in the direction of its strike. The axis of the anticline passes south of Whitmire where the top of the Burgen sandstone reaches an elevation of about 50 feet above the river. From this vicinity the strata dip northward so that the Burgen and Tyner formations and the Sylamore sandstone member of the Chattanooga are beneath the surface at the confluence of Illinois River and Flint Creek. There is a slight rise to the north so that the Sylamore sandstone is exposed on Flint Creek south of Flint Post-Office.

Two anticlines on Spavinaw Creek are indicated by the distribution of the Chattanooga shale. The creek flows on the Boone chert near the mouth of Cloud Creek but the strata rise to the east and west, so that the Chattanooga shale forms the valley floor. The axis of the eastern fold was not located. To the west the strata rise very gently as far as the line between the Siloam Springs and Pryor quadrangles, and then more rapidly to the axis of the fold at Spavinaw.

The dips in all these folds are gentle, the maximum being about 5 degrees.

Exposures of the Boone chert commonly show apparent dips, but they are irregular in direction, and probably are due in large measure to the solution of the limestone beds and the resulting slump of the chert. Some of the dips may be due to folding, but it is impossible to determine in the short exposures which are true dips and which are due to slump.

STRUCTURE OF THE PRYOR QUADRANGLE.

The minor structure is much less pronounced in the Pryor quadrangle than in the area to the south and southeast in the Muskogee and Tahlequah quadrangles. Faulting of the type so common in those quadrangles is almost absent in the Pryor, and the folds are more gentle. The general direction of the folding is more nearly east and west than northeast and southwest.

Faults.—Four of the faults of the extreme northern portion of the Muskogee quadrangle extend for short distances into the Pryor quadrangle. The two faults in the southern part of T. 18 N., R. 21 E., converge to the north and intersect on the west side of Blackbird Creek, about 2 miles north of the quadrangle line. The faults in the southern part of T. 18 N., R. 20 E., also converge and intersect about the same distance north of the line. The actual intersection of neither pair of faults was observed, but the northern limit of the down-dropped blocks of the Winslow formation was determined with a fair degree of accuracy. The faults may continue beyond their intersections but it is impossible to trace them in the Boone chert.

The *Locust fault* extends southward from the vicinity of Locust Grove nearly or quite to the southern boundary of the quadrangle. The downthrow is to the west, bringing the Chester formations below the level of the top of the Boone hills on the east side of the fault for the greater part of its length. Near its southern extremity the fault brings the Chattanooga shale in contact with the Boone formation well above the base. The displacement of the fault is probably nowhere more than 200 feet.

The *Seneca fault* extends northeastward from a point about 3 miles south of Pryor to the vicinity of Spurgen, Missouri, passing near Seneca, Missouri, from which place the fault takes its name. In the Pryor quadrangle, the fault is a simple block fault, varying from one-eighth of a mile to more than one-half mile wide. The block consists of the Morrow limestone, and sandstones and shales of the lower part of the Winslow formation which are brought into contact with the Chester formations on either side for the greater part of its course. In the southwestern part of T. 22 N., R. 20 E., the lower Pennsylvanian rocks are brought down between outcrops of the Boone formation on either side and, immediately to the southwest, between the Boone and the Fayetteville formations. Where the dips in the fault block can be determined they are to the northwest and at angles up to 30 degrees. In the valley of Grand River in the vicinity of Strang the fault is concealed by the alluvium, but to the northeast it is plainly shown with the higher Chester formations and the lowest Pennsylvanian rocks brought down into the Mayes limestone or into the Boone formation. The dips of the rocks on either side of the block, except very near the fault, is away from the fault at angles up to 5 degrees. It appears then, that the fault is due to the dropping of a block on the crest of a rather strong anticline. The maximum displacement is probably about 300 feet.

Two minor faults of small extent and displacement were observed, one in southern part of sec. 16, T. 19 N., R. 19 E., and one in the eastern part of sec. 6 of the same township.

Folds.—The strata in the Pryor quadrangle are nearly everywhere affected by minor folding, but most of the folding is gentle. All the major tributaries of Grand River from the east flow on or near the axes of anticlines. The anticline on Spavinaw Creek has been described in connection with the structure of the Siloam Springs quadrangle. The anticlines on Salina, Spring, and Clear creeks are of the same type, but are less pronounced. The fold on Spring Creek brings the Chattanooga shale and the Ordovician rocks to the surface a short distance above the junction of Spring and Little Spring creeks. These folds extend across Grand River

more regular in some specimens than in others, and occasionally they appear to occur in transverse rows, especially in connection with the sub-lamellose bands just mentioned.

In the brachial valve the structure is the reverse of that described. In the most strongly characteristic specimens, the external mold appears to be marked by sharply defined regular spine bases with prominent spines. In others the appearance is more that of continuous costae. Regularly concentric sub-lamellose bands frequently occur, and spines are developed on this valve as well as on the other.

Remarks.—This is an abundant species in the Oklahoma collections. The specimens reach a length of about 35 mm. and a width of about 30 mm. The costae while irregular, usually number about 10 or 11 in 10 mm.

Occurs in collections M 19, F 1, F 2, F 3, F 10, F 11, F 12, P 1, P 2, P 3, P 5, P 7, and P 8.

Genus PUSTULA Thomas.*

PUSTULA ALTERNATA Norwood and Pratten.

1855. *Productus alternatus,* Norwood and Pratten, Jour. Acad. Nat. Sci. Phila., (2), vol. 3, p. 20, pl. 2, figs. 1a-e.
1858. *Productus vittatus,* Hall, Geol. Iowa, vol. 1, pt. 2, p. 639.
1863. *Productus gradatus,* Swallow, Trans. St. Louis Acad. Sci., vol. 2, p. 93.
1914. *Echinoconchus alternatus,* Weller, Mon. Ill. State Geol. Survey, No. 1, p. 138, pl. 17, figs. 1-7.

Remarks.—The material of this species is poorly preserved and there is a little doubt as to the identification. No features distinguishing it from *Pustula punctata* Martin can be made out from the specimens in hand, but the reference is made to the Mississippian rather than to the Pennsylvanian species.

Occurs in collections M 10, M 20, F 13, F 19, F 20, F 21, F 22, and P 7.

PUSTULA MOOREFIELDANA Girty.

1911. *Productus moorefieldanus,* Girty, Bull. U. S. Geol. Survey, No. 439, p. 48, pl. 3, fig. 6.

Remarks.—Several specimens in collection M 4 are referred to this species.

*Loc. cit. The genus *Pustula* includes those productid forms in which the ornamentation is essentially spinose. The generic name *Echinoconchus* proposed by Weller (Mon. Ill. State Geol. Survey, No. 1) later in the same year (1914) in a synonym.

PUSTULA SUBSULCATA Girty.

1911. *Productus subsulcatus,* Girty, Bull. U. S. Geol. Survey, No. 439, p. 47, pl. 3, figs. 12-14.

Present at localities M 3, M 4, M 7, M 8a, and M 8b.

PUSTULA BISERIATA Hall?

1856. *Productus biseriatus,* Hall, Trans. Albany Inst., vol. 4, p. 12.
1906. *Productus biseriatus,* Beede, 30th Ann. Rept. Ind. Dept. Geol. and Nat. Res., p. 325, pl. 29, figs. 8-12.
1911. *Productus biseriatus,* Girty, Bull. U. S. Geol. Survey, No. 439, p. 46, pl. 3, figs. 10-11.
1914. *Echinoconchus biseriatus,* Weller, Mon. Ill. State Geol. Survey, No. 1, p. 141, pl. 17, figs. 10-15.

Remarks.—One incomplete specimen from collection M 4 is doubtfully referred to this species. It is also known to occur in the upper part of the Boone formation.

Genus AVONIA Thomas.*

AVONIA OKLAHOMENSIS n. sp.

Pl. IV, Figs. 4-11.

Description.—Shell small to medium, the dimensions of the type specimen being: length along hinge line, 23 mm., (hinge line equal to or only very slightly less than the greatest width of the shell); length from the umbonal region, 23 mm.; from the hinge line, 17 mm.; convexity, 12 mm.

Pedicle valve with the greatest convexity near the middle of the shell. Beak projecting slightly over the hinge line. The medial portion (ventre, Thomas) is broadly flattened, with very steep slopes to the lateral margins. The slope from the umbones to the cardinal margins is at first convex and then broadly concave to the margin. Auriculations small and outlined by the bases of 3 or 4 strong, erect spines. The posterior portion of the valve is ornamented by growth lines or ribs with a few scattered spine bases. The anterior portion is ornamented by strong sub-angular costae separated by broader rounded grooves. The costae begin abruptly about the middle of the shell at the growth line or rib connecting the extremities of the auriculations and continue to the anterior margin without bifurcations. Those on the lateral slopes are nearly obsolete and widely spaced. Spine bases are few in number. The whole surface of the valve is ornamented with fine concentric markings which show only on well preserved specimens.

*Loc. cit. The genus *Avonia* includes those productid forms in which the ornamentation is spinose in the young stages and costate in the older stages.

Brachial valve gently concave, with the ornamentation corresponding to that of the pedicle valve.

Remarks.—This is a rare form occurring only in collection M 4, with one specimen from collection F 16 doubtfully referred to the species. It may be compared with the figures of *Productus lachrymosus* var. *limus* Walcott* from the Devonian of the Eureka district, Nevada.

Genus DIAPHRAGMUS Girty.

DIAPHRAGMUS ELEGANS Norwood and Pratten.

1855. *Productus elegans,* Norwood and Pratten, Jour. Acad. Nat. Sci. Phila. (2), vol. 3, p. 3, pl. 1, figs. 7 a-c.
1860. *Productus Cestriensis,* Worthen, Trans. St. Louis Acad. Sci., vol. 1, p. 570.
1910. *Diaphragmus elegans,* Girty, Ann. N. Y. Acad. Sci., vol. 20, p. 217.
1911. *Diaphragmus elegans,* Girty, Bull. U. S. Geol. Survey, No. 439, p. 51, pl. 4, figs. 4-5.
1914. *Diaphragmus elegans,* Weller, Mon. Ill. State Geol. Survey, No. 1, p. 136, pl. 12, figs. 8-17.

Remarks.—One of the most abundant species in the Oklahoma collections. The specimens from the Fayetteville and Pitkin formations are somewhat broader than those from the Mayes, corresponding to the difference between the Moorefield and Fayetteville forms in Arkansas noted by Girty. It is especially abundant in the limestone of the Fayetteville, almost entirely composing some layers locally. It becomes less abundant to the north, decreasing in number as *Productus inflatus* increases at the same horizon.

From localities M 2, M 7, M 8c, M 9, M 11, M 13, M 14, M 15, M 16, M 17, M 18, M 19, M 21, F 1, F 2, F 4, F 5, F 6, F 7, F 9, F 16, P 2, P 4, P 5, P 6, P 7, P 8, and P 9.

Genus MARGINIFERA Waagen.

MARGINIFERA ADAIRENSIS Drake?

Pl. IV, Figs. 12-14.

1898. *Productus (Marginifera) adairensis,* Drake, Proc. Am. Phil. Soc., vol. 36, No. 156, p. 402, pl. 9, figs. 1-3.

Remarks.—The shells referred to this species are small, the maximum length being about 15 mm., and the maximum width about 20 mm. The pedicle valve is strongly convex, with concave slopes to the cardinal extremities. The beak is fairly prominent and strongly incurved. The brachial valve is nearly flat over the visceral portion, strongly inflected around the edges. The visceral portion of the valve is surrounded by a strong ridge on the interior

*Mon. U. S. Geol. Survey, vol. 8, pl. 13, figs. 18, 18a.

of the valve, on account of which the species is placed in the genus *Marginifera.* The surface of both valves is ornamented with very fine costae which are not noticeable on weathered specimens. There is a suggestion of reticulation on the anterior portion of the pedicle valve.

The size and shape of the shell together with the ornamentation separate the species distinctly from any with which it is associated. The resemblance to Drake's figures and description is very strong, but in the absence of the type specimens the reference is made with some doubt.

From localities M 7, M 14, M 19, and F 3.

PENTAMERIDAE.

Genus CAMAROPHORIA King.

CAMAROPHORIA CESTRIENSIS n. sp.

Pl IV, Figs. 15-26.

Description.—Shell small, subovate to subpentagonal, length and width nearly equal, the greatest width anterior to the middle of the shell. The dimensions of the largest shell and one of average size are as follows: length of pedicle valve, 13 mm. and 10.5 mm.; length of brachial valve, 11 mm. and 9 mm.; greatest width, 12.5 mm. and 9.5 mm.; thickness, 9 mm. and 6.5 mm.

Pedicle valve arched from beak to front, greatest convexity in the umbonal region, slope steep toward the cardinal margin, and very gentle to the antero-lateral margin. The mesial sinus begins posterior to the middle of valve, and deepens rapidly anteriorly being produced into a lingual extension deeply inflecting the margin of the brachial valve, with a single, ill-defined, rounded plication in the anterior portion. Beak small and incurved. The median septum usually shows as a dark line on the surface and the spondylium is often exposed by the breaking away of the beak.

Brachial valve more convex than the pedicle the greatest depth anterior to the middle. Slope from the middle to the beak and margins about equal except on the mesial fold; the mesial fold begins about the middle of the valve and has a single ill-defined furrow. Beak pointed and incurved beneath that of the pedicle valve.

Ordinarily the lateral slopes are without plications, but in a few of the largest specimens a very faint plication is developed at the anterior margin near the mesial fold on the brachial valve and a corresponding furrow is shown on the ventral valve.

Surface markings consist of faint concentric lines of growth.

Remarks.—This species is easily separated from *C. explanata*, the only other species of the genus known to occur in the Chester, by its larger size and by the absence of well defined plications on the lateral slopes.

In collections M 4, F 1, F 7, F 16, P 4, P 5, P 7, P 9, and P 10.

TELOTREMATA.

RHYNCHONELLIDAE.

Genus CAMAROTOECHIA Hall and Clarke.

CAMAROTOECHIA PURDUEI Girty.

1910. *Camarotoechia purduei,* Girty, Ann. N. Y. Acad. Sci., vol. 20, No. 3, pt. 2, p. 219.
1911. *Camarotoechia purduei,* Girty, Bull. U. S. Geol. Survey, No. 439, p. 60, pl. 5, figs. 5, 5a.
1911. *Camarotoechia purduei* var. *agrestis,* Girty, Bull. U. S. Geol. Survey, No. 439, p. 60, pl. 5, figs. 1-4a.
1911. *Camarotoechia purduei* var. *laxa,* Girty, Bull. U. S. Geol. Survey, No. 439, p. 61, pl. 5, figs. 6-11b.

Remarks.—The specimens included under this title show considerable variation in size, and in number, arrangement, and angularity of plications, but are believed to represent one species. Girty separates his varieties *laxa* and *agrestis* on the basis of size of shell and on the number and angularity of the costae. The variety *agrestis* is said to be larger than typical *purduei* and to have usually 4 plications on the fold in place of 3. In the Oklahoma collections there seems to be no such relation; the specimens in collection F 10 are, as a rule, considerably larger than those in collection M 2, but the majority of the larger shells have 3, while the majority of the smaller ones have 4 plications on the fold. In fact, the gradation in characters is so uniform that it seems necessary to include the forms under the one species, although specimens representing Girty's varieties could be selected.

From localities M 2, M 3, M 6, M 7, M 8b (?), M 12, M 13, M 20, M 21, F 1, F 8, F 10, F 11, F 12, F 14, F 16, F 17, F 19, F 20, and F 22. The specimens from M 8b are very doubtfully referred to this species. They are much larger than common, and the plications are broad, low and rounded.

Genus LEIORHYNCHUS Hall.

LEIORHYNCHUS CARBONIFERUM *Girty.*

1877. *Leiorhynchus quadricostatus*?, Meek, U. S. Geol. Expl. 40th Par. Rept., vol. 4, p. 79, pl. 3, figs. 9-9b.
1909. *Liorhynchus* aff. *mesicostale,* Girty, Bull. U. S. Geol. Survey, No. 377, p. 26, pl. 2, figs. 11-12.

1911. *Liorhynchus carboniferum,* Girty, Bull. U. S. Geol. Survey, No. 439, p. 54, pl. 6, figs. 1-8, pl. 7, figs. 13-16.

Remarks.—This form occurs only in the lower part of the Mayes limestone, where it is locally very abundant. In collections M 1, M 3, M 4, M 5, M 6, M 8a, M 8b, and M 11.

LEIORHYNCHUS CARBONIFERUM var. POLYPLEURUM Girty.

1911. *Liorhynchus carboniferum* var. *polyleurum,* Girty, Bull. U. S. Geol. Survey, No. 439, p. 59, pl. 7, figs. 7-12.

Remarks.—A few small specimens from locality M 8b are referred to this vicinity.

Genus MOOREFIELDELLA Girty.

MOOREFIELDELLA EUREKENSIS Walcott.

1884. *Rhynchonella Eurekensis,* Walcott, Mon. U. S. Geol. Survey, vol. 8, p. 223, pl. 18, figs. 8-8c.
1911. *Moorefieldella eurekensis,* Girty, Bull. U. S. Geol. Survey, No. 439, p. 63, pl. 5, figs. 12-17.

Remarks.—This species has a restricted range in the lower part of the Mayes limestone. It offers no striking variations from the figures and descriptions of the specimens from the Moorefield shale of Arkansas.

In collections M 4, M 5, M 8b, M 12, M 13, and M 20, locally extremely abundant.

Genus DIELASMA King.

DIELASMA SHUMARDANA Miller.

1863. *Terebratula arcuata,* Swallow, Trans. St. Louis Acad. Sci., vol. 2, p. 83 (Not *T. arcuata,* Roemer, 1840).
1883. *Terebratula shumardana,* Miller, Am. Pal. Foss., 2nd. ed., p. 299.
1914. *Dielasma shumardanum,* Weller, Mon. Ill. State Geol. Survey, No. 1, p. 268, pl. 31, figs. 25-27.

Remarks.—This species is one of rather common occurrence in the Chester of Oklahoma. In some collections the material is too poorly preserved to make the identification certain.

In collections M 2, M 4 (?), M 8c, M 11, M 12, M 13, M 14, M 18, F 1, F 2, F 3, F 9 (?), F 12 (?), P 7 (?), and P 9.

DIELASMA COMPRESSA n. sp.

Pl. IV, Figs. 27-29.

Description.—Shell of small to medium size, elongate-subovate in outline, greatest length about one and one-third times the great-

the beak there is only one plication in the sinus, but the number increases to 10 or 12 near the front margin. The method of increase cannot be told definitely from the specimens in hand. The lateral slopes have about 15 fine rounded plications similar to those of the sinus. The surface is ornamented by concentric marking and by radiating striae which are quite distinct where the preservation is good.

Remarks.—This species is easily distinguished from any associated with it by the fineness of the plications and by the broad, rounded sinus.

From the shale of the Fayetteville formation above the limestone, locality F 8.

Genus BRACHYTHYRIS McCoy.

BRACHYTHYRIS OZARKENSIS n. sp.

Pl. V, Figs. 3-6.

Description.—Shell of medium size, sub-orbicular in outline, greatest width near the mid-length, cardinal extremities rounded. The dimensions of a nearly perfect specimen of small size are: length, 20 mm.; width, 23 mm.; thickness, 11 mm.; convexity of pedicle valve, 7 mm.; convexity of the brachial valve, 4 mm.; length of the hinge-line, 10 mm. The maximum dimensions shown are: length, 35 mm.; width about 35 mm.; convexity of pedicle valve, 13 mm., and of the brachial valve about 6 mm.; length of hinge-line about 15 mm.

Pedicle valve strongly convex, with its greatest convexity posterior to the middle, surface curving abruptly to the cardinal margin, less sharply to the lateral margins, and with a gentle slope to the anterior margin. Convexity of the valve extending to the cardinal margin. Beak prominent, pointed and strongly incurved; cardinal area rather small, concave, becoming more curved toward the beak, central part occupied by a triangular delthyrium, lateral margins not well defined. Lateral slopes with 5 or 6 broad, slightly elevated plications, separated by narrow, shallow depressions, plications' obsolete near the cardinal extremities. Mesial sinus originating at the beak, very shallow and ill-defined, scarcely indenting the anterior margin, with three poorly defined plications anteriorly, of which the central one is usually smaller than the others.

Brachial valve much less convex than the pedicle, greatest convexity near the middle, compressed toward the cardinal extremities. Beak projecting slightly beyond the hinge-line. Mesial fold only slightly elevated, widening rapidly toward the front, with 3 or 4 poorly defined plications anteriorly which are practically ob-

solete in the larger specimens. Plications of the lateral slopes similar to those of the pedicle valve. The grooves on either side the mesial fold are wider than the others.

Minute surface markings consist of extremely fine, wavy, concentric lines. On partially exfoliated specimens very fine longitudinal lines are also shown, especially in the grooves between the plications.

Remarks.—The material of this species is fairly abundant but is mostly fragmentary. The species is easily differentiated from *B. subcardiiformis* Hall by the absence of a false cardinal area and by the broad, low plications, and from *B. suborbicularis* Hall by the fewer plications and the less developed fold and sinus.

From localities M 7 (?), F 10, F 11, F 12, F 13, F 14, and F 16.

Genus RETICULARIA McCoy.

RETICULARIA SETIGERA Hall.

1858. *Spirifer setigerus,* Hall, Geol. Iowa, vol. 1, pt. 2, p. 705, pl. 27, figs. 4a-b.
1911. *Reticularia setigera,* Girty, Bull. U. S. Geol. Survey, No. 439, p. 69, pl. 8, fig. 6.
pl. 74, figs. 12-22.

Remarks.—This shell is found in the three Chester formations in several localities but nowhere is it extremely abundant. The specimens differ considerably in the strength of the fold and sinus. Those in collection M 4 have these features almost or quite obsolete, and may represent a variety or even a distinct species. The material is not abundant, however, and is retained under *R. setigera* with some doubt.

In collections M 2, M 3, M 4 (?), M 6, M 7, M 8a, M 8c, M 14, M 15, M 16, F 1, F 4, F 5, F 7, F 9, F 13, F 14, F 16, P 7, P 8, P 9, and P 10.

Genus AMBOCOELIA Hall.

AMBOCELIA LEVICULA Rowley?

1900. *Ambocoelia levicula,* Rowley, Am. Geologist, vol. 25, No. 5, p. 262, pl. 5, figs. 12-14.
1911. *Ambocoelia levicula* (?), Girty, Bull. U. S. Geol. Survey, No. 439, p. 73, pl. 8, figs. 7-9.
1914. *Ambocoelia levicula,* Weller, Mon. Ill. State Geol. Survey, No. 1, p. 426, pl. 77, figs. 26-31.

Remarks.—This species is found abundantly only in the Mayes limestone in the southern portion of the area. It is believed to be identical with the species listed under this name by Girty from the