views of a nearly perfect right valve showing form, ornamentation, and radial crossed-lamellar structure (visible on the posterior auricle), holotype, x 3, x 5, and x 7, respectively; Upper Carboniferous (middle Pennsylvanian), Clinton County, Ill.; Illinois Univ. Type Coll., no. 12,880.
 - 16—A left valve showing the peculiar resilifer of Streblochondria, in which the triangular shape has a backward obliquity, in harmony with the symmetry of the entire shell, topotype of Crenipecten foerstii Herrick, which is here placed in the synonymy of Streblochondria? tenuilineata (Meek and Worthen), x 3; Upper Carboniferous (lower Mercer limestone), Flint Ridge, Ohio; Kansas Univ. Paleont. Type Coll., no. 384.3.
- 17, 18—Streblochondria? infelix (Girty). Poorly preserved right valves, topoparatype and holotype (fig. 18), x 5 and x 2, respectively; Upper Permian (middle part of Capitan limestone), Guadalupe Mountains, West Texas; U.S. Geol. Survey, Type Coll., nos. 414, 415.......p. 86

Newell, Carboniferous and Permian Aviculopectinidae



Newell, Carboniferous Aviculopectinidae

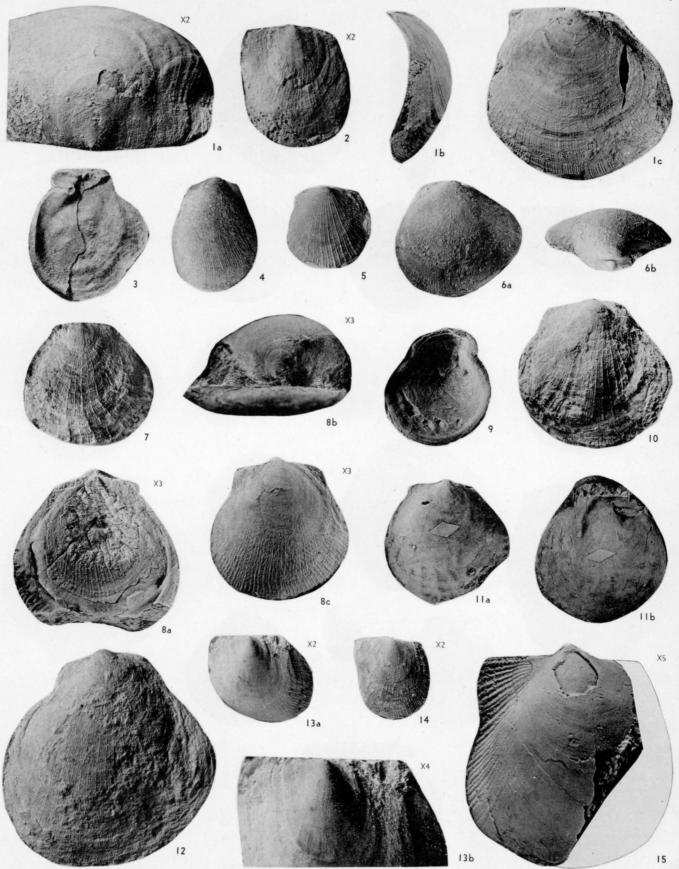
PLATE 16.—CARBONIFEROUS AVICULOPECTINIDAE.

- 2, 3—Pseudomonotis beedei Newell, n. sp.p. 96
 - 2—Side view of a left valve, showing coarse ornamentation and relatively blunt beak characteristic of the species, holotype, x 1; Upper Carboniferous (Haskell oolitic limestone, upper Pennsylvanian), near Lawrence, Kans.; Kansas Univ. Paleont. Type Coll., no. 385.1.
 - 3—Paratype, x 1, Upper Carboniferous (Westerville oolite, middle Pennsylvanian), Turner, Kans.; Yale Univ., Peabody Mus., no. 3,143.
- 4a-c—Pseudomonotis inflata Mather. Internal mold, holotype, x 1; Upper Carboniferous (Kessler limestone, lower Pennsylvanian), near Fayetteville, Ark.; Chicago Univ., Walker Mus., no. 16,057.
- 5a-c, 7, 9a,b, 11—Streblochondria sculptilis (Miller), genotype of Streblochondria Newell, n. gen.p. 82
 - 5a-c—A fine large left valve, showing characters of the interior and exterior, a topotype, x 2, x 1, and x 1, respectively; Upper Carboniferous (Westerville oolitic limestone, middle Pennsylvanian), Kansas City, Mo.; Kansas Univ. Paleont. Type Coll., no. 386.1.
 - 7—An incomplete right valve of a young individual, a topotype, x 3; Upper Carboniferous (Westerville oolitic limestone, middle Pennsylvanian), Kansas City, Mo.; Kansas Univ. Palcont. Type Coll., no. 386.2.
 - 9a, b-An incomplete left valve of a young individual, view

- of ligament area and reversed resilifer, x 7, and side view, x 3; Upper Carboniferous (Westerville oolitic limestone), Turner, Kans.; Kansas Univ. Paleont. Type Coll., no. 386.3.
- 11—A well-preserved right valve showing the form and ornamentation, holotype, x 2; Upper Carboniferous (Westerville oolitic limestone, middle Pennsylvanian), Kansas City, Mo.; Cincinnati Univ. Mus., no. 3,894.
- 6, 10, 12-15—Streblochondria hertzeri (Meek).p. 82
 - 6—A wax cast of a large left valve, a hypotype, x 1; Upper Carboniferous (McArthur limestone, lower Penusylvanian), Moore coal mine, Elk Township, Vinton County, Ohio; Ohio State Univ. Paleont. Coll., no. 15,246.
 - 10—A wax impression of a right valve, x 1; Upper Carboniferous (lower Mercer limestone), Newark, Licking County, Ohio; Yale Univ., Peabody Mus., no. 14,475.
 - 12—Wax cast of a large left valve, a topotype, x 1; Upper Carboniferous (lower Mercer limestone, lower Pennsylvanian), Flint Ridge, Licking County, Ohio; U.S. Nat. Mus., no. 89,790.
 - 13, 14—Subinternal molds of left valves, showing faithfully the peculiar resilifer of the genus, topotypes, x 2 and x 3, respectively; Upper Carboniferous (lower Mercer limestone, lower Pennsylvanian), Flint Ridge, Licking County, Ohio; U.S. Nat. Mus., no. 89,790 and Kansas Univ. Paleont. Type Coll., no. 387.
 - 15—Side view, left valve, x 2, the hypotype described by Mather; Upper Carboniferous (Kessler limestone, lower Pennsylvanian), near Brentwood, Ark.; Chicago Univ., Walker Mus.
- 8a, b—Streblochondria sp. A well-preserved fragment of a right valve showing characters of the hinge, a hypotype, x 3; Upper Carboniferous (Des Moines beds, lower Pennsylvanian), Springfield, Ill.; U.S. Nat. Mus., no. 36,185.

PLATE 17.—CARBONIFEROUS AND PERMIAN AVICULOPECTINIDAE (Pseudomonotis).

Figure 1a-2—Pseudomonotis robusta Beedep. 98 1a—Dorsal view, left valve, showing flat umbo and shape of growth lines, holotype, x 2; Upper Carboniferous (Westerville oolite) Turner, Kans.; Kansas Univ. Paleont. Type Coll., no. 388. 1b—Front view, same specimen, x 1. 1c—Side view, showing relatively long hinge, same specimen, x 1. 2—Juvenile topotype showing low convexity and rhombic form, x 2; Yale Univ. Peabody Mus.	12—Holotype of P. kansasensis Beede, placed in synonomy of P. equistriata Beede, x 1, from Turner, Kans.; Kansas Univ. Paleont. Type Coll., no. 390. 13a—Dorso-lateral view, showing growth lines on the umbo, a paratype of P. kansasensis, now placed in P. equistriata, x 2; Kansas Univ. Paleont. Type Coll., no. 390.2. 13b—Dorso-lateral view of same, x 4. 14—A juvenile, x 2, left valve; Kansas Univ., Paleont. Type Coll., no. 390.3.
3-7, 9, 10, 12-14—Pseudomonotis equistriata Beede, Upper Carboniferous (Westerville oolite) in and around Kansas City	8a-c—Pseudomonotis precursor Mather. Holotype, approximately x 3; Upper Carboniferous (Brentwood, limestone, lower Pennsylvanian), near Fayetteville, Ark., Chicago Univ., Walker Musp.101 8a—Right valve showing fine costae, bounded peripherally by what appears to be a cicatrix of attachment. 8b—Dorsal view, showing relative form of the two valves, and form of the nearly smooth umbo of the left valve. 8c—View of left valve, showing fine costae and hemispherical form.
5—Side view of a rather coarse juvenile, left valve, x 1; Yale Univ., Peabody Mus.	11a, b—Pseudomonotis bawni (Meek and Hayden).
 6a—Side view of an internal mold, left valve, with fragments of shell adherent, x 1; Kansas Univ. Paleont. Type Coll., no. 389.3. 6b—Dorsal view of the same, showing mold of slightly oblique resilifer, x 1. 7—A left valve with slightly coarser costae than is common for the species, x 1; Kansas Univ. Paleont. Type Coll., 	Lower Permian (Big Blue series), near Manhattan, Kans.; U.S. Nat. Mus. no. 3,958. 11b—Side view of internal mold of right valve of same specimen as above.
on. 389.4. 9—Interior view of a left valve showing massive construction of the shell and triangluar resilifer, x 1; Yale Univ., Peabody Mus. 10—Left valve with slightly coarser costae than is common for the species, x 1; Kansas Univ. Paleont. Type Coll., no. 389.5.	15—Pseudomonotis? aurisculpta (Mather). A left valve, showing curious costate ornamentation restricted to the anterior part, holotype, x 5; Upper Carboniferous (Hale formation, lower Pennsylvanian), near Fayetteville, Ark., Chicago Univ., Walker Mus., no. 16,050p. 108



Newell, Carboniferous and Permian Aviculopectinidae

Newell, Carboniferous and Permian Aviculopectinidae

PLATE 18.—CARBONIFEROUS AND PERMIAN AVICULOPECTINIDAE (Pseudomonotis).

Figure

1a-2—Pseudomonotis spinosa Sayre. Upper Carbonif-

erous (Westerville oolite), Kansas City, Mo. p. 99

1a-Side view of left valve showing smooth umbo, scaly

8-Right valve, paratype of P. hawni ovata, x 1, placed here

intermediate area, and peripheral plicate area, lectotype,

Figure

Mus., no. 1,158.

in the synonomy of P. hawni s.s.; Lower Permian (Herington limestone), Cottonwood Creek, Kansas; U.S. Nat.

-Subinternal mold of a hypotype, x1; Lower Permian

18-Side view of left valve, showing obsolescent sculpture of the shell, holotype; U.S. Geol. Survey, no. 1,420.

nintermediate area, and peripheral pitcate area, lectotype, x 2; Kansas Univ. Paleont. Type Coll., no. 391.1. 1b—Umbonal view of same, showing opisthocline obliquity of juvenile stage, x 3. 1c—Front view of same, showing obscure marginal constriction around smooth umbonal area, x 2. 2—Side view of left valve of paratype, x 2; Kansas Univ. Paleont. Type Coll., no. 391.2.	 (Herington limestone), near Peabody, Kans.; Kansas Univ. Paleont. Type Coll., no. 394.1. 10—Subinternal mold of a right valve, x 1, same loc. as fig. 9; Kansas Univ. Paleont. Type Coll., no. 394.2. 11a—Side view of right valve of a hypotype, x 1, showing umbonal cicatrix of cementation and obsolescent byssal notch. 11b—Side view, left valve of same, x 1; Lower Permian (Florena shale), near Grand Summit, Kans.; Kansas Univ. Paleont. Type Coll., no. 395.
3, 5a, b—Pseudomonotis sayrei Newell, n. spp. 100 3—Side view of left valve, holotype, showing smooth constricted umbonal area surrounded by a mature area which is both plicate and scaly, x 2; Upper Carboniferous (Westerville oolite), Kansas City, Mo.; Kansas Univ. Paleont. Type Coll., no. 392.1. 5a—Side view, right valve, showing costate and depressed juvenile area surrounded by a smooth area (of attachment) with plications appearing at the periphery, x 2. 5b—Left valve, same specimen, x 2.	 12—Subinternal mold of a characteristic specimen, x 1; Lower Permian (Herington limestone), near Peabody, Kans.; Kansas Univ. Paleont. Type Coll., no. 394.3. 13—Hypotype, x 1; Lower Permian (Herington limestone), near Peabody, Kans.; Kansas Univ. Paleont. Type Coll., no. 394.4. 14a—Wax cast of right valve, x 1; Permian (probably Herington limestone), Cottonwood Creek, Kans. This is thought to be a paratype of P. bawni ovata (Meek and Hayden) which is here placed in the synonomy of P. bawni. 14b—Same, showing ligament area and oblique resilifer, x2.
4, 6, 7—Pseudomonotis fredoniensis Newell, n. sp, Upper Carboniferous (Stanton limestone, middle Pennsylvanian), Fredonia, Kansp. 101 4—Side view of left valve, showing fine and prominent costae, holotype, x 1; Kansas Univ. Paleont. Type Coll., no. 393.1. 6—Side view of a left valve, showing smooth and constricted umbo surrounded by a costate mature area, a paratype, x 2; Kansas Univ. Paleont. Type Coll., no. 393.2. 7—Side view of left valve, a paratype, x 1; Kansas Univ. Paleont. Type Coll., no. 393.3.	 15—Subinternal mold, hypotype, x2; Lower Permian (Herington limestone), near Peabody, Kans.; Kansas Univ. Paleont. Type Coll., no. 394.5. 16—Subinternal mold of a specimen showing the characteristic acute beak, probably a paratype of P. hauni ovata, x 1; Permian (probably from the Herington limestone, Cottonwood Creek, Kans.); Yale Univ., Peabody Mus. 17, 18—Pseudomonotis sublaevis (Girty). Type specimens, x 1, Upper Carboniferous Yeso formation, (upper Pennsylvanian?), San Andreas Mountains, New Mexico
8-16—Pseudomonotis hawni (Meek and Hayden).	17—Side view of left valve of a poorly preserved paratype; U.S. Geol. Survey, no. 1,421. 18—Side view of left valve, showing obsolescent sculpture of

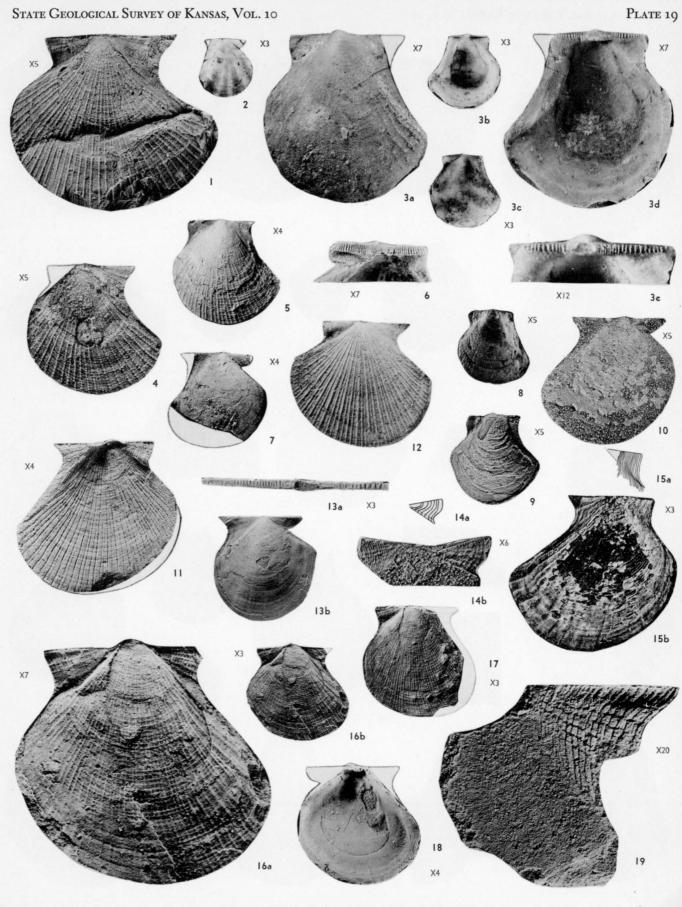
PLATE 19.—UPPER CARBONIFEROUS EUCHONDRIIDAE (Euchondria).

Figure

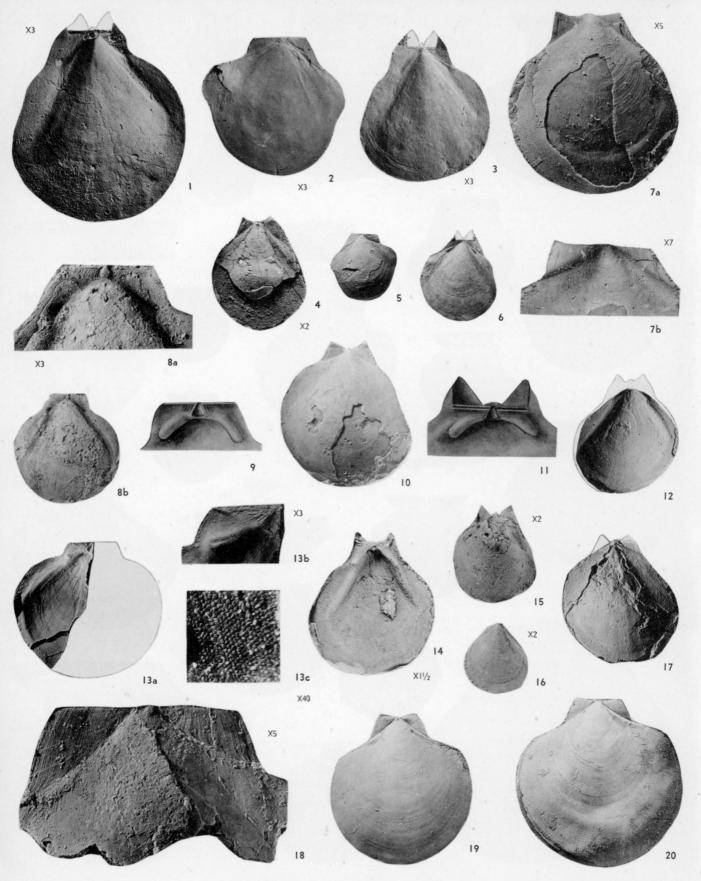
- - 1—A relatively large distorted left valve, a subinternal mold reflecting in a subdued manner the intersecting costae and crowded concentric fila, and a trace of the series of ligament pits along the hinge margin of the anterior auricle, a hypotype, x 5.
 - 4—A smaller left valve, showing better the configuration and ornamentation characteristic of left valves of the species, the crowding of the concentric fila being characteristic of the species, a hypotype, x5.
- 2, 3, 6, 7—Euchondria subcancellata Newell, n. sp. Type specimens from Upper Carboniferous (upper Labette shale, lower Pennsylvanian), o.6 mile west of Lockland station on the C.R.I. & P. railroad, 1 mile northwest of Stratman, St. Louis County, Mo. (Knight's loc. 43)......p. 107
 - 2—A right valve showing radial color markings which are common but highly variable in pattern in specimens from this locality, photographed under xylol, a topoparatype, x 3; Kansas Univ. Paleont. Type Coll., no. 396.2.
 - 3a-e—Views of a nearly perfect left valve, showing obsolescent ornamentation, color markings, hinge character, etc; hinge axis is at the base instead of the top of the cardinal area (as indicated by the angular relation between area and plane of commissure in complementary valves) so that the cardinal crenulations could not interlock when valves were closed; holotypes, x 7 (3a, 3d), x 3 (3b, 3c), and x 12 (3e); Kansas Univ. Paleont. Type Coll., no. 396.1.
 - 6—A rather gross and gerontic right valve, showing ligament area and multiple resilifers comparable to those in *Perna*, x 7; the ligament area forms an angle of about 30 degrees with the plane of commissure, so that the crenulated areas of two complementary valves would not be in contact when the valves were closed; Kansas Univ. Paleont. Type Coll., no. 396.3.
 - 7—A fragmentary right valve, a topoparatype, x 4; Kansas Univ. Paleont. Type Coll., no. 396.4.
- - 8--A small left valve, immature and badly worn, labelled holotype although it does not agree with published drawings accompanying the original description, x 5.
 - 9—A somewhat larger left valve, also badly worn, a topoparatype, x 5. The species cannot be recognized from these specimens.
- 10, 11, 18—Euchondria levicula Newell, n. sp. Type specimens from Upper Carboniferous (lower and middle Pennsylvanian) of Missouri and Iowa.
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5-A left valve showing form and radial costae crossed by the

- rather widely spaced fila characteristic of the species, a paratype, x 4; upper part of Labette shale (lower Pennsylvanian), 0.6 mile west of Lockland station on the C.R.I. and P. railroad, 1 mile northwest of Stratman, St. Louis County, Mo. (Knight's loc. 43); Kansas Univ. Paleont. Type Coll., no. 397.2.
- 10—Outer ostracum film of a right valve showing faithfully the form and smooth surface of the valve, a topoparatype, x 5; Hushpuckney shale (middle Pennsylvanian), Devil's Backbone, Winterset, Iowa; Yale Univ., Peabody Mus., no. 14,478.
- 11—An external mold (concave imprint) of a large left valve, showing the checkerboard ornamentation of the species in which the spaces between the costae and fila are nearly square, holotype, x 4; Hushpuckney shale (middle Pennsylvanian), Devil's Backbone, Winterset, Iowa; Yale Univ., Peabody Mus., no. 14,478-4.
- 18—An internal view of a right valve, showing profile and musculature like that of Aviculopecten, a paratype, x 4; upper Labette shale (lower Pennsylvanian), o.6 mile west of Lockland station on the C.R.I. and P. railroad, 1 mile northwest of Stratman, St. Louis County, Mo. (Knight's loc. 43); Kansas Univ. Paleont. Type Coll., no. 397.1.
- 12-13b—Euchondria smithwickensis Newell, n. sp. Types from Upper Carboniferous (Smithwick shale, lower Pennsylvanian), of north-central Texas. p. 106
 - 12—A wax cast of a large left valve, showing the characteristic form of left valves in *Euchondria*, a topoparatype found on the same slab with holotype, x 1; Smithwick shale, east of San Saba, Tex.; Yale Univ., Peabody Mus., no. 14,479.
 - 13a, b—Views of a right valve showing the curious posteriorly abbreviated form and the crenulated ligament area of *Euchondria*, holotype, x 3 and x 1; Smithwick shale (lower Pennsylvanian), east of San Saba, Tex.; Yale Univ., Peabody Mus., no. 14,479.
- - 14a, b—Subinternal mold of part of a right valve, showing progressive loss of byssal notch characteristic of *Euchondria* and a trace of the row of resilifers along the hinge margin, a topotype found on the same slab with the holotype but not mentioned by the author, x 6.
 - 15a, b—View of inner surface of outer ostracum of a left valve in which the inner shell material has been destroyed in fossilization, patches of the external mold show through in the central area, holotype, x 3.
- 16, 17, 19—Euchondria pellucida (Meek and Worthen), types from Upper Carboniferous (Des Moines subseries, lower Pennsylvanian), Adams County, Ill., Illinois Univ., no. 10,932.p. 106
 - 16a, b—A nearly complete left valve showing the form and ornamentation, designated here the lectotype, x 7 and x 3, respectively.
 - 17—An imperfect left valve, a topoparatype, x3.
 - 19—Greatly enlarged external mold of the posterior part of a right valve, showing the imprints of concentric rows of prisms characteristic of *Euchondria*, a topotype, found on the same slab with the holotype, but not mentioned by the authors, x 20.



Newell, Upper Carboniferous Enchondriidae



Newell, Carboniferous and Jurassic Amussiidae

PLATE 20.—CARBONIFEROUS AND JURASSIC AMUSSIIDAE

(Pernopecten, Entolium).

Figure

- - 1—Wax cast of an internal mold of a large left valve, showing cardinal groove for the reception of a corresponding ridge on the right valve, also showing crura, resilifer, and characteristically abbreviated posterior margin, paratype, x 3; Liverpool formation (lower Pennsylvanian), SW. 1-4 sec. 15, Knox Township, Knox County, Ill.; Illinois Geol. Survey.
 - 2—A mature right valve, external view, showing anterior and posterior projections (crests) characteristic of the species, a topoparatype, x 3; lower Mercer limestone (lower Pennsylvanian), Flint Ridge, Licking County, Ohio; U.S. Nat. Mus. no. 89,789.
 - 3—Inner view of a characteristic left valve, retaining, however, only the outer ostracum which shows the radial structure characteristic of left valves, a topoparatype, x 3; lower Mercer limestone (lower Pennsylvanian), Flint Ridge, Licking County, Ohio; U.S. Nat. Mus. no. 89,789.
 - 5—A characteristic right valve, a topoparatype, x 1; lower Mercer limestone (lower Pennsylvanian), Flint Ridge, Licking County, Ohio; U.S. Nat. Mus. no. 89,789.
 - 6—A nearly perfect internal mold of a characteristic left valve, holotype, x 1; lower Mercer limestone (lower Pennsylvanian), Flint Ridge, Licking County, Ohio; U.S. Nat. Mus. 89,789.
- 4—Pernopecten attenuatus (Herrick). A left valve showing the relatively slender proportions of the species, a hypotype, x 2; Upper Carboniferous (roof of Danville coal, lower Pennsylvanian), Danville, Ill.; Yale Univ., Peabody Mus., no. 14,493....p. 113
- - 7a, b—Enlargements of a juvenile left valve, showing that the hinge margin is straight in the early ontogeny, also a distinct byssal sinus is indicated in the early growth lines of the anterior (left) auricle, indicated derivation from a shell having somewhat the form of Streblopteria, topoparatype, x 5 and x 7, limestone thought to be Wakarusa, south of the Thurman fault, at Thurman, Iowa; Yale Univ., Peabody Mus., no. 14,485.
 - 8a, b—Internal mold of a mature right valve, showing impressions of a cardinal ridge, resilifer, crura, and examples of the much discussed parallel ridges and grooves on both sides of the resilifer, a paratype, x 3 and x 1; Howard limestone, 2 miles north of Thurman, Iowa; Yale Univ., Peabody Mus., no. 14,436.
 - 9—Idealized and somewhat diagrammatic restoration of a right valve showing the cardinal ridge, which apparently articulated in a groove in the left valve, showing also the auricular crura, resilifer, which is ventral to the hinge axis, and the controversial ridges parallel to, and on each side of, the resilifer.
 - 10-A nearly complete left valve, showing a distinctive pos-

Figure

- terior profile as compared with *Pernopecten prosseri* or *Pernopecten obioensis*, n. sp., holotype, x 1; from a limestone thought to be Wakarusa, south of Thurman fault, at Thurman, Iowa; Yale Univ., Peabody Mus., no. 14,485.
- 11—Restoration of a left valve showing the curious box-like excavations at the base of the auricles, cardinal groove, crura, and resilifer, grooves on each side of resilifer have not been observed in left valves, although they probably occur in some individuals.
- 12, 13, 17, 18—Pernopecten prosseri (Mark). Type specimens, Upper Carboniferous (Ames limestone, upper Pennsylvanian), New Concord, Ohio, Ohio Univ., no. 14,036.p. 111
 - 12—View of interior of a left valve showing crura, muscle marks, and marginal ridges, wax cast of a paratype, x 1.
 - 13a-c—A fragment of a right valve, inner surface, a paratype, portion of hinge, showing fine ridges parallel to resilifer, x 3, entire specimen, x 1, and small area of outer ostracum, photographed in air, x 40.
 - 17—A nearly complete left valve, showing the form and distinctive lack of a shoulder (or crest) behind the posterior auricle, selected here as lectotype, x 1.
 - 18—Dorsal part of a right valve, showing difference in auricles and the progressive loss of a byssal notch in the anterior auricle, paratype, x 5.
- 14—Pernopecten cf. shumardanus Winchell. Shown for comparison, a wax cast of a left valve showing cardinal groove, resilifer, crura, marginal ridges, or folds; the auricles are not well preserved so that their form may not be shown correctly, a hypotype, x 1.5; Waverly sandstone (Mississippian), Cuyahoga, Ohio; U.S. Nat. Mus.
- 15, 16—Pernopecten obliquus Girty. Type specimens, x 2, Permian (middle of Capitan limestone) Capitan Peak, Guadalupe Mountains, West Texas.

- 15—A left valve, one of Girty's figured syntypes (Girty's pl. 9, fig. 13) showing the auricles which, being embedded in matrix, are visible only under a liquid such as xylol; U.S. Geol. Survey Type Coll., no. 406.
- 16—Another fragmentary left valve; U.S. Geol. Survey Type Coll., no. 405.
- 19, 20—Entolium demissum (Phillips). Topotype specimens of the genotype species of Entolium from the Brown (oolitic hematite) Jura, Wasseral-flingen, Wurtemburg, Germany. Although the preservation in these shells is perfect there is no shell microstructure comparable with that of the Paleozoic pernopectens.
 - 19—A left valve, showing the orbicular shape, unlike the asymmetrical form of the pernopectens, x 1; Yale Univ., Peabody Mus., no. 14,494.
 - 20—A right valve, differing only slightly in form from the left valve, x 1; Yale Univ., Peabody Mus., no. 6,725.