UNITED STATES DEPARTMENT OF THE INTERIOR
Harold L. Ickes, Secretary

GEOLOGICAL SURVEY
W. C. Mendenhall, Director

Professional Paper 186—M

A REDESCRIPTION OF FERDINAND ROEMER'S PALEOZOIC TYPES FROM TEXAS

BY

JOSIAH BRIDGE AND GEORGE H. GIRTY

Shorter contributions to general geology, 1936

(Pages 239–271)

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1937

For sale by the Superintendent of Documents, Washington, D. C. - - - - - - Price 10 cents

CONTENTS

ILLUSTRATIONS

A REDESCRIPTION OF FERDINAND ROEMER'S PALEOZOIC TYPES FROM TEXAS

By Josiah Bridge and George H. Girty

ABSTRACT

This paper presents a redescription of the types of the Paleozoic fossils from the Central Mineral Region of Texas originally described by Ferdinand Roemer in 1849 and 1852, which have long been inaccessible to American students. These descriptions are accompanied by new figures which include the type specimens, topotypes now in the United States National Museum, and the types of several other species that are now considered to be synonyms. The localities that furnished the original specimens have been reestablished within fairly narrow limits, and the stratigraphic horizons have been accurately determined. The type material has been compared with material from other parts of the United States, and the geographic range of several of the forms has been greatly extended.

ACKNOWLEDGMENTS

The authors are deeply indebted to Dr. N. Tilman, curator of the Museum of Geology and Paleontology, of the University of Bonn, Germany, for the loan of the type material and for the information furnished with it. They are also indebted to Prof. A. K. Miller, of the State University of Iowa, for the loan of a large number of specimens from the Deadwood formation of the Black Hills, South Dakota.

The relocation of some of the type localities and the collection of some of the topotype material was done by Josiah Bridge in 1934 in the course of an investigation aided by a grant from the Penrose Bequest of the Geological Society of America.

HISTORY

In 1845, 1846, and 1847 Dr. Ferdinand Roemer, a noted German geologist and paleontologist, spent about 17 months traveling in the then newly annexed State of Texas, gathering scientific data, and also visiting the various German settlements to obtain information of general interest to emigrants. The greater part of this time was spent in the Coastal Plain and the Edwards Plateau, which at that time were the settled portions of the State. In the course of this trip he spent about a month in the Central Mineral Region, which was then Indian country, and he seems to have been the first geologist to recognize and describe the Paleozoic rocks in that region.[1]

Roemer's first account of the geology of Texas, contained in a letter written from the field to the editor of the American Journal of Science,[2] makes no mention of Paleozoic rocks, but he comments on specimens of granite which had been brought to him from outcrops north of Fredericksburg.

A second preliminary paper, written after his return to Europe,[3] gives a brief account of his trip to the San Saba River, describes the route traveled, notes the occurrence of granite, Lower Silurian (so designated by him) and Carboniferous rocks, and gives brief descriptions of them. He mentions the occurrence of *Asaphus*, *Bronteus*, *Euomphalus*, *Spirifer*, *Productus*, and *Terebratula* but gives no descriptions. In 1849 he published a comprehensive report on his travels in Texas,[4] a popular account intended primarily for German emigrants. The greater portion of the book consists of the journal of his trip, together with many observations about the country, its resources and inhabitants. Chapters 19 to 22 describe his journey into the Central Mineral Region. Besides the narrative, there is an introductory chapter which gives a brief summary of the history of the State, an account of its geography, climate, agricultural and mineral resources, the history of the German settlements within the State, and a bibliography of books and other published articles relating to Texas.[4a]

At the end of the book there is a scientific appendix in which his geologic, zoologic, and botanic observations are collected and summarized. The Paleozoic strata of the Central Mineral Region and 11 species of fossils found in them are described. This constitutes the first published report on the Paleozoic stratigraphy and paleontology of Texas. He lists the following Paleozoic species, and describes those preceded by an asterisk. The age designations in this list are his.

1. *Lingula acutangula, n. sp. Silurian.
2. Orthis, sp. ind. Silurian.
3. Orthis umbraculum L. v. Buch. Carboniferous.
4. Terebratula pugnus Sowerby. Carboniferous.
5. *Spirifer meusebachianus, n. sp. Carboniferous.
6. *Productus, sp. ind. Carboniferous.
7. *Productus, sp. ind. Carboniferous.
8. *Euomphalus polygyratus, n. sp. Silurian.

[1] See Hill, R. T., The present condition of knowledge of the geology of Texas: U. S. Geol. Survey Bull. 45, pp. 15–18, 1887. Comstock, T. B., Texas Geol. Survey 1st Ann. Rept., pp. 240–241, 1889 [1890].

[2] Roemer, F., A sketch of the geology of Texas: Am. Jour. Sci., 2d ser., vol. 2, pp. 358–365, 1846.

[3] Roemer, F., Contributions to the geology of Texas: Am. Jour. Sci., 2d ser., vol. 6, pp. 21–28, 1848.

[4] Roemer, F., Texas, mit besonderer Rücksicht auf deutsche Auswanderung und die physischen Verhältnisse des Landes, xiv, 464 pp., Bonn, 1849.

[4a] In 1935 a translation of these portions of the work, by Oswald Mueller, was published in San Antonio.

9. *Euomphalus sanctisabae, n. sp. Silurian.
10. *Pterocephalia sanctisabae, n. sp. Silurian.
11. *Pygidium of a trilobite, gen. and sp. unknown. Silurian.

The report is accompanied by a hand-colored reconnaissance map, which shows his interpretation of the geology of the State and also his approximate route from Fredericksburg to the San Saba River and return.[4b]

In 1852 Roemer's monumental work on the Cretaceous formations of Texas was published.[5] Although devoted primarily to the description of the Cretaceous rocks and fossils, it contains an appendix in which, among other things, are descriptions of the Paleozoic strata and fossils. In all, he describes 12 species from the Lower Silurian (so designated by him) and Carboniferous. He redescribes the five new species of the previous report and adds a sixth, assigns four forms to previously described species, and describes two trilobites without referring them to a genus. These descriptions are accompanied by a lithographed plate on which all the species described, except *Terebratula pugnus* Sowerby and *Productus cora* D'Orbigny, are illustrated. The list of species, with Roemer's age designations, is as follows:

1. *Spirifer meusebachanus. Carboniferous.
2. *Orthis arachnoidea Phillips. Carboniferous.
3. Terebratula pugnus Sowerby. Carboniferous.
4. *Productus flemingii Sowerby=no. 7 in preceding list. Carboniferous.
5. Productus cora D'Orbigny=no. 6 in preceding list. Carboniferous.
6. *Lingula acutangula Roemer. Silurian.
7. *Euomphalus polygyratus Roemer. Silurian.
8. *Euomphalus sanctisabae Roemer. Silurian.
9. *Euomphalus gyroceras, n. sp. Silurian.
10. *Pterocephalia sanctisabae Roemer. Silurian.
11. *Cephalon and pygidium of a trilobite, genus unknown. Silurian.
12. *Pygidium of a trilobite, genus unknown=no. 11 of preceding list. Silurian.

All these forms except no. 3 are described in detail, and those preceded by an asterisk are illustrated on the accompanying plate.

This portion of the report was promptly reviewed by Barrande,[6] who noted at once the twofold division of the Lower Silurian of Roemer, a fact which seemed to have escaped Roemer.

Barrande had previously examined the works of Owen and Hall and had concluded that the oldest faunas which they had obtained from the Lake Superior and New York regions were approximately the same and that they represented his Primordial (Cambrian) fauna. He now compared the trilobites and the *Lingula* described by Roemer with those figured by Owen and Hall, noted the similarity of their stratigraphic position, and concluded that Roemer had found the Primordial fauna in Texas and that it was the equivalent of the lowermost Paleozoic in Wisconsin and New York. He also observed that the various species of *Euomphalus* which Roemer had described had not been found in association with the trilobites and correctly concluded that they indicated a younger fauna.

Roemer's two reports have been of great value to students of Texas geology, but they are among the rarities of early American geologic literature. As the types of the Cretaceous and Paleozoic species described in them are preserved in the Geological and Paleontological Museum of the University of Bonn and are therefore not readily accessible to American students, the precise identification of many of the species has long been a difficult matter. Notwithstanding these difficulties, the satisfactory identification of most of the Cretaceous species has long since been accomplished, but there are very few references to the Paleozoic forms except bibliographic citations. This may be due in part to the fact that, being attached to a report entitled "The Cretaceous formations of Texas," the Paleozoic species have escaped general notice, but it is largely because very little stratigraphic and paleontologic work has been done on the early Paleozoic strata of the State.

During the second half of the nineteenth century the Central Mineral Region was visited at various times by parties from the Texas Geological Survey, but, with the single exception of the work done by Shumard, no new paleontologic data were acquired. The results of these investigations have been summarized in the papers by Hill and Comstock already cited.

Actual identification of Roemer's species has been made by only a few paleontologists. Shumard, while State geologist of Texas, published a brief notice of the region in 1860[7] and a more detailed account the following year. In this second paper[8] he described the Paleozoic rocks of Burnet County in considerable detail, gave several measured sections, and described nine new species of fossils, all Cambrian. One of Roemer's unnamed trilobites was named *Dikelocephalus roemeri* by Shumard, but none of his other species were mentioned. No illustrations accompanied these figures. The types are thought to have been deposited in the Texas State collection and, if so, were destroyed when the capitol burned in 1881. In 1914 Walcott[9] referred *Dikelocephalus roemeri* to *Ptychoparia* without discussion, and later he made it the type species of his new

[4b] The map is reproduced in Mueller's translation, but the text of the appendix is omitted. The existence of this translation was not known to the authors until after this paper had gone to press. All translations from "Texas" included herein are from the appendix, and all references to "Texas" apply to the original work.

[5] Roemer, F., Die Kreidebildungen von Texas und ihre organischen Einschlüsse, mit einem die Beschreibung von Versteinerungen aus paläzoischen und tertiären Schichten enhaltenden Anhange, und mit 11 von C. Hohe nach der Natur auf Stein gezeichneten Tafeln, 100 pp., Bonn, 1852.

[6] Barrande, J., Silur-Gebilde in Texas und am oberen See: Neues Jahrb., 1853, pp. 446–447.

[7] Shumard, B. F., [On Lower Silurian in Burnet County, Tex.]: St. Louis Acad. Sci. Trans., vol. 1, pp. 672–673, 1860.

[8] Shumard, B. F., The Primordial zone of Texas, with descriptions of new fossils: Am. Jour. Sci., 2d ser., vol. 32, pp. 213–221, 1861.

[9] Walcott, C. D., *Dikelocephalus* and other genera of the Dikelocephalinae: Smithsonian Misc. Coll., vol. 57, no. 13, p. 352, 1914.

genus *Elvinia*.[10] The name was derived from the town of Elvins, St. François County, Mo., where the species also occurs, furnishing another example of the close geologic relationship of the two areas.

Hall and Whitfield [11] and Walcott [12] described species of *Pterocephalia* from the Eureka district, and Walcott also described additional species from China.[13] He also identified Roemer's type species, *P. sanctisabae*, from material collected in Burnet County, Tex., and included this identification in faunal lists without further description.[14] He redescribed and figured *Lingula acutangula*, the only early Paleozoic brachiopod which Roemer described.[15]

The foregoing references appear to be the only published identifications of Roemer's species based on specimens, and none of the authors had access to the types. In 1931 the type specimens were loaned to the United States Geological Survey through the courtesy of Dr. N. Tilman, curator of the Museum of Geology and Paleontology at the University of Bonn, and for the first time it was possible to make comparisons. These specimens and the notes accompanying them have been of great assistance, and it has been possible to identify nearly every one of Roemer's species in the National Museum and Geological Survey collections. The study of the matrix in which the types are preserved has aided materially in assigning the type specimens to their proper stratigraphic horizons.

For the various reasons stated on the preceding pages, it seems desirable to publish translations of the original descriptions and to accompany these by notes based not only on the types but also on collections in the United States National Museum and elsewhere. A translation of Roemer's remarks about the Paleozoic stratigraphy is also included, partly as a matter of general interest and partly because they contain more precise information regarding the exact localities from which his collections were made. An effort has been made to fix each locality as accurately as the statements in Roemer's text, supplemented by personal knowledge of the region, will permit.

ROEMER'S LOCALITIES

Roemer collected his Paleozoic fossils at five localities. Four of these are in the San Saba Valley, and the fifth is somewhere on the great limestone plateau that forms the north border of the granite area in Llano County. An effort has been made by Bridge to reestablish these localities in order to secure topotype material. A study of Roemer's narrative, followed by field investigations in the fall of 1934, has enabled this to be done with a reasonable degree of certainty for four of the localities.

It is a fairly safe assumption that the present roads were established along former Indian trails, and that many of them have not been materially relocated. This is particularly true of the principal crossings of the larger rivers, the greater number of which are still unbridged.

Roemer states that his party traveled northwestward from Fredericksburg a distance of about 80 miles to reach the San Saba River. In so doing, it seems fairly certain that he followed the approximate course of the present Fredericksburg, Mason, and Brady highway to a point near Mason and then took a more northerly direction, reaching the San Saba Valley in the vicinity of Voca. The distance which he gives is somewhat greater than that of the present route, but it must be remembered that all of his mileage is estimated, and also that he must have done considerable meandering to and fro to get over some of the rougher parts of the country. His brief descriptions of the geology along this route tally very well with present observations. He speaks of passing directly from the Cretaceous rocks onto a sandstone (Trinity or Hickory, or both), and from this onto the granite, without noting the presence of the "Silurian" (Cap Mountain, Wilberns, and Ellenburger) limestones, before reaching the Llano River. These conditions exist along the general course of the Fredericksburg-Mason road. The Cambrian limestones, though not entirely missing, are strongly overlapped by the Cretaceous rocks and are easily overlooked.

Roemer states that after crossing the Llano River his party traveled over granite for about 20 miles and then crossed a long, narrow, steep-sided eastward-trending ridge of limestone [16] which rested upon the granite, and that in another 12 miles they reached the San Saba River. This ridge is plainly the long tongue of Cambrian and Cretaceous rocks that crosses the present highway about 6 miles north of Mason He makes no comment about the age of the limestones in this ridge at this point in the narrative, but in another place [17] he states that the first Silurian limestones were observed on the journey between the Llano and San Saba Rivers; he notes they were full of trilobite remains but does not state that any of his specimens came from this place. He does not mention the overlying Cretaceous rocks at this point, but he probably observed them. About the only place where he could

[10] Walcott, C. D., Cambrian and Lower Ozarkian trilobites: Smithsonian Misc. Coll., vol. 75, no. 2, p. 56, 1924; vol. 75, no. 3, pp. 88, 89, 1925.

[11] Hall, James, and Whitfield, R. P., U. S. Geol. Expl. 40th Par. Rept., vol. 4, p. 221, pl. 2, figs. 4-7, 1877.

[12] Walcott, C. D., Paleontology of the Eureka district: U. S. Geol. Survey Mon. 8, pp. 58, 59, pl. 9, fig. 21, 1884.

[13] Walcott, C. D.. Cambrian faunas of China: U. S. Nat. Mus. Proc., vol. 29, pp. 67, 68, 1905; Smithsonian Misc. Coll., vol. 57, no. 4, p. 80, pl. 14, fig. 12, 1911; Carnegie Inst. Washington Pub. 54, vol. 3, pp. 146, 147, pl. 14, figs. 4, 5, 8, 1913.

[14] Walcott, C. D., Cambrian Brachiopoda: U. S. Geol. Survey Mon. 51, p. 212, 1912.

[15] Walcott, C. D., Cambrian Brachiopoda, *Obolus* and *Lingulella*, with description of new species: U. S. Nat. Mus. Proc., vol. 21, no. 1152, pp. 392-394, pl. 28, 1898; Cambrian Brachiopoda: U. S. Geol. Survey Mon. 51, pp. 474-476, pl. 17, figs. 1, 1a-o, 1912.

[16] Roemer, F., Texas, p. 289, 1849.

[17] Idem, p. 388.

have found Cambrian limestones along this route between the Llano and San Saba Rivers is on the south side of this ridge where the present Mason-Katemcy road crosses it. Elsewhere along this same ridge the Cretaceous rests on granite, so that it seems fairly certain that he crossed it at about this point. After crossing the ridge, the party seems to have turned slightly east of north, reaching the San Saba River somewhere between Voca and the mouth of Lost Creek. After halting here for a day they crossed the river, made two short marches along the north bank, and made their third camp in the San Saba Valley at a point said to be about 14 miles upstream from the point at which they had first reached the river. They were probably close to Camp San Saba, although the distance that Roemer gives is too great. All the Cambrian species which Roemer describes were collected while at this camp. The greater part of these Cambrian fossils come from the *Camaraspis* zone, which occurs in the lower portion of the Wilberns formation. This zone is exposed along the San Saba River about a mile east of the present highway crossing, at a ford, and as this is the only place in this part of the San Saba Valley where this zone is exposed, it seems certain that Roemer must have obtained his fossils from this particular belt of outcrop. In 1934 Bridge collected *Pterocephalia sanctisabae*, *Elvinia roemeri*, and other characteristic species from beds exposed at water level on the north side of the San Saba River just below the ford half a mile northeast of Camp San Saba and 1 mile east of the new bridge on United States Highway 385 (pl. 66, *B*). Five or six feet above this zone are beds carrying *Eoorthis remnichia texana* in great abundance, which may be the "form similar to *Orthis*" that he mentions. The lithology of the beds carrying *Pterocephalia* is identical with that of the fragment containing Roemer's types.

The expedition continued along the north bank of the river until it reached the old Spanish mission and fort near the present town of Menard (pl. 66, *A*) and after spending a day or so in that neighborhood crossed the river and returned along the south bank. Roemer noted the occurrence of Carboniferous strata about 15 to 20 miles downstream from the fort and one Carboniferous species, *Spirifer meusebachanus*, was collected here from beds now placed in the Canyon group.[18] He also obtained two "Silurian" species, *Eccyliomphalus gyroceras* and *Ophileta polygyrata*, from this same general locality.

In 1934 Bridge collected *Eccyliomphalus gyroceras* and *Ophileta polygyrata* from the white limestone that forms the base of the Ellenburger limestone in this area, in a small ravine on the south side of the San Saba River half a mile east of the north-south highway that parallels the Mason-Menard County line. These species are abundant at this place and were found at several places between this ravine and the ford at the Blockhouse ranch, about a mile farther east (downstream), and the lithology of the strata containing them is similar to the matrix of Roemer's specimens. These are the most westerly exposures of this part of the Ellenburger in the San Saba Valley, and, as they are at about the proper distance downstream from Menard, it would seem that Roemer's specimens came from this general locality.

The remaining "Silurian" specimen, *Lecanospira sanctisabae*, was collected on the first day of the return journey from the San Saba Valley. The party had followed the river downstream, past the point where they first reached it, until the valley reentered the Carboniferous rocks. They seem to have reached a point a few miles west of the present town of San Saba. Here they turned almost due south and returned to Fredericksburg. Although Roemer describes the route fairly well, there are no conspicuous landmarks along it which enable it to be located exactly. However, they must have crossed the great plateau formed by the Ellenburger limestone, which bounds the granite area on the north, on about the line of the present Pontotoc-San Saba road. *Lecanospira sanctisabae* is a characteristic fossil in beds of Roubidoux age in the Ellenburger, and specimens have been collected at this horizon along the above-mentioned road on the divide at the headwaters of Wallace Creek, latitude 31°06′, longitude 98°51′.[19] This is probably the belt from which Roemer's specimens came, but the exact locality is of course uncertain. The fifth locality, which is the one from which the greater number of Carboniferous specimens came, has not been definitely located. The narrative places it near the site of their last camp in the San Saba Valley, about 35 miles downstream from the spot where the Cambrian collections were made. This would place it somewhere in the vicinity of San Saba. It is described as being in a small tributary valley on the left bank of the river.

ROEMER'S OBSERVATIONS ON THE PALEOZOIC STRATIGRAPHY OF TEXAS

Roemer's observations on the Paleozoic stratigraphy of Texas are brief. In the following translations, page references in parentheses refer to other portions of the original text, and phrases in brackets are interpolations by the present writers that are necessary in order to clarify certain statements:

THE OLDER OR PALEOZOIC ROCKS

In this broad region, the northwestern portion of which is covered by Cretaceous rocks, there is a relatively small area on the right bank of the Colorado River between the Pedernales and San Saba Rivers in which ancient stratified and massive crystalline rocks occur. Rocks of this type were first observed on the journey northward from the Llano to the San Saba River. These are impure, crumbly, partly crystalline gray limestones

[18] Roemer, F., Texas, pp. 314, 420, 421, 1849; Kreidebildungen, pp. 7, 88, 1852.

[19] See soil map of San Saba County, U. S. Dept. Agr., Bur. Soils, 1916.

in horizontal or gently tilted strata. They are surrounded by [rest on] granite. They are full of organic remains, the most abundant and characteristic of which are various species of trilobites. A few specimens of *Orthis* were also noted.

This same impure gray crystalline limestone was also observed in the valley of the San Saba River about 40 English miles below the old Spanish fort (p. 299). Here [also] trilobites are the most abundant fossils. One of these in particular (*Pterocephalia sanctisabae*, n. sp.) is readily distinguished from all known trilobite genera by broad leaf-like expansion [of the margins] of the cephalon and pygidium. The trilobites, although differing from known genera, are more closely related to Silurian types than to those of any other period of the Paleozoic. Associated with these trilobites are an *Orthis* and a species of *Lingula* (*L. acutangula*, n. sp.).

Farther upstream in the San Saba Valley a hard yellowish-gray limestone was found overlying [the trilobite beds]. From the few fossils which were obtained from it, it must also be of Silurian age.

Rocks that must be of Silurian age were also found downstream from the first-mentioned locality. This is a very tough, cherty limestone, filled with small quartz druses, and at this locality it forms barren, stony heights on both sides of the river (p. 317). Almost no fossils were observed, except a form of *Euomphalus* (*E. sanctisabae*, n. sp.), and this is different from most of the known Silurian species.

Another division of Paleozoic rocks was also found in association with the Silurian rocks in the San Saba Valley.

About 60 English miles below the old Spanish fort, in a small valley tributary to the San Saba, are strongly upturned ledges of a hard, black, massive limestone which contain large kidney-shaped masses of dark chert. This limestone is profusely fossiliferous, and the fossils show plainly that it is of Carboniferous age (p. 318). The most abundant fossil is a small species of *Productus* which, if not identical with, is at least very closely related to a form found abundantly in the Carboniferous limestone of Illinois. Associated with this species is *Orthis umbraculum* L. v. Buch (*Spirifera crenistriata* Sowerby), *Terebratula pugnus* Sowerby, and a finely striated *Productus* closely related to *P. cora* D'Orbigny. A single hand specimen of this limestone which I brought back with me resembles the black limestone of Visé so closely in its outward appearance as to be easily confused with it.

About 20 miles below the old Spanish fort a gray limestone containing large masses of black chert was found on the right bank of the river. From this several specimens of a *Spirifer* (*S. meusebachanus*, n. sp.) were collected. This species with its many divided and fasciculated ribs is a distinctive Carboniferous form and in many ways is most closely related to *Spirifer tasmani* Morris,[20] from Van Diemen's Land [Tasmania].

This universal distribution of species of the Carboniferous period even to the remotest portions of the earth furnishes a new illustration of the lack of climatic differences in the ancient geologic periods.

Not a trace of Devonian strata was found, and this is in complete accord with other observations. For example, as far as is known, there are no strata of Devonian age in that portion of North America which is west of the Mississippi River. This is particularly true along the Meramec River in Missouri, where, without a single exception, the Carboniferous limestone rests directly on Silurian strata. This is proved by the faunas of the two series of ancient rocks, which contain nothing that could be interpreted as the equivalent of the Devonian period.

The most westerly point at which rocks of the Devonian period are definitely known is at the Falls of the Ohio at Louisville. At this place they are so thin and so closely related to the underlying Silurian by rocks which from their fossil content may be regarded as a transition series that their complete disappearance farther west is already indicated to a certain degree.—Texas, pp. 388–390, 1849.

[20] See Buch, L. v., Die Bäreninsel, nach Keilhau geognostisch beschrieben, p. 11, figs. 3a, b, Berlin, 1847.

OLDER OR PALEOZOIC ROCKS

No rocks belonging to the periods immediately preceding the Cretaceous are known in Texas. This applies in particular to the Jurassic formations, whose absence throughout the entire continent of North America was pointed out many years ago by Leopold von Buch, and of which not a trace has been definitely reported as a result of several investigations since that time. [A long footnote summarizes the results of these investigations.]

Just a little is definitely known of the occurrence of Triassic strata in Texas. The single observation on the rocks on the upper course of the Red River, in Falconer's journal,[21] indicates that possibly these rocks belong to this period. On the upper course of the Red River and westward from the Wichita River this traveler found strata of red sandstone interbedded with fibrous gypsum covering a broad area. Later on, in going westward from Cross Timbers, he observed the deep-red color of the water and the sand in all the rivers and brooks which he crossed, also a noticeable salt content in all standing and running water. The red color and salt and gypsum content of the rocks on the upper part of the Red River, which undoubtedly owes its name and color to them, may also serve to show its equivalence with the Bunter sandstone of Europe. However, such correlations, based entirely on lithologic observations and without knowledge of stratigraphic relationship and contained fossils, are always untrustworthy.

On the other hand, rocks of the older or Paleozoic period are definitely known in Texas. Not only Silurian strata but also those belonging to the Carboniferous have been definitely recognized by their paleontologic character. The older rocks are found in the mountainous portion of Texas, particularly in the region between the Llano and San Saba Rivers. They occur here together with massive crystalline rocks in a few comparatively small areas and appear to be completely encircled by Cretaceous rocks.[22]

1. In the region between the Llano and San Saba Rivers the first Silurian rocks were seen about 70 English miles northwest of the German settlement of Fredericksburg, on the Pedernales. At this place they are completely surrounded by granite and occur in a very narrow tongue of land extending from west-southwest to east-northeast. The rock is an impure, partly crystalline, much weathered and decomposed limestone in slightly dipping or almost horizontal layers. It is completely filled with the head and tail shields of characteristic trilobites. This same impure limestone was also found in the San Saba Valley about 40 miles below the old Spanish fort (Texas, p. 299). Here also the strata are essentially horizontal. The limestone contains many green grains of iron silicate. Although firm and compact while in the ledge, the strong crystalline structure of the rock causes the surface of broken fragments to crumble readily. The entire mass of the limestone is filled with countless detached trilobite shields, almost to the total exclusion of other organic remains. These trilobites appear to belong to genera and species which, while different from known forms, most closely resemble Silurian types. From the confused mass of fragments the following species can be separated:

[21] Falconer, Thomas, Notes on a journey through Texas and New Mexico in the years 1841 and 1842: Royal Geog. Soc. London Jour., vol. 13, p. 210, 1842.

[22] The distribution of these older rocks is shown on the geologic map that accompanies the general report on Texas. The boundary between the Carboniferous and Silurian strata is not shown, the few poor observations available not being sufficient to permit this being done.—J. B.

(1) *Pterocephalia sanctisabae*, n. sp. A species that is readily distinguished from other trilobites by the remarkable leaflike expansion of the cephalon and pygidium.

(2) Pygidium of an otherwise unknown form which is remarkable because of the great height of the axis.

(3) Pygidium and cephalon of a species which resembles *Calymene* in the lateral notching of the glabella but which, however, belongs to an entirely different genus.

The only other fossils found here were a *Lingula* (*L. acutangula*, n. sp.) related in shape to *L. cuneata* Hall, from the Medina sandstone of Silurian age at Lockport, N. Y., and an *Orthis* closely resembling *Orthis testudinaria* Dalman.

Lastly, there is another stratigraphic series which is to be classified as Silurian. This is a white or bright-gray, tough, cherty limestone containing many small quartz druses. It forms the barren rock-strewn uplands that are found along both sides of the San Saba River in the middle portion of its course (Texas, p. 317). The only fossil that was observed in great abundance was a species of *Euomphalus* (*E. polygyratus*, n. sp.) [23] but this does not definitely determine the Silurian age of these rocks, because, on the one hand, the *Euomphalus* shows great differences from known Silurian species, and, on the other hand, the petrographic character of the rock gives no suggestion that they belong to any other portion of the older rocks.

2. Carboniferous limestone was definitely recognized at two places in the San Saba Valley. The first locality was about on the right bank of the river about 20 miles below the old Spanish fort (Texas, p. 314). In this locality it consists of a well-stratified tough yellowish-gray limestone which contains large masses of black chert. Its identification as Carboniferous is determined particularly by the presence of a *Spirifer* (*S. meusebachanus*, n. sp.) which belongs to a group of Carboniferous species distinguished by the fasiculate arrangement of the ribs and which is very closely related to another *Spirifer* (*S. tasmani* Morris) from Van Diemen's Land.

The Carboniferous was just as definitely identified at a second locality farther down the valley and about 60 miles below the old Spanish fort (Texas, p. 389). In a small tributary valley on the west side of the San Saba River are heavy, steeply dipping ledges of tough black limestone containing streaks of dark chert a foot in thickness. This limestone is rich in fossils, among which the following species were recognized:

- *Productus flemingii* Sowerby, especially abundant.
- *Productus cora* D'Orbigny.
- *Terebratula pugnus* Sowerby.
- *Orthis arachnoidea* Phillips.

These fossils leave no doubt as to the age of this rock. A single fossiliferous fragment of this limestone which I brought back with me resembles hand specimens of European Carboniferous limestones and is hardly to be distinguished from those from Visé, on the Maas. * * *—Kreidebildungen, pp. 86–87, 1852.

DESCRIPTION OF SPECIES

The material received from Bonn consists of 20 lots, numbered 1 to 20. These numbers have nothing to do with the numbers assigned to the specimens in either of Roemer's papers. Each lot consists of a single fragment of rock containing one or more fossils, except lot 4, which contains two fragments. Each lot is accompanied by a label giving the name and many of them other information about the specimen. These notes show which specimens served as the principal sources of the original illustrations, which were used to supply supplementary details, and which were considered by Roemer to be the types. This information has been incorporated in the revised descriptions.

[23] Evidently a misprint. *E. sanctisabae* is elsewhere said to be abundant here. *E. polygyratus* was said to have been collected some 40 miles or so farther southwest, and Roemer notes that only a single specimen was obtained. (See Texas, pp. 314, 421; also Kreidebildungen, pp. 91, 339.)—J. B.

CAMBRIAN SPECIES

By JOSIAH BRIDGE

BRACHIOPODA

Lingulepis acutangula (Roemer)

Plate 67, figures 10a, b; plate 68, figures 1–6

1849. *Lingula acutangula* Roemer, Texas, p. 420.

1852. *Lingula acutangula* Roemer, Die Kreidebildungen von Texas, p. 90, pl. 11, figs. 10a, b.

1852. *Lingula pinnaformis* Owen, Geological Survey of Wisconsin, Iowa, and Minnesota, p. 583, pl. 1b, figs. 4, 6, 8. (For synonymy of *Lingulepis pinnaformis* see Walcott, U. S. Geol. Survey Mon. 51, pp. 545–546, 1912. The following citations refer only to Roemer's types and to forms identified as *L. acutangula*.)

1889. *Lingula acutangula*. Miller, North American geology and paleontology, p. 349.

1897. *Lingulepis acutangulus*. Schuchert, U. S. Geol. Survey Bull. 87, p. 259 (generic reference).

1933. *Lingulella acutangula*. Bridge, in Sellards, Adkins, and Plummer, Texas Univ. Bull. 3232, p. 231, pl. 2, fig. 9 [not fig. 8]. (No description; fig. 9 is the holotype.)

Not 1898. *Obolus* (*Lingulella*) *acutangulus*. Walcott, U. S. Nat. Mus. Proc., vol. 21, pp. 392, 394, pl. 27, fig. 6, pl. 28, figs. 1, 2.

Not 1912. *Lingulella acutangula*. Walcott, U. S. Geol. Survey Mon. 51, p. 474, pl. 17, figs. 1, 1a–1o.

Not 1931. *Lingulella acutangula*. Dake, Missouri Bur. Geology and Mines, 2d ser., vol. 23, pp. 61, 86, 87, 96 (cited in faunal lists).

ORIGINAL DESCRIPTIONS

1. *Lingula acutangula*, n. sp. *Shell ovate, subtriangular, produced anteriorly into an acute beak, posteriorly rounded.*[24]

Allied to *L. cuneata* Conrad (see Hall, Geology of New York, pt. 4, pl. 1, no. 2, fig. 5), from the Medina sandstone at Lockport. From the gray Silurian limestone with abundant trilobite remains at the locality described on page 299.—Texas, p. 420.

6. Lingula acutangula

Plate 11, figures 10, 10a, 10b

Lingula acutangula F. Roemer, Texas, p. 420.

Length 8''', width 6'''

Shell ovate, subtriangular, short, slightly convex, the posterior end rounded, the anterior end produced into a narrow beak. The shell is oval, almost triangular, short, slightly convex, posteriorly rounded, the anterior end drawn out into a sharply pointed beak.

At a few places on the upper surface of damaged shells one can plainly see the laminated structure of the shell, which is made up of thin plates laid one above the other. The chitinous condition, which is characteristic of the genus and which is usually well preserved, is less commonly shown.

[24] In all descriptions the portions in italics are in Latin in the original texts. Phrases in brackets indicate additions and interpretations by the translator.

A. RUINS OF THE MISSION SAN SABA, "THE OLD SPANISH FORT" OF ROEMER, ABOUT A MILE WEST OF MENARD, TEX.

B. LOWER PART OF THE WILBERNS FORMATION ON NORTH BANK OF SAN SABA RIVER AT FORD HALF A MILE EAST OF HIGHWAY BRIDGE AT CAMP SAN SABA.

In its outward appearance this form resembles *Lingula cuneata* Conrad (see Hall, Geology of New York, pt. 4, pl. 1, no. 2, fig. 5), from the Medina sandstone at Lockport. However, when compared with specimens of the New York form which are before me, it is to be distinguished by its much sharper beak.

Occurrence: Common in the gray, brightly crystalline Silurian limestone, with abundant trilobites in the San Saba Valley.

Description of the figures: Figure 10a, view of the outer surface; figure 10b, profile view.—Kreidebildungen, p. 90.

NOTES ON THE TYPE SPECIMEN

A comparison of the type specimen with the types of the well-known *Lingulepis pinnaformis* (Owen) shows plainly that they are the same species, and as Roemer's name has priority, *L. pinnaformis* (Owen) becomes a synonym of *L. acutangula* (Roemer).

Roemer's material consists of a single imperfect specimen (no. 20) on a fragment of gray, coarsely crystalline glauconitic limestone. The matrix is identical with that in which the trilobites are preserved. It also contains a few fragments of trilobite tests, none of which are complete enough for identification.

The specimen is a somewhat exfoliated ventral valve, which lacks the extreme tip of the beak and most of the anterior and left anterolateral margin. In its present condition it is 16 millimeters long and 13 millimeters wide, but when complete its dimensions must have been approximately 19 by 16 millimeters. These measurements agree very closely with Roemer's (8 by 6 lines) and constitute additional evidence in support of the idea that this was his type specimen.

The original figure (pl. 67, fig. 10a), is much narrower than the type specimen and shows a sharp angulation at the junction of the anterolateral and posterolateral margins, which does not exist on the type specimen. In view of these differences it is not at all surprising that this species has been misidentified by subsequent workers. The convexity of the valve is 2.8 millimeters.

The anterior end of the shell, to judge from the course of the growth lines, was evidently rather blunt and broadly rounded, the anterior margin passing into the anterolateral margins without any sharp angulation.[25] The posterolateral margins are slightly concave and meet at the beak in an angle of 78°. Where the outer surface is preserved, it is ornamented by fine, concentric, somewhat irregular growth lines.

The shell itself is about 0.2 millimeter thick and is composed of white crystalline calcite. The inner surface, where exposed by the exfoliation of the shell, is marked by strong radiating ribs, crossed by heavier, widely spaced concentric lines. In the middle of the shell about three of the ribs occur in the space of 1 millimeter, whereas the concentric lines are spaced about 1 millimeter apart. Both sets become more closely spaced toward the beak. The muscle scars are not exposed.

[25] In Roemer's description the terms "anterior" and "posterior" are used in the opposite sense from present usage.

When compared with the types of *Lingulepis pinnaformis* the similarity of form and size is at once apparent. The outline of the valve and the relative proportions are practically identical. Roemer's specimen is slightly larger than the largest of Owen's types (pl. 68, fig. 6), but specimens of this size are common in areas where the species is abundant. The measurements of three ventral valves among Owen's types are, length, 16, 15.5, and 13 millimeters; width, 12.5, 13, and 11 millimeters; convexity, 2.2, 2.2, and 2 millimeters. These specimens also display the faint radial internal markings which show so plainly on Roemer's specimen.

The surprising thing about this identification is the fact that *Lingulepis pinnaformis* has not been recorded from Texas. Walcott records *L. acuminata* (which he considered to be the same as *L. pinnaformis*) from four localities in the Central Mineral Region and also from El Paso.[26] None of these appear to belong to *L. acutangula;* in fact, they are all narrower and more sharply acuminate than the forms which he referred to this species. Nor does the species appear in any of the collections made by Dake and the writer.

The species has been identified in a collection from the Hickory (?) sandstone [27] at a point about a quarter of a mile east of Sandy post office, Blanco County. Most of the material from this locality is fragmentary, but several good specimens that agree very closely with Roemer's specimen were obtained. The species is evidently not common over the entire area, but it may be locally abundant, as in this locality.

COMPARISON WITH OTHER SPECIMENS REFERRED TO LINGULEPIS ACUTANGULA

There have been few references to this species. Schuchert changed the generic reference to *Lingulepis* but did not discuss the species. In 1898 Walcott referred to the species and published illustrations of a Texas form which he identified as *Lingulella acutangulus*. In his monograph on Cambrian Brachiopoda Walcott describes this species in detail and illustrated it with a plate containing not only the illustrations of his previous paper but also many others. All these specimens came from three localities in the Central Mineral Region, and it is extremely abundant in these localities and many others in that area.

The most obvious difference between this form and Roemer's specimen is in the proportion of length to width. In Roemer's specimen this is approximately 10 : 8.5, but in Walcott's specimens it averages 10 : 6.75. All of Walcott's specimens, both figured and unfigured, are smaller than Roemer's. The largest specimen (Mon. 51, pl. 17, fig. 1e) is 14.5 millimeters long. Another specimen (pl. 17, fig. 1) is nearly as large, but

[26] Walcott, C. D., Cambrian Brachiopoda: U. S. Geol. Survey Mon. 51, pp. 544–550, pl. 42, figs. 1k–1o, 1912.

[27] These outcrops have not been visited, and it is not definitely known whether they are actually Hickory or the Lion Mountain sandstone member of the Cap Mountain.

the average length of the ventral valve is between 9 and 10 millimeters.

Edwards,[28] who has restudied nearly all of Walcott's material in preparation of a monograph on the Cambrian brachiopods of Wisconsin, refers *Lingulella acutangula* Walcott to *L. arguta* Walcott, and this seems to be the correct assignment. The various references to *L. acutangula* subsequent to the publication of Walcott's monograph (with the exception of fig. 9, pl. 2, Texas Univ. Bull. 3232, 1933) are also assignable to *L. arguta.*

It is entirely possible that the very broad forms which are here designated *Lingulepis acutangula* represent the extremely mature stage of a form that is somewhat narrower in the normal adult stage, for the successive growth increments tend to increase the width of the shell more rapidly than the length. If this is true, both types should be found more or less intimately associated at all localities. This is not the case. *Lingulepis acutangula* is not a common form. It is not common at any of the Cambrian localities in central Texas that have been examined, and as yet it has not been found in association with a narrow form such as *L. arguta.* On the other hand, where it is extremely abundant, as for example in the Eau Claire formation of southern Wisconsin, it fills certain strata to the almost total exclusion of other forms. A certain amount of individual variation is observable when large numbers of specimens belonging to this species are compared, and it is quite possible to divide them into several groups that might be termed species or varieties, but such a course would serve no useful purpose, as it would have neither stratigraphic nor geographic significance.

OCCURRENCE

The type specimen came from the San Saba Valley at a point about half a mile east of Camp San Saba, McCulloch County. The horizon is basal Wilberns. The species also occurs in a sandstone thought to be the Hickory in the valley of Hickory Creek about a quarter of a mile east of Sandy post office, Blanco County.

"Orthis" sp. undet.

ORIGINAL DESCRIPTION

2. *Orthis* sp. ind. Related to *O. testudinaria* Dalman. Found in association with the foregoing species [*L. acutangula*].—Texas, p. 420.

REMARKS

This form was neither described nor figured in the Kreidebildungen, although it is mentioned at several places. No specimens answering to its description were included in the shipment from Bonn. Roemer evidently had in mind one or more of the coarsely ribbed brachiopods such as *Billingsella coloradoensis, Eoorthis wichitaensis, E. indianola,* or *E. remnichia texana,* all of which are more or less abundant in the Upper Cambrian of this area. According to Walcott's faunal lists, *B. coloradoensis* is almost invariably associated with *Lingulella arguta,*[29] whereas the other forms occur at a higher horizon, in the base of the Wilberns formation. *Eoorthis remnichia texana* is extremely abundant at the locality east of Camp San Saba in a bed about 5 feet above the beds carrying *Pterocephalia.*

[28] Edwards, Ira, unpublished manuscript.

TRILOBITA

Genus PTEROCEPHALIA Roemer

Pterocephalia sanctisabae Roemer

Plate 67, figures 1a–d; plate 68, figures 7–43

1849. *Pterocephalia sanctisabae* Roemer, Texas, p. 421.
1852. *Pterocephalia sanctisabae* Roemer, Die Kreidebildungen von Texas, p. 92, pl. 11, figs. 1a–d.
1877. *Conocephalites* (*Pterocephalus*) *laticeps* Hall and Whitfield, U. S. Geol. Expl. 40th Par. Rept., vol. 4, p. 226, pl. 2, fig. 37.
1884. *Ptychoparia* (*Pterocephalus*) *laticeps.* Walcott, Paleontology of the Eureka district: U. S. Geol. Survey Mon. 8, p. 59.
1889. *Pterocephalia laticeps.* Miller, North American geology and paleontology, p. 564.
1889. *Pterocephalia sanctisabae.* Miller, idem, p. 564.
1933. *Pterocephalia sanctisabae.* Bridge, in Sellards, Adkins, and Plummer, Texas Univ. Bull. 3232, p. 232, pl. 2, figs. 26, 27. (Types refigured without description.)

ORIGINAL DESCRIPTIONS

10. *Pterocephalia sanctisabae,* n. sp. This species undoubtedly belongs to a new genus which I here name *Pterocephalia* on account of the remarkable extremely thin, leaf-like expansion of the cranidium. The diagnosis of this form is as follows: *Head expanded in a leaf-like plate in front and on both sides of the glabella. Glabella with four incised furrows on each side; tail bordered by a broad, rounded, leaf-like depressed margin.*

The thorax is not known, and therefore association of this pygidium and cranidium is questionable; however, on account of the analogous structure of the two it is extremely probable.

This species is widely separated from all other known trilobites by this leaf-like expansion of the cranidium and pygidium. It is common in a gray Silurian limestone at the locality previously described on page 299.—Texas, p. 421.

This preliminary description was greatly expanded in the "Kreidebildungen" and was accompanied by several excellent illustrations.

10. Pterocephalia sanctisabae

Plate 11, figures 1a–d

Pterocephalia sanctisabae F. Roemer, Texas, p. 421.

Certain weathered layers of gray limestone outcropping in the San Saba Valley are filled with trilobite remains to the almost total exclusion of other types of animal life. Noteworthy among these is a cephalon which appears here for the first time and which does not seem to be related to any known genus of trilobites. It differs especially in the very wide, leaf-like, thin expansion of the

[29] Walcott, C. D., Cambrian Brachiopoda: U. S. Geol. Survey Mon. 51, pp. 212–213, 1912.

anterior portion of the cephalon. A careful examination has made it possible to determine the generic characters of the trilobite to which this head belongs. A pygidium is also referred to the same genus with a considerable degree of certainty. The reason for including this pygidium in the genus lies in the analogous broad, leaf-like expansion which it possesses, in the large number of pygidia which are found, and in the absence of any other cephala in these strata with which it could be associated.

The cephalon figured on plate 11, figures 1a and 1b, which is one of four identical specimens now before me, will be described first. On the whole it is very flat, in the anterior portion somewhat concave. The length is somewhat greater than the width, but in regard to this statement it should be borne in mind that the free cheeks which lie outside of the facial suture are missing on all the examples before me. The glabella narrows anteriorly and is not half as long as the cephalon. On the sides it is separated from the fixed cheeks by a clearly defined furrow. At the anterior end it is separated from the broad winglike anterior expansion of the cephalon by a shallow furrow, ornamented with many small, delicate radial wrinkles. The occipital furrow is well developed and is deeper on the sides than in the middle. On each side are two sharp glabellar furrows directed posteriorly, which do not join across the center but which occupy about one-third the width of the glabella. There is also a third pair, which are weaker, shorter, and almost horizontal. The center of the occipital ring is raised into a short blunt knob.

The fixed cheeks on each side of the glabella are strongly arched from the margin of the glabella to the facial suture. The course of the facial suture is not as plain as is indicated in the figure. A somewhat elevated and prominent portion of the border is to be considered as the palpebral lobe—that is, that portion of the cranidium which carries the eye tubercules. The free cheeks are not known, but from the shape of the cranidium and the width of the pygidium assigned to it they are thought to be narrow and do not essentially affect the shape of the cranidium. The occipital furrow on the fixed cheeks is plainly visible but is not as deep as it is upon the glabella. The broad, flat, leaf-like expansion on the anterior portion of the cranidium is almost plane but is slightly concave from the anterior to the posterior end. The semicircular anterior margin has a fine raised line parallel to it at a distance of about one line. The upper surface of this leaf-like expansion as ordinarily preserved is smooth, but in a single specimen in which the outer shell layer is largely destroyed the surface is covered with very fine, sharp, anastomosing raised lines, similar in character to those which are found in many other trilobite genera—for example, *Bronteus*. No traces of the dorsal furrow that bounds the glabella are to be found on this leaf-like expansion. When the cephalon just described is compared with the typical trilobite head, it appears that the entire leaf-like expansion of the anterior portion of the cephalon must be regarded as an extraordinary widening of the frontal border (*limbus*), for there is nothing else except the frontal border in front of the sharply defined glabella.

The pygidium assigned to the cephalon just described possesses the following characteristics. It is semicircular, with the anterior corners rounded, the anterior and central portions strongly elevated, while the lateral and posterior edges are extended into a smooth, broad, paper-thin lamella. The axis, which is small in comparison to the entire pygidium, narrows posteriorly and terminates slightly beyond the half-length of the pygidium. It is strongly elevated, almost half-cylindrical, and carries 9 to 10 well-marked annulations. The upper surface of the pygidium slopes away from both sides of the axis gradually at first and then descends steeply to the flat marginal expansion. The elevated laterial slopes of the pygidium lying next to the axis are ornamented with slightly raised, gently curving pleurae, one for each segment of the axis. They flatten out and vanish when they reach the flat marginal expansion. This flattened marginal border of the pygidium is ornamented with extremely fine, sharp, raised lines similar to those found on the anterior border of the cephalon. It is otherwise smooth.

Little is known of the thorax, at least in association with either the cephalon or the pygidium. In one piece of rock a single incomplete segment which probably belongs to this form has been found lying close to the cephalon. It is thin, very smooth, 1.5 lines wide, weakly arched, and the ends are blunt and obliquely truncate.

From the foregoing description, the generic characters may be summed up as follows:

Pterocephalia,[30] n. gen.

Head semicircular, thin, almost plane, the portion lying in front of the glabella expanded into a long thin lamina.

Glabella subtrigonal, narrowest anteriorly; circumglabellar furrow continuous; glabellar furrows in three pairs, of which two are longer and obliquely directed, and one, the anterior pair, horizontal and shorter, not continuous.

Facial suture widely separated anteriorly, forming an almost straight line from the frontal to the occipital margin.

Thoracic segments smooth, obliquely truncated on each end, number (?).

Pygidium semicircular, convex, bordered by a wide, thin plate which is especially produced posteriorly; axis elevated, narrow, composed of 9 to 10 segments; pleura distinctly incurved, becoming short and disappearing posteriorly.

One species: Pterocephalia sanctisabae.

Common in the crystalline gray limestone carrying abundant trilobite remains which occurs in the San Saba Valley.

Description of figures: Figure 1a, view of cephalon from above; figure 1b, view of cephalon in profile; figure 1c, view of pygidium from above; figure 1d, view of pygidium in profile.—Kreidebildungen, p. 92.

NOTES ON THE TYPE SPECIMENS

The type material consists of a fragment of grayish-white, coarsely crystalline limestone containing two cranidia (no. 1); and four other fragments of the same type of rock containing incomplete pygidia (nos. 2, 3, 4). The label accompanying lot 1 bears the following note: "Probably the original of plate 11, figure 1b; certainly the original of plate 11, figure 1a, explicitly mentioned by Roemer." The smaller cranidium is practically complete, and its measurements agree very well with those of the original illustration. Inasmuch as Roemer based his genus and species on the cranidium, these cranidia should be considered syntypes, and the associated pygidia may be considered paratypes. According to Roemer's statement there should be four cranidia, hence four syntypes, but there were only two heads in the material received from Bonn.

The most obvious differences between the original specimens and the figures are the conspicuous eye lines, which are neither illustrated nor mentioned in the descriptions. These lines rise opposite the anterior pair of glabellar furrows and are directed outward and slightly backward, terminating at the anterior ends of the palpebral lobes. They are a conspicuous feature

[30] Etymol.: πτερόν, a wing; κεφαλή, a head.

of all specimens that have been examined and are also present in other species referred to this genus.

In the original figure the glabella and brim are drawn slightly wider than they are in the specimen, and the facial suture is too sharply indented at the anterior end of the fixed cheek. Both of the type cranidia are more or less imperfect at this point, but the course of the suture is well shown on other specimens in the collections of the United States National Museum. The remaining important difference is that the posterior lateral lobes of the fixed cheeks are about 1.5 millimeters longer than the figure indicates.

At first sight the four fragmentary pygidia appear to belong to two or three distinct species, but on closer study the differences are found to be due chiefly to conditions of preservation and are therefore more apparent than real. The two large specimens are evidently adult forms, and the smaller ones probably represent immature individuals. The label accompanying the large specimen (no. 3), shown on plate 68, figure 8, bears the following note: "Designated by Roemer as the original of figure 1c." On the label accompanying the other large specimen (no. 2), plate 68, figure 9, is written, "Probably the original of plate 11, figure 1d." Neither specimen, however, conforms exactly to the illustrations.

The dimensions of the type specimens are included in the table facing page 248.

A single fragmentary pleural segment included in the type material marked "San Saba * * * 10" may be the specimen mentioned by Roemer, but it differs in several particulars. It is about 23 millimeters long and 8 millimeters wide. Neither end is preserved, but the direction and curvature of the furrow indicate that it came from the right side of an individual. There is no way of telling whether this is the specimen mentioned by Roemer or not, as it was not figured, but its general size and shape seem to preclude it from belonging to *Pterocephalia.*

NOTES ON ADDITIONAL MATERIAL REFERRED TO THIS SPECIES

About 36 cranidia, all more or less fragmentary, have been compared with the types, and detailed measurements of most of these are plotted in the table facing page 248. The table also shows measurements of several pygidia, but these are much less abundant in the collections available. By this means it has been possible to compare specimens of all sizes from 11 localities in Texas, Oklahoma, Missouri, South Dakota, and Nevada with the types. The most striking result of these measurements is the very close agreement of the proportions of each specimen regardless of size or of geographic source. For example, if the ratio of the length of the cephalon to the length of the glabella in the type specimen is compared with this ratio in the other specimens, it will be found that the differences between them are so slight as to be well within the probable error of measurement, and also within the limits of individual variation.[31] Comparisons of the ratio of other combinations of measurements on the type with the ratio of the same combinations on other specimens give equally close results.

Comparisons may also be made by establishing the ratio of a certain measurement on the type to the same measurement on the specimen to be compared, and then comparing this ratio with the ratio of other measurements on the same pair of specimens.

This very close agreement of relative proportions, regardless of size or geographic source (see table), is one of the strongest reasons for considering all these forms to be a single species.

The pygidia from the Black Hills average somewhat wider than those from other localities but agree in all other respects. As they are preserved in a shale and are considerably flattened, whereas all the other specimens are preserved uncrushed in limestone, this extra width is interpreted as a result of the flattening, which, from the original shape of the pygidium, should be more transversely than longitudinally.

COMPARISON WITH OTHER SPECIES NOW REFERRED TO PTEROCEPHALIA SANCTISABAE

1. An examination of the type material of *Pterocephalia laticeps* (Hall and Whitfield) leaves no doubt that it is synonymous with *P. sanctisabae* Roemer. The species was described from the lowest limestones on Pogonip Mountain, White Pine district, Nev., now known to be of Upper Cambrian age. The cranidium as illustrated differs from *P. sanctisabae* in its narrower, more elongate, and somewhat angular glabella. The specimen from which Hall and Whitfield's illustration (pl. 68, fig. 40) was made shows all these characters, but not as strongly as the illustration would indicate. Associated with the type cranidium is the mold of a second cranidium which has almost exactly the size and proportions of the larger of the two type cranidia of *P. sanctisabae.* (See table, columns 2 and 32.) A clay squeeze taken from this second Nevada specimen and subjected to slight lateral compression developed the same peculiar combination of features which characterizes the figured cranidium of *P. laticeps*, and this, together with the fact that the rock in which this specimen is preserved shows traces of compression, indicates that *P. laticeps* was founded on a distorted specimen (pl. 68, figs. 40–42). An additional bit of evidence that favors this interpretation is found in a small collection from the Secret Canyon

[31] These comparisons are most easily made by setting the two measurements which are to serve as the basis of comparison opposite each other on a slide rule and noting the difference between the proportional and actual measured dimension of the corresponding measurements on other specimens. In making these comparisons, naturally the more accurate of the two measurements to be compared should govern. In the table doubtful and obviously incomplete measurements are indicated by a query (?), and the figure given is usually less than what it should be.

shale south of the Hamburg mine, near Eureka, Nev. This collection contains six fragmentary cranidia, all of which have been identified as *P. laticeps* but which actually resemble *P. sanctisabae* far more closely. (See table, columns 34–36.) This relationship of *P. sanctisabae* and *P. laticeps* is easily demonstrated by comparing the cranidia of the types of these forms by the method outlined above. When the ratio of two measurements of length or of width on the type is compared with the same ratio based on measurements of *P. laticeps*, the agreement is found to be remarkably close.

For example, if the ratio of length of cranidium to length of glabella of the type of *P. sanctisabae* (24:10) is taken as the standard of comparison, it will be found that a cranidium 30 millimeters long should have a glabella 12.5 millimeters long, whereas the glabella of *P. laticeps* has a length of 12.25 millimeters. This is a discrepancy of only 2 percent, and it can certainly be charged to individual variation, or to error in measurement, or to both.

Similarly, if the ratio of width of cranidium to width of glabella of the type is taken as a standard (22:8.5), a cranidium which is 21 millimeters wide should have a glabella which is 8.1 millimeters wide. These last two measurements are those of the type of *P. laticeps* and show practically no discrepancy.

However, if the ratio of length of cranidium to width of cranidium (24:22) is taken as the standard, a cranidium 30 millimeters long should be 27.5 millimeters wide, whereas the cranidium of *P. laticeps* is only 21 millimeters wide. This is a discrepancy of nearly 24 percent, and the difference between the two measurements (6.5 millimeters) furnishes a measure of the amount of compression which the specimen has undergone.

The pygidium assigned to *P. laticeps* is figured as having a strong notch at the center of the posterior margin, whereas that of *P. sanctisabae* has only a shallow emargination at this point, but an examination of the specimen from which the figure of *P. laticeps* was drawn strongly suggests that this notch is due to a fracture of the posterior margin. No other pygidium assigned to *P. laticeps* preserves this margin, and the point cannot be settled at this time. The measurements of the pygidium of *P. laticeps* indicate that it has the same proportions as the pygidia of *P. sanctisabae*. (See table, columns 1, 2, and 31.)

2. *Dicellocephalus multicinctus* Hall and Whitfield,[32] later referred by Walcott [33] without discussion to *Apatokephalus*, appears to have been founded on a fragmentary pygidium of *Pterocephalia sanctisabae* which lacks the entire posterior margin. The specimen is so broken that it gives a slight suggestion of possessing five blunt spines, which were accepted as real by Hall and Whitfield and were sketched in on the original figure, though regarding this feature the authors themselves were none too certain. A careful examination of the specimen shows that this suggestion of spines is entirely accidental, the part of the margin which is indicated as being preserved being the result of a fracture that probably healed during the life of the animal (pl. 68, fig. 37). In all other respects the specimen agrees perfectly with other pygidia of *P. sanctisabae*. (See table, column 32.)

DISTRIBUTION

Roemer's specimens were collected on the north bank of the San Saba River about half a mile east of Camp San Saba. (See p. 242.) An examination of the collections in the United States National Museum shows that the species is represented in collections from the Wilberns formation of Texas, the Honey Creek formation of the Wichita and Arbuckle Mountains, the Davis formation of the Ozark region, the Deadwood formation in the Black Hills, and the Secret Canyon shale of the Eureka district, Nev. It was also collected on Pogonip Mountain, in the White Pine district, Nev., from beds whose exact age is not known, but from the very narrow vertical range of the species elsewhere it would seem safe to refer these strata to the Secret Canyon. In every geographic province in which it has been found and at almost every locality within these provinces the species is associated with *Elvinia roemeri* (Shumard), and at most places with species of the genus *Camaraspis*.

In Texas the *Camaraspis* zone occurs in the Wilberns formation about 0 to 50 feet above the heavy sandstone which Paige mapped as the top of the Cap Mountain (Lion Mountain sandstone member). In the Wichita Mountains it is about 135 feet above the top of the Reagan sandstone at one locality, but in the West Timbered Hills of the Arbuckle Mountains it is about 100 feet above the Reagan sandstone, according to measurements by C. E. Decker. In the St. François Mountains of Missouri the zone is about 10 to 15 feet thick and occurs in the Davis formation about 20 to 25 feet above the top of the Bonneterre dolomite. The exact position of the zone in the Secret Canyon shale of Nevada is not known at present.

In the Black Hills of South Dakota *Pterocephalia sanctisabae*, associated with *Elvinia roemeri* and other characteristic forms, has been found in a greenish-gray shale about 175 feet above the base of the Deadwood formation in Whitewood Canyon in the northern part of the town of Deadwood. These specimens were collected by Ed Barragy, of the University of Iowa, and have been made available for comparison by Dr. A. K. Miller, of that institution. In Wisconsin the *Camaraspis* zone occurs in the Ironton member of Franconia formation. *Elvinia* is fairly common in this

[32] U. S. Geol. Expl. 40th Par. Rept., vol. 4, p. 226, pl. 2, fig. 37, 1877.
[33] Walcott, C. D., Smithsonian Misc. Coll., vol. 57, p. 352, 1914.

zone, but *Pterocephalia* is extremely rare, although it has recently been found at one or two localities by Raasch.[34]

COMPARISON WITH OTHER SPECIES ASSIGNED TO PTEROCEPHALIA

Pterocephalia occidens Walcott[35] appears to be a valid species. All the known specimens came from a single locality south of the Hamburg mine, in the Eureka district, Nev. The formation is probably the Secret Canyon shale, although the original description states that they came from the "Hamburg" (Dunderberg) shale. The type cranidium is very small, being only 6.5 millimeters long. The largest approximately complete cranidium in the collection is 17 millimeters long, and other fragments indicate a maximum length of 20 millimeters. From this it would seem that the species is somewhat smaller in average size than *Pterocephalia sanctisabae*. The two anterior pairs of glabellar furrows are wanting or very faintly developed in *P. occidens*, and the last three segments of the pygidium are much fainter.

Pterocephalia asiatica Walcott[36] is a valid species. The type is fragmentary, but enough of the cranidium is preserved to show the essential generic characters. In most respects it is very similar to *P. sanctisabae*. The associated pygidium is too fragmentary for exact determination and probably does not belong to the same genus.

Dicellocephalus (*Pterocephalia*) *bilobatus* Hall and Whitfield,[37] afterward referred by Walcott to *Platycolpus*[38] and still later to *Anomocare*,[39] does not appear to belong to *Pterocephalia* but on the contrary seems best referred to some division of the Saukinae. The species is founded on a pygidium with a deeply cleft posterior margin which at first sight somewhat resembles *Pterocephalia*. However, the axis contains but 6 segments, as against 10 to 11 in *Pterocephalia*. In addition, the marginal expansions are proportionately narrower, and the pleural furrows extend almost to the margin.

Pterocephalia busiris Walcott, described in the same reports as the preceding species, is based on two pygidia that show none of the essential characters of *Pterocephalia*. It is a well-marked form and has been doubtfully assigned to *Lioparia* by Kobayashi.[40]

Pterocephalia? liches Walcott, the third Chinese species, is likewise not a member of the genus and has been made the type of the new genus *Kolpura* by Resser and Endo.[41]

As a result of these comparisons it appears that the genus as now known contains three species—namely, *Pterocephalia sanctisabae* Roemer, the genotype, which is widely distributed in the basal Wilberns and its equivalents in the Upper Cambrian of the Central and Western United States; *P. occidens* (Walcott), associated with *P. sanctisabae* in the Eureka district; and *P. asiatica* Walcott, from the Upper Cambrian of the Shantung district of China.

SYSTEMIC POSITION

Roemer stated that *Pterocephalia* differed from all known genera of trilobites in certain particulars but made no attempt to show its relationships. Shumard[42] considered it "to be related, if not identical with *Conocephalites* of Zenker," but did not discuss it further. Hall and Whitfield[43] made it a subgenus of *Conocephalites* without discussion. Walcott[44] at first considered it to be a subgenus of *Ptychoparia*, but in his later papers he gave it full generic rank. He never described the genus nor discussed its affinities. It was listed and described in Miller's "North American geology and paleontology" but is not mentioned in the English editions of Zittel's textbook nor in Grabau and Shimer's "North American index fossils."

Ulrich[45] listed the genus from Missouri, and Ulrich and Resser[46] mentioned it in a discussion of the genetic relationships of the dikelocephalids. In their paper they suggested that *Pterocephalia* should be placed in Raymond's subfamily Hungaiinae, but at the same time they removed this group from the Dikelocephalidae and suggested that it represents a distinct family which might also include Walcott's genera *Burnetia* and *Elkia*. This assignment was doubtless suggested by the broadly expanded margins of the cephalon and pygidium, but to the writer it seems more probable that this is a case of homeomorphy, and that the similarity is more apparent than real. Nor does *Pterocephalia* seem to be closely related either to *Hungaia* or to *Burnetia* or *Elkia*.

In none of these forms is the expansion of the brim at all comparable with that of *Pterocephalia*. In the Dikelocephalinae and presumably in *Burnetia* and *Elkia* also the facial suture remains on the dorsal surface in crossing the median line, whereas in *Pterocephalia* it becomes marginal or submarginal directly in front of the eyes. The eye lines, which are conspicuous in

[34] Raasch, G. O., personal communication, 1935.

[35] Walcott, C. D., Paleontology of the Eureka district: U. S. Geol. Survey Mon. 8, p. 58, pl. 9, fig. 21, 1884.

[36] Walcott, C. D., U. S. Nat. Mus. Proc., vol. 39, p. 67, 1905; Research in China: Carnegie Inst. Washington Pub. 54, vol. 3, p. 146, pl. 14, figs. 5, 5a, 5b, 1913.

[37] U. S. Geol. Expl. 40th Par. Rept., vol. 4, p. 227, pl. 2, fig. 37, 1877.

[38] Walcott, C. D., Smithsonian Misc. Col., vol. 57, p. 349, 1914.

[39] Idem, p. 366.

[40] Kobayashi, T., The Cambro-Ordovician formations and faunas of south Chosen: Tokyo Imp. Univ., Fac. Sci., Jour., sec. 2, vol. 4, pt. 2, p. 231, 1935.

[41] Resser, C. E., and Endo, R., in Kobayashi, T., op. cit., pp. 90, 231.

[42] Shumard, B. F., The Primordial zone of Texas, with descriptions of new fossils: Am. Jour. Sci., 2d ser., vol. 32, p. 214, 1861.

[43] Hall, James, and Whitfield, R. P., U. S. Geol. Expl. 40th Par. Rept., vol. 4, pp. 221–223, 1877.

[44] Walcott, C. D., Paleontology of the Eureka district: U. S. Geol. Survey Mon. 8, pp. 58, 59, 1884; Cambrian faunas of China: U. S. Nat. Mus. Proc., vol. 29, no. 1415, pp. 67–68, 1905; Cambrian faunas of China: Smithsonian Misc. Coll., vol. 57, no. 4, p. 80, 1911; Research in China: Carnegie Inst. Washington Pub. 54, vol. 3, pp. 146, 147, 1913.

[45] Ulrich, E. O., in Weller, Stuart, and St. Clair, Stuart, The geology of Ste. Genevieve County, Mo.: Missouri Bur. Geology and Mines, 2d ser., vol. 22, p. 51, 1928.

[46] Ulrich, E. O., and Resser, C. E., The Cambrian of the upper Mississippi Valley, pt. 1: Milwaukee Pub. Mus. Bull., vol. 12, no. 1, pp. 12–15, 1930.

Pterocephalia, are not developed in the other forms. The head is thus truly ptychoparian, differing from other genera in that family chiefly in the great development of the brim.

In *Pterocephalia* the axis of the pygidium contains 10 or 11 segments, twice the number characteristic of the Dikelocephalidae and Hungaiidae. The pygidia of *Burnetia* and *Elkia* are not definitely known, and hence no comparisons are possible.

Kobayashi [47] places the genus in the family Ptychopariidae and proposes a new subfamily, the Pterocephaliinae, to contain *Pterocephalia*, *Amecephalus*, *Amecephalina*, and possibly *Alokistocare* and *Coosia*.

Elvinia roemeri (Shumard)

Plate 67, figures 2a, b, 3a, b; plate 69, figures 1–22

1849. Pygidium of a trilobite of unknown genus and species, Roemer, Texas, p. 422, Nr. 11.
1852. Pygidium of a generically undetermined trilobite, Roemer, Die Kreidebildungen von Texas, p. 94, pl. 11, figs. 3a, b.
1852. Cephalon * * * of a trilobite belonging to an unknown genus, Roemer, Die Kreidebildungen von Texas, p. 93, pl. 11, figs. 2a, b (not 2c, d).
1861. *Dikelocephalus roemeri* Shumard, Am. Jour. Sci., 2d ser., vol. 32, pp. 220, 221.
1877. *Crepicephalus* (*Loganellus*) *unisulcatus* Hall and Whitfield, U. S. Geol. Expl. 40th Par. Rept., vol. 4, p. 216, pl. 2, fig. 22 (not fig. 23).
1884. *Ptychoparia unisulcatus*. Walcott, Paleontology of the Eureka district: U. S. Geol. Survey Mon. 8, p. 58.
1889. *Dicellocephalus roemeri*. Miller, North American geology and paleontology, p. 544.
1912. *Ptychoparia matheri*. Walcott, Smithsonian Misc. Coll., vol. 57, no. 9, p. 268, pl. 44, figs. 15–17.
1914. *Ptychoparia roemeri*. Walcott, Smithsonian Misc. Coll., vol. 57, no. 13, p. 352 (generic reference).
1924. *Elvinia roemeri*. Walcott, Smithsonian Misc. Coll., vol. 75, no. 2, p. 56, pl. 11, fig. 3.
1925. *Elvinia roemeri*. Walcott, idem, no. 5, pp. 88, 89, pl. 17, figs. 9–13.
1928. *Elvinia roemeri*. Ulrich, in Weller and St. Clair, Missouri Bur. Geology and Mines, 2d ser., vol. 22, pl. 51 (cited in faunal list).
1931. *Elvinia roemeri*. Dake, Missouri Bur. Geology and Mines, 2d ser., vol. 23, p. 88 (cited in faunal list).
1933. *Elvinia roemeri*. Bridge, in Sellards, Adkins, and Plummer, Texas Univ. Bull. 3232, p. 232, pl. 2, figs. 17–19.

ORIGINAL DESCRIPTIONS

11. Pygidium of a trilobite of unknown genus and species. This is recognized by its very strongly elevated, half-cylindrical axis, which distinguishes it from other [known] trilobites.—Texas, p. 422.

12. Pygidium of a generically undetermined trilobite. Plate 11, figs. 3a, b. (See F. Roemer, Texas, p. 422, no. 11.)

This pygidium is almost semicircular, arched, bordered by an upturned rim. The axis is thick and broad and is raised in the form of a hemicylinder high above the lateral sides of the shield. The width and height remain the same to the posterior margin of the shield, where it is abruptly truncated. The axis, aside from the anterior bordering ring, shows four annulations, the last one of which is more or less divided into two parts by a depression. Only the three anterior rings continue on to the strongly arched sides as broad, flattened pleurae.

The outstanding character of this pygidium is the thick axis, which maintains the same width throughout its length. The flattened, short pleurae indicate affinities with certain trilobite genera such as *Ceraurus* Green (*Cheirurus* Beyrich) and particularly *Sphaerexochus* Beyrich. However, in these last-named genera the outer margin is serrate, while in this specimen it is entire and plainly rounded.

Occurrence: Several complete examples of this pygidium, one of the largest of which is figured, were found in association with the other trilobites in the Silurian limestone in the San Saba Valley.

Description of the figures: Figure 3a, from above; figure 3b, profile view.

Besides the trilobites which have been described, the same rock contains three or four other forms, but the specimens before me are so incomplete that it is impossible to describe them adequately.—Kreidebildungen, p. 94.

11. Cephalon * * * of a trilobite belonging to an unknown genus. Plate 11, figures 2a, b.[48]

The material pertaining to this trilobite which is now before me shows clearly that it belongs to a distinct genus, but it is not sufficient to allow me to determine all of its generic characters.

The cephalon is elevated, semicircular in section, the anterior end with a broad, abruptly deflected border. The posterior end is bordered by an occipital ring which is set off by a well-marked occipital furrow. The glabella is bounded on all sides by a distinct furrow and rises to the same height as the fixed cheeks. It shows two faint, slanting glabellar furrows on each side. The course of the facial suture—in other words, the lateral edges of the cranidium—is not as plainly shown in the examples before me as in the illustration. However, one can readily see that in general it agrees with the facial suture in the genus *Calymene* in that the two lines are widely separated from each other at the anterior end and run in an oblique direction to the posterior corners of the cephalon. The free cheeks are missing in all known specimens. * * * No thoracic segments which might belong to this cranidium and pygidium are known. The relationship of the parts which have been described to other trilobite genera is not clear. The cephalon, on the one hand, shows a few similarities in structure with *Calymene*, but the pygidium, on the other hand, shows an entirely different type of structure.

Occurrence: Associated with the preceding [*P. sanctisabae*] in the crystalline Silurian limestone of the San Saba Valley.

Explanation of figures: Figure 2a, view of cephalon from above: 2b, the same in profile * * *.—Kreidebildungen, pp. 93, 94.

From the foregoing descriptions it will be seen that Roemer did not suggest any relationship between the cranidium and pygidium which are here classed as a single species. On the contrary, he considered a fragmentary cranidium of *Idahoia* to be a pygidium and associated it "very doubtfully" with the cranidium.

In 1861 Shumard published descriptions of several Cambrian species from the Central Mineral Region, among them *Dikelocephalus roemeri*. In his description of this species he says: "An excellent figure of this head is given by Dr. Roemer in his 'Kreidebildungen von Texas' (Taf. XI, fig. 2a), but the author proposes

[47] Kobayashi, T., op. cit., pp. 230, 231.

[48] The portions of the description which are omitted refer to another specimen which Roemer assumed to be the pygidium of this species but which is actually a fragmentary cranidium referred to *Idahoia*. (See p. 256.)—J. B.

no name for the species." Inasmuch as Shumard's specimens were never figured, and as his types appear to be lost, the specimen upon which Roemer's figure was based and which Shumard explicitly referred to his species is the nearest thing to a type that exists. In one sense, it might be considered a paratype, as it is a specimen mentioned in addition to the types in the original description, even though the author had only the figure available for comparison.

Shumard described a pygidium which he thought belonged to this species and also noted that the so-called pygidium which Roemer had assigned to it was actually the head of another form and referred it to *Arionellus*.

In 1924 Walcott [49] established the genus *Elvinia*, with *Dikelocephalus roemeri* as the genotype. The description was very brief, and the following year he published a second and somewhat more extended description.[50] In the second paper he stated that the pygidium assigned to *Elvinia roemeri* is not the same as the one described by Shumard, but he did not note that it is one of the unidentified forms described and figured by Roemer.

REVISED DESCRIPTION

Cranidium strongly convex, the length slightly more than half the greatest width; width of the frontal margin between the angles of the facial suture at the rim about half the width across the posterior lateral lobes; the angle between the axial plane and a line passing through the extremities of the rim and the posterior lateral lobes about 30°.

Glabella cuneiform, the sides converging anteriorly at an angle of 30°; abruptly truncated anteriorly, moderately elongated; sharply set off from the remainder of the cranidium by a strong circumglabellar furrow and slightly elevated above it. Width of the glabella at the posterior end approximately one-third the total width, and its length about seven-tenths that of the cranidium.

The anterior pair of glabellar furrows are extremely faint and cannot be detected on most specimens, especially those which preserve the test. They originate about opposite the eye lines and are directed posteriorly at an angle of 30°; second pair also faint but much more commonly observable, directed posteriorly at an angle of about 45°; third pair (first pair in Walcott's description) strongly defined, directed posteriorly at the same angle as the preceding pair for about one-third the width of the glabella, their inner ends connected by a strong transverse furrow. The course of this furrow is the distinguishing generic character cited by Walcott in his original description of *Elvinia*.

Occipital furrow rather strongly defined, narrowest along the axial plane and becoming wider and shallower toward the margins of the glabella.

Frontal border broad, convex, and abruptly deflected; divided into two very unequal portions by the marginal furrow; the width of the brim approximately three times that of the rim. Rim prominent, narrow, strongly rounded, broadly triangular.

Fixed cheeks rather narrow, about two-thirds the width of the glabella, and only slightly broadened at the palpebral lobes, which are not noticeably elevated above the surface of the cheek. Posterior lateral lobes broad and long, curved strongly downward, the extremities bluntly rounded.

Eye lines prominent, directed posteriorly at an angle of about 10°.

Facial suture cutting the frontal margin in front of the anterior corners of the glabella and extending laterally across the rim until it reaches a position in front of the posterior end of the palpebral lobe, thus giving the portion of the rim that is attached to the cranidium its triangular outline. In crossing the marginal furrow the facial suture bends abruptly inward to the anterior end of the palpebral lobe, curves gently around it, and then swings off at an angle of about 35°, cutting the posterior margin a short distance inside the genal angle.

None of the cranidia in the collections of the United States National Museum have the free cheeks attached. However, the cheek described here is associated with the cranidia at almost every locality from which the species has been collected, and it is the only one in the collections that can be logically assigned to this form. The outline is approximately that of a quarter ellipse, with the width slightly greater than the height. Marginal furrow strong and well defined anteriorly, becoming shallower and fainter as it approaches the genal angle. Occipital furrow broad and shallow. Rim strong and smoothly rounded, the anterior end produced into a spine by the course of the facial suture across it. Genal angle carrying a short, slender spine, which is directed outward at an angle of about 35° from the axial line. Surface of the cheek smoothly rounded.

Eyes not well preserved on any of the material at hand. They are about one-third the length of the cheek, crescentic, narrow, and not strongly elevated.

Doublure, hypostoma, and thoracic segments unknown.

Pygidium semicircular, about twice as wide as long. Anterior margins curving slightly back from the axis, strongly rounded at the outer angles. Posterior and lateral margins forming a semicircle, the edge rather strongly upturned, thickened, and rounded as if it were rolled about a wire. In many specimens this upturned margin is broken away, and the pygidium assumes

[49] Walcott, C. D., Smithsonian Misc. Coll., vol. 75, no. 2, p. 56, pl. 11, fig. 3, 1924.
[50] Idem, no. 3, p. 88, pl. 17, figs. 9–13, 1925.

a triangular shape which at first sight causes it to be regarded as a distinct form.

Axis stout, about one-third the width of the pygidium, its sides parallel, strongly elevated, extending nearly to the posterior margin, the posterior end blunt, rounded, and standing high above the rim. Annulations four, not including the articulating ring, the terminal one double.

Lateral slopes moderately convex, becoming concave near the posterior and lateral margins. Each slope with three rounded pleural ridges, one opposite each of the three anterior annulations of the axis; the ridges separated by broad, shallow grooves.

Surface of the entire test smooth.

NOTES ON ROEMER'S SPECIMENS

Roemer's material contains two cranidia and two pygidia referable to this species. There is also a third cranidium in the type lot, but it belongs to a different genus. (See p. 255.) The cranidia are numbered 6 and 7, the pygidia 9 and 10. The labels accompanying the cranidia bear the following inscription: "Trilobite genus? *caput*. F. Roemer, Kr. v. Texas, Taf. XI, fig. 2a. Silurian, San Saba, Texas." On the back of the label of no. 6 is the following note: "On the back of the board to which this specimen was fastened is a note by Roemer stating definitely that this is the original (of fig. 2a)." On the back of the specimen itself is a notation in ink "I, 2, a." The "I" is very close to the margin and is evidently a portion of the Roman numeral XI. The other cranidium has no supplementary notes on either the label or the specimen.

The two cranidia are of medium size. Both specimens lack the outer half of the brim and the extremities of the posterolateral lobes. The occipital and posterior glabellar furrows are clearly defined; the anterior pair shows faintly in specimen no. 6. The eye lines are also indicated faintly in this specimen; in the other the surface of the test is flaked off at this point. The outlines of the glabella and fixed cheeks agree fairly well with the illustration, but the brim was evidently added from the third cranidium, which, as has already been noted, belongs to a different genus.

The two pygidia show a considerable variation in size, one being at least a third larger than the other. In both, the posterior and lateral margins are more or less incomplete. Both are referred to the same species. They conform to the descriptions, and no additional notes are necessary.

The label attached to the larger of the two specimens (no. 9) bears the following notation: "Trilobite genus? pygidium, F. Roemer, Kr. v. Texas, Pl. XI, figs. 3a, b, San Saba, Texas, Silurian." On the reverse is the following statement: "Definitely designated by Roemer as the original." The label accompanying the smaller specimen (no. 10) has practically the same notation on its face and the following on the reverse side: "Has probably served to supplement fig. 3a." Roemer's figures 2a and 2b give a fair idea of the cranidium but are incorrect in many of the details. The facial suture is incorrectly drawn, the eye lobes are too small and too prominent, the posterior lateral lobes are too short, and the rim is too thin and too sharply curved. His illustrations of the pygidium, figures 3a and 3b, are much better.

NOTES ON OTHER TYPES

Walcott's type cranidium (plesiotype) selected "as most nearly representing Shumard's description of the species" is about one-fourth larger than Roemer's specimens and is much more nearly complete. At first sight, Walcott's specimen appears to be sufficiently different to be regarded as another species. It appears to be flatter and to have a less abruptly deflected brim, but a comparison of the profiles shows that this is largely an optical illusion caused by the lack of part of the brim and all of the rim in Roemer's specimens. Such minor differences as do exist, such as the slight flattening of the cranidium, are those which are conceivably due to age. The greater part of the cranidium is exfoliated, traces of the skin remaining at the corners of the brim and along the posterior margin. The deep notch in the brim is due to an injury that healed during the life of the animal, for the chitinous skin is rolled around the edges of the fracture.

The pygidium figured by Walcott is identical in size and proportions with the larger of Roemer's specimens, and it shows the details of the upturned rim better than either of them.

The cranidium of *Crepicephalus unisulcatus* Hall and Whitfield is unquestionably an *Elvinia*, but the associated pygidium belongs to a different genus.

The type lot, the figured cranidium and pygidium on a fragment of limestone (U. S. Nat. Mus. 24574), came from the Eureka district, Nev., exact horizon and locality unknown. Associated with this specimen are two other lots from limestones in the Secret Canyon shale, Eureka district (localities 61 and 63), bearing the same number (24574) but collected at much later dates. Cranidia and free cheeks in these later collections were identified as *C. unisulcatus* by Walcott. Hall and Whitfield's original locality is very poorly described, and there is no way of determining whether either of Walcott's collections came from it, but there is a strong probability that all three collections came from the same horizon. The type cranidium is slightly smaller than Roemer's smaller specimen (no. 7). The margins of the fixed cheeks are broken away or buried in the matrix, and the posterior lateral lobes are missing, all of which tends to give the cranidium a narrow and more elongate appearance. The glabella appears to be squarer than the average, and the brim is more strongly arched and more sharply deflected. These characters seem to be peculiar to this specimen, the cranidia in other collections from the Eureka district agreeing more closely with the Middle Western types. The anterior pair of glabellar furrows are not preserved, and the second pair are very faint on the holotype but much more distinct on the paratype. *Elvinia unisulcata* has been considered to be a distinct species, but the type specimen is very poor, and most of the forms that have been referred to it agree better with *E. roemeri.* The writer considers *E. unisulcata* a synonym of *E. roemeri.*

Ptychoparia matheri Walcott is considered to be a synonym of *Elvinia roemeri. Ptychoparia matheri* was founded on several imperfect cranidia, a few free cheeks, and a single imperfect and very small pygidium from the top of the Potsdam sandstone near Whitehall, N. Y. The largest and most nearly complete cranidium, the one figured by Walcott and refigured on plate 69, figure 11, is slightly larger than Walcott's plesiotype of *Elvinia roemeri.* The relative proportions of the glabella and of such other parts of the two cranidia as may be compared are practically identical, with the exception of the width across the anterior end of the brim, which is relatively narrower in the New York specimen. The only other cranidium in this lot that is complete enough to permit this comparison to be made shows the same proportions as the Texas specimens, and this variation in width has been noted in collections from other localities. There is no fixed amount of variation, and the specimens cannot be divided into two sharply contrasted groups on this basis. In general, it may be said that the width across the brim is commonly slightly more than the length of the glabella, but it may narrow until it equals or is slightly less than this length. Moreover, this distinction does not appear to have either stratigraphic or geographic significance, and for these reasons it is not considered to be of specific importance. The free cheeks agree very well with cheeks from other localities. The pygidium is very small and very poorly preserved. It may not belong to the genus—in fact, according to Resser, it belongs to *Dunderbergia.* At one time the Potsdam sandstone was thought to be much younger than the beds carrying the *Camaraspis* fauna in the Mississippi Valley, but at present practically all stratigraphers agree that they are equivalent.

The genus *Moosia,* proposed by Walcott in the same paper with *Elvinia,* is now considered to be a synonym of it.[51] The genus was founded on a small lot of badly crushed specimens from the Goodsir formation in British Columbia. Both cranidium and pygidium show the typical characters of *Elvinia,* and the writer agrees with Resser and Kobayashi in placing them in the same genus. The material now available is so scanty and so badly crushed that it is not possible to make detailed comparisons of the type species *E. grandis* with *E. roemeri.* There seem to be a number of rather striking differences, and for the present it is regarded as a distinct species. The lower few hundred feet of the Goodsir formation carry the typical *Camaraspis* fauna.

[51] Resser, C. E., Nomenclature of some Cambrian trilobites: Smithsonian Misc. Coll., vol. 93, no. 5, p. 42, 1935. Kobayashi, T., The Cambro-Ordovician formations and faunas of south Chosen: Tokyo Imp. Univ., Fac. Sci., Jour., sec. 2, vol. 4, pt. 2, p. 282, 1935.

REMARKS

At first glance it would seem possible to divide the specimens here grouped under the name *Elivnia roemeri* into three or four species, and in fact this has been done, although some of them have never been published. Most of these species were described from a single locality, and in many of the descriptions the author did not have other material available for comparison. It is only within the last few years that enough specimens have been brought together to permit detailed studies to be made. In all, some 40 cranidia and a smaller number of free cheeks and pygidia have been used in making these comparisons. This material came from 18 localities scattered through the States of New York, Wisconsin, South Dakota, Missouri, Oklahoma, Texas, Utah, and Nevada.

The most striking result of this comparison is that while certain variations which have been called species exist, they have neither geographic nor stratigraphic significance. For example, *Elvinia roemeri,* originally described from Texas, has been listed from Oklahoma, Missouri, Wisconsin, and South Dakota. "*Elvinia unisulcata*" (type locality Nevada) has been reported from Utah, South Dakota, Missouri, and Texas, and "*E. matheri*" (type locality New York) has also been identified in Wisconsin and Missouri.

In his second description of *Elvinia roemeri* Walcott states that "it will be necessary to make several species from among the numerous specimens from Texas," and this was done in the collections, although the distinctions were never published. Some of these forms had a similarly wide distribution. Actually, there is as much or more variation between the individuals assigned to one or another of these so-called species as there is between the types of the various forms, and many specimens cannot be placed satisfactorily in any one of them. (See table on p. 255.)

Comparative measurements, in millimeters, of 12 cranidia of Elvinia roemeri

[Measurements followed by plus sign are incomplete because of fracturing. Width of brim is an unreliable measurement, partly because of individual variations and partly because corners are often deeply buried or lost. Large specimens are relatively less convex than smaller ones.]

	Texas				New York	Nevada		Utah	South Dakota		Missouri	Oklahoma
						E. "unisulcata", U. S. N. M. 24574			Locality 88-a. Deadwood			
	Paratype A (pl. 69, fig. 1)	Paratype B (pl. 69, fig. 4)	Plesiotype, locality 70, U. S. N. M. 70259 (pl. 69, fig. 9)	Locality 68, U. S. N. M. 93013 (pl. 69, fig. 15)	*P. "matheri"*, holotype, U.S. N. M. 58585 (pl. 69, fig. 11)	Holotype (pl. 69, fig. 17)	Plesiotype (pl. 69, fig. 18), locality 63	Locality 32-t, U. S. N. M. 93026 (pl. 69, fig. 32)	U. S. N. M. 93024 (pl. 69, fig. 16)	Pl. 69, fig. 14	Locality 11-k, Flat River, U. S. N. M. 93011 (pl. 69, fig. 12)	Locality 89-v, West Timbered Hills, U. S. N. M. 93025 (pl. 69, fig. 19)
Length of cranidium	------	------	25.6	16.6	28+	14	16.5	23	17	27.5	23.6	28+
Width of cranidium at posterior lateral lobes	27+	25+	46	24+	----------	15+	30	40	27.6	40+	41	52
Length of brim	------	------	7.7	4.4	7	3.8	4.2	7	5	8	7.2	7.6+
Width of brim	15	------	22.5	12.5	22.5+	11	12.4	17.5	12.2	20.5+	19.5	------
Length of glabella	13	11.5	17.9	12.3	21	10.2	12.3	16	12	19.5	16.4	20.4
Width of glabella	10.5	9	15	10	17	8.3	9.8	13.5	9.5	17.5	13.4	17
Width of glabella at anterior end	6	5	7.5	5.2	8.7	4.7	5	8	5.1	9	7.6	10
Width of fixed cheek at palpebral lobes	4.1	4	7	4.3	8.5	3.5	5	6.6	4.8	----------	7	7.3
Width of cranidium at palpebral lobes	18	15.5	26	17.2	31	14	18	[1] 23	16	----------	22.2	28
Height of occipital ring	4	3	5	3.7	5.2	2.6	4.2	5	3.5	5+	5.5	6.5
Height of cranidium	5.8?	5.1?	10.4	6	12	5.8	7	11	8.5	9+	13	9
Angle of glabella	30°	30°	30°	30°	30°30′	29°	30°	30°	30°	30°30′	30°	30°

[1] Presence or absence of test seriously affects certain measurements, especially width across palpebral lobes.

OCCURRENCE

Roemer's specimens were collected on the San Saba River at the same locality and from the same beds that yielded *Pterocephalia*. Shumard's specimens were collected at the head of Clear Creek, Burnet County. His statement that it is associated with *Tricrepicephalus texanus* is an error, for although the *Tricrepicephalus* horizon is present at this locality, it is at least 100 feet lower in the section. Walcott's specimens came from two localities in the Central Mineral Region. He gives the horizon as Cap Mountain, but later work has shown that the correct horizon is the basal part of the Wilberns formation. It has been found at several other localities in the Central Mineral Region and is invariably associated with *Pterocephalia sanctisabae*. The same association is found in the Honey Creek limestone in the Arbuckle and Wichita Mountains of Oklahoma, in the basal part of the Davis formation of Missouri, at a certain horizon in the Deadwood formation in the Black Hills, and in the Secret Canyon shale in the Eureka district of Nevada. It also occurs in the Ironton member of the Franconia formation in Wisconsin, where it is associated with *Camaraspis*, *Idahoia*, *Irvingella*, and other genera characteristic of the Wilberns, Honey Creek, and Davis. It occurs also in the top of the Potsdam sandstone in the Lake Champlain region, in beds in the Dugway Range in Utah which are presumably the equivalent of the upper portion of the Orr formation in the adjacent House Range, in Upper Cambrian limestones in the southwestern part of Sublette County, Wyo., and in limestones in the lower portion of the Pogonip limestone of the White Pine district of Nevada. It has a somewhat greater vertical range than *P. sanctisabae*, for it is also found sparingly in the *Irvingella major* zone, which immediately overlies the *Camaraspis* zone in many areas.

Specimens of *Elvinia roemeri* from the Ore Hill limestone of Pennsylvania agree in all respects with the forms just described and serve to correlate the Ore Hill with the lower Franconia. The species has recently been found in collections from southwestern Wyoming.

The species has been recognized in collections from about 19 localities in 9 widely separated States, and in almost every locality it is associated with other equally characteristic forms. This association over so broad an area is of great value in interregional correlation.

Aphelaspis depressa (Shumard)

Plate 69, figures 23–26

1861. *Conocephalites depressus* Shumard, Am. Jour. Sci., 2d ser., vol. 32, pp. 219, 220.

1889. *Ptychoparia depressa.* Miller, North American geology and paleontology, p. 565.

1935. *Aphelaspis depressa.* Resser, Smithsonian Misc. Coll., vol. 93, no. 5, p. 11.

Among the Roemer specimens is a small fragment of limestone (no. 5) which bears the same label as those accompanying the cranidia of *Elvinia roemeri* (nos. 6 and 7). The label also carries the following notation: "Almost certainly used in filling out fig. 2c." The block contains several fragmentary cranidia, three of which are fairly complete and all of which belong to the same species. The species is entirely different from *E. roemeri* and has been identified with one of Shumard's unfigured species, *Conocephalites depressus*. This species has recently been made the type of a new genus, *Aphelaspis*, by Resser, but it has never been figured. The best-preserved cranidium of Roemer's specimen is figured in plate 69, figures 23, 24. Other specimens from Texas selected by Walcott to replace Shumard's lost types are shown in plate 69, figures 25, 26.

The original description is sufficient and need not be repeated.

OCCURRENCE

This species is extremely abundant in the upper part of the Cap Mountain formation, in limestones immediately below the Lion Mountain sandstone member, and in limestone lenses in the base of that member. It occupies a zone about 40 feet thick, which, owing to the abundance of this form, has come to be known as the *Aphelaspis* zone.

This zone does not occur on the San Saba River at the ford half a mile east of Camp San Saba, or at any other point farther upstream. It is exposed on both sides of the river just west of Voca, and this particular specimen is believed to have come from that locality. The lithology is so very similar to that of the *Camaraspis* zone that they could easily be confused with one another.

Idahoia? sp.

Plate 67, figures 2c, d; plate 69, figures 27, 28

1852. * * *[52] Pygidium of a trilobite belonging to an unknown genus, Roemer, Kreidebildungen, p. 93, pl. 11, figs. 2c–d.

1861. *Arionellus* sp. Shumard, Am. Jour. Sci., 2d ser., vol. 32, p. 221.

ORIGINAL DESCRIPTION

The pygidium (figs. 2c, d) next to be described is very doubtfully associated with this cephalon. It was not observed joined to the cephalon by means of the thorax, but only as separate parts. The reason for considering them to be related is the fact that they are associated together and that both show about the same degree of rounding [elevation]. The pygidium in question is strongly elevated, almost triangular, and terminates posteriorly in a small, somewhat posteriorly directed spine. In the middle of the pygidium is an oval, strongly and evenly elevated area surrounded on all sides by a furrow. The posterior portion of the furrow that outlines this area appears to continue along the lateral margins of the shield on both sides. However, it is not a plane, as the drawing would indicate. The anterior portion of the furrow separates the oval area from the forward portion of the shield, which is bowed upward in a cross roll [transversely], and this in turn is separated from the upturned anterior margin by a broad furrow. * * *

Occurrence: Associated with the preceding in the crystalline Silurian limestone in San Saba Valley.

Explanation of the figures: * * * 2c, view of the pygidium from above; 2d, view of the pygidium in profile.

REMARKS

Roemer's material consists of a small fragment of limestone (no. 8) containing an imperfect cranidium. Only the occipital ring, the glabella, and a portion of the brim, retaining parts of the test, are preserved. All of the margin, except that of the occipital ring, is missing, so that from the specimen it is very difficult to form any idea of the original outline. The glabella has parallel sides and is evenly rounded anteriorly. It is rather strongly elevated. The circumglabellar furrow is distinct and strongly impressed. No glabellar furrows can be detected, but the lack of them may be due to conditions of preservation. Occipital furrow strong; occipital ring broadly triangular; the apex to the rear and terminated by a strong, posteriorly directed occipital spine. The brim is about equally divided into a strongly deflected, preglabellar area and a flat or slightly upturned rim. The preglabellar area bears markings that resemble radial striations, but this may be due to weathering.

The accompanying label bears the following notation: "8) Trilobite genus? pygidium? F. Roemer, Texas, pl. 11, figs. 2c, d, Silurian, San Saba, Texas."

The general appearance of this specimen suggests that it should be placed in Walcott's genus *Idahoia*. The glabella of this specimen is more truly oval than in typical *Idahoia*. Moreover, *Idahoia* has never been found in beds as low as the *Camaraspis* zone but occurs somewhat higher in the section in the *Ptychaspis-Prosaukia* zone.[53]

Roemer's specimen could also be referred to the genus *Saratogia*, a form which is closely allied to *Idahoia* and which future work may show to be congeneric with it. In *Saratogia* the glabella is more rectangular in outline and more abruptly truncated anteriorly, the glabellar furrows show more distinctly, and the preglabellar area and rim are slightly different, but whether these differences are generic or specific is yet to be determined.

OCCURRENCE

The specimen is said to have been collected at the same locality that yielded the other trilobites. No other specimens referable to this form have been found in the collections from Texas, but an undescribed species believed to be identical with it occurs in the Ironton member of the Franconia formation in Wisconsin.

[52] Section omitted here is given in the description of *Elvinia roemeri*.

[53] Raasch, G. O., Stratigraphy of the Cambrian system of the upper Mississippi Valley: Kansas Geol. Soc., Ninth Ann. Field Conference, Guidebook, p. 303, 1935.

ORDOVICIAN SPECIES

By Josiah Bridge

GASTROPODA

Ophileta polygyrata (Roemer)

Plate 67, figures 4a, b; plate 69, figures 29–34, 36, ?35

1849. *Euomphalus polygyratus* Roemer, Texas, p. 421.
1852. *Euomphalus polygyratus* Roemer, Die Kreidebildungen von Texas, p. 91, pl. 11, figs. 4a, b.
1889. *Euomphalus polygyratus.* Miller, North American geology and paleontology, p. 404.
1900. *Pleurotomaria hunterensis* Cleland, Bull. Am. Paleontology, vol. 4, no. 18, pl. 16 (42), pl. 4, fig. 2 (not fig. 1).
1903. *Polygyrata polygyratus.* Weller, New Jersey Geol. Survey, Paleontology, vol. 3, Paleozoic faunas, p. 130.
1903. *Polygyrata sinistra* Weller, idem, p. 130.
1903. *Polygyrata hunterensis.* Weller, idem, p. 130.
1915. *Polygyrata hunterensis.* Bassler, U. S. Nat. Mus. Bull. 92, p. 1020.
1915. *Polygyrata polygyrata.* Bassler, idem, p. 1020.
1915. *Polygyrata sinistra.* Bassler, idem, p. 1020.
1919. *Ophileta complanata* Bassler, Maryland Geol. Survey, Cambrian and Ordovician, p. 302, pl. 31, figs. 2–5.
1932. *Ophileta polygyrata.* Bridge, in Dake and Bridge, Geol. Soc. America Bull., vol. 43, p. 741, pl. 12, fig. 10 (type refigured).
1933. *Ophileta polygyrata.* Bridge, in Sellards, Adkins, and Plummer, Texas Univ. Bull. 3232, p. 233, pl. 3, fig. 10 (type refigured).

ORIGINAL DESCRIPTIONS

8. *Euomphalus polygyratus.* n. sp. *Shell 1''3''' in diameter, convex, with numerous whorls, 9–10, narrow, subequal, appressed,* [*the upper surface*] *of each one lying in the same plane and forming a low cone above.*

This species resembles *E. gualteriatus* Goldfuss (*Helicites gualteriatus* Schlotheim) in that the upper surface of all the whorls forms a blunt conical surface, but it differs from this form in the much greater number of whorls [which it possesses].

A single specimen was found in gray (Silurian?) limestones about 20 English miles below the old Spanish fort.—Texas, p. 421.

7. Euomphalus polygyratus

Plate 11, figures 4a, b

Euomphalus polygyratus F. Roemer, Texas, p. 421.

Diameter 1''3''', height 5'''

Shell coiled dextrally, convex above, bluntly conical, concave below; with numerous (9–10) narrow, almost equal, appressed whorls, the same forming a blunt, conical surface; with the section across the whorls subrhomboidal.

The shell is convex above, obtusely conical, concave below; whorls numerous (9–10), narrow, very slowly increasing in width, thus forming almost equal whorls which are pressed closely on one another with the upper surface in the same obtuse conical plane without interruption. The cross section of the whorl is almost rhomboidal.

This form is particularly distinguished by two characters—by the obtusely conical upper surface, which is formed by the edges of the whorls meeting without interruption, and by the significant number of the whorls. It has the first of these characters in common with *Euomphalus gualteriatus* Goldfuss (*Helicites gualteriatus* Schlotheim), from the Silurian strata of Sweden and Russia, which [species], on the other hand, differs from it in the much lower number of whorls (3–4) and in the much more rapid manner in which they enlarge.

Occurrence: The single specimen that serves as the basis of the preceding description is an internal mold found in a gray limestone in San Saba Valley about 20 miles below the site of the old Spanish fort. The relationship of this species with a Silurian form indicates that the limestone which contains it is itself a part of the Silurian system and probably of the older Silurian.

Description of figures: Figure 4a, view from above; figure 4b, apertural view.—Kreidebildungen, p. 91.

NOTES ON THE TYPE SPECIMEN

The holotype (no. 11) is an internal mold preserved in a fine-grained gray, slightly magnesian limestone. Only the dorsal surface is shown, the umbilicus being concealed by the matrix. The outer whorls are broken at several places, allowing good cross sections of the whorl to be obtained. The upper surface is deeply weathered, so that all surface markings are obliterated, and the whorls forming the summit of the spire are eroded away. Seven whorls may be definitely counted, and the extremely slow rate of increase in diameter of these indicates that there were at least four more in the spire. The ratio of increase is about 6:5.

What appears to be the aperture is shown in the upper right-hand corner as the specimen is figured. The small projections in the extreme upper and lower right-hand corners fail to show cross sections of the whorl and are considered to be matrix.

The whorl is rhomboidal in cross section, wider than high, the upper and lower outer slopes meeting the slightly supramedian peripheral keel at an angle of about 65°. The upper surface is so badly corroded that no traces of the sigmoid profile of the shoulder remain.

The dimensions of the fragment are, actual diameter 31 millimeters, restored diameter 35 millimeters, actual height 12 millimeters, restored height 15 millimeters, diameter of umbilicus approximately 29 millimeters, height of body whorl near aperture 4 millimeters, width at same point 7.7 millimeters (estimated), apical angle 125°.

The shell agrees very closely in size and general proportions with the large syntype of *Pleurotomaria hunterensis* Cleland. (See table, p. 258.) The most noticeable difference is in the apical angle, which is 115° in Cleland's specimen [54] and between 120° and 125° in Weller's. The latter figure agrees almost exactly with the apical angle of the small, incomplete specimen shown in Cleland's figures 7 and 8.

COMPARISON WITH OTHER FORMS

The great similarity between *Euomphalus polygyratus* Roemer, *Pleurotomaria hunterensis* Cleland, and *Polygyrata sinistra* was originally pointed out by Weller,[55] who assigned all three forms to his genus *Polygyrata*

[54] Cleland, H. F., The Calciferous of the Mohawk Valley: Bull. Am. Paleontology, vol. 3, no. 13, p. 12 (124), pl. 17, figs. 7, 8, 1900.

[55] Weller, Stuart, The Paleozoic faunas: New Jersey Geol. Survey, Paleontology, vol. 3, p. 130, 1903.

but retained them as distinct species. Later Ulrich and Bridge,[56] after comparing the types of the three species, concluded that *Polygyrata sinistra* Weller was a synonym of *Ophileta hunterensis* (Cleland). They also noted the great similarity between these forms and Roemer's specimen but provisionally considered them to be distinct. As *P. sinistra* was the type of Weller's genus, and *Ophileta* was the older name, *Polygyrata* was made a synonym of *Ophileta*. The restudy of Weller's type showed that he was mistaken in interpreting his species as a sinistrally coiled form. The growth lines, which are faintly preserved on the outer whorl (pl. 69, fig. 34), show plainly that the shell coiled to the right in the normal manner and not to the left as shown in Weller's figure.[57]

The basis of Weller's interpretation is to be seen in a small healed fracture, a minute scissors fault which has displaced the shell on each side of the break to the extent indicated by the depth of the whorls in his figure 2. At the same time, there was also a slight amount of lateral displacement, and it was this fact which caused him to interpret the shell as sinistral. The growth lines on the specimen (pl. 69, figs. 33, 34) show that this is not the case.

The differences between these New York and New Jersey forms and Roemer's specimen are very slight, the latter being slightly smaller, with slightly narrower whorls and a wider suture line. It is an internal mold, which preserves no traces of the outer shell. These are present in the other specimens, and this is believed to account for the difference, for the shell is invariably thickened along the peripheral keel, and this thickening broadens the whorls and narrows the suture line. In the autumn of 1934 the writer collected several specimens referable to this species at two localities in the western part of the Central Mineral Region. One of these was on the San Saba River in the general vicinity of the locality that furnished Roemer's specimen (p. 242), and the other was on Honey Creek southwest of Mason. Some of these specimens preserve the outer shell (pl. 69, fig. 36). The agreement between these forms and those from New York and New Jersey is so close that the writer regards them as conspecific, and as *Ophileta polygyrata* has many years' priority, *O. hunterensis* (Cleland) (including *Polygyrata sinistra* Weller) is regarded as a synonym.

The measurements of the various specimens used in this comparison are given below:

Measurements, in millimeters, of specimens of Ophileta

[An asterisk indicates that the measurement has been computed to allow for a portion of the specimen which is not preserved]

	O. polygyrata holotype	O. hunterensis holotype	O. hunterensis fragment	O. sinistra
Diameter	*35	38	15	36
Altitude	*15	*19	5	7—
Apical angle	125°	115°	115°	125°
Diameter of umbilicus	29—	30?	5. 5	29?
Width of body whorl near aperture, suture to periphery	3. 2?	4. 4	------	4

OCCURRENCE

According to Roemer the holotype was collected in the San Saba Valley about 20 miles downstream from the old Spanish fort (Menard). This is all the information given in his description, but from a study of his narrative [58] it seems fairly certain that the specimen was collected on the return journey, and that it came from the south bank of the river about 5 miles below the point where the Paleozoic strata disappear beneath the Cretaceous rocks in the bed of the river. This locality is probably in Mason County somewhere near the Menard County line.

As noted above, the writer has collected *Ophileta polygyrata* at two localities. In both it occurs in association with *Eccyliomphalus gyroceras* (Roemer) in dense white limestone of Gasconade age that forms the base of the Ellenburger throughout most of the western part of the Central Mineral Region. This limestone is the one which Dake and Bridge [59] called the *Eccyliomphalus gyroceras* zone and which they considered to be the middle division of their Gasconade faunal equivalent. This is now known to have been an error, as recent work has shown conclusively that their so-called lower member of the Gasconade faunal equivalent is merely the down-faulted upper member. Thus the Gasconade faunal equivalent as now known consists of two members—a lower white limestone carrying *Eccyliomphalus gyroceras* and *Ophileta polygyrata* and an upper dolomitic zone carrying the more common Gasconade assemblage.

Eccyliomphalus gyroceras (Roemer)

Plate 67, figures 6a, b; plate 70, figures 6–10

1852. *Euomphalus gyroceras.* Roemer, Die Kreidebildungen von Texas, p. 91, pl. 11, figs. 6a, b.

1889. *Eccyliomphalus gyroceras.* Miller, North American geology and paleontology, p. 403.

[56] Ulrich, E. O., and Bridge, Josiah, *Ophileta, Polygyrata*, and *Lecanospira* [abstract]: Geol. Soc. America Bull., vol. 43, no. 1, p. 278, 1932.

[57] Weller, Stuart, op. cit., pl. 4, fig. 1.

[58] Roemer, F., Texas, p. 314, 1849.

[59] Dake, C. L., and Bridge, Josiah, Faunal correlation of the Ellenburger limestone of Texas: Geol. Soc. America Bull., vol. 43, p. 735, fig. 2, 1932.

1898. *Phanerotinus gyroceras.* Weller, U. S. Geol. Survey Bull. 153, p. 420.

1915. *Eccyliomphalus gyroceras.* Bassler, U. S. Nat. Mus. Bull. 92, p. 467.

1932. *Eccyliomphalus gyroceras.* Bridge, in Dake and Bridge, Geol. Soc. America Bull., vol. 43, p. 740, pl. 12, fig. 6.

1933. *Eccyliomphalus gyroceras.* Bridge, in Sellards, Adkins, and Plummer, Texas Univ. Bull. 3232, p. 233, pl. 2, fig. 6.

ORIGINAL DESCRIPTION

9. Euomphalus gyroceras, n. sp.

Plate 11, figures 6a, b

Diameter 1″1‴; height 2‴

Shell an incomplete spiral in one plane, with whorls completely separate, with less than two [*whorls*]. *Cross section of the whorl a compressed oval.* The shell is an incomplete spiral, coiled in the same plane, forming less than two complete volutions, often scarcely one, in which case it appears hook-shaped. The whorls free, separated by a wide interval. The cross section of the whorl is oval, somewhat compressed dorsoventrally.

This form is most closely related to those in the Devonian limestones at Paffrath am Rhein and in the Harz Valley. It also resembles *Euomphalus serpula* De Koninck (*Serpularia centrifuga* A. Roemer), which occurs in the Carboniferous limestone of Belgium and which also differs from the typical form of the genus in its free whorls, which do not touch each other. The Texas species, however, differs from the European forms in the compressed, oval cross section of the whorl, which is circular in *Euomphalus serpula*, and in the coiling of the whorls in the same plane, while the European forms for the most part are more or less plainly conically coiled. In addition, the number of whorls in the latter species is greater.

The generic designation of this form is doubtful, because all the Texas specimens agree in the wide separation and small number of the whorls—characters not attributed to the genus *Euomphalus*. A great number of Texas specimens were examined, and all agree in these particulars, so that it is plainly the normal habit of the species. Moreover, although a single specimen with free whorls is occasionally found in other gastropod genera that have the whorls in close contact—for example, *Helix*—the close-coiled condition is the normal one, while here the opposite is the case. In addition, the small number of volutions constitute a form which is very different from that of the true *Euomphalus*. In case more detailed studies should justify the removal of this and similar forms from this genus (*Euomphalus*), it might be placed in the new genus *Serpularia*,[60] which my brother, A. Roemer, has named.

Finally, it is to be noted that these shells, which for the most part are preserved as natural longitudinal sections, show no internal cross partitions or septa, similar to those possessed by many true species of *Euomphalus*.

Occurrence: Many specimens with partly preserved shells were collected from a compact bright yellowish-gray limestone (Carboniferous limestone?) occurring in the valley of the San Saba River about 20 English miles below the old Spanish fort.

Description of figures: Figure 6a, view from above; figure 6b, cross section of the last whorl.—Kreidebildungen, p. 91.

[60] Name preoccupied by *Serpularia* Münster, 1840 (Vermes). *Serpularia* A. Roemer, 1843 (Mollusca) = *Serpulospira* Cossman, 1915, genotype *Serpularia centrifuga* A. Roemer, 1843, according to information furnished by J. B. Knight. The genotype is a Devonian form, but future work may show that many of the early Paleozoic American species now referred to *Eccyliomphalus* should be placed here.—J. B.

REMARKS

The type material consists of two specimens (nos. 13 and 14), both of which are natural, longitudinal sections preserved in a limestone matrix. The original figure is evidently based on the specimen illustrated in plate 70, figure 6, and a note on the back of the label confirms this conclusion. The specimens must be considered syntypes.

Syntype A (the specimen just mentioned) shows a longitudinal section as seen from the ventral side (on the assumption that the direction of coiling is dextral) and consists of about 1¼ volutions. The inner end of the whorl tapers to a fine point, and there is no trace of a more closely coiled inner portion, but the lack of this is probably due to weathering. No section of the whorl is obtainable on this specimen. The ventral side appears to have been smoothly rounded, with the maximum convexity slightly toward the inside of the center The ventral side of the aperture seems to have been entire or very slightly sinuate.

Syntype B (pl. 70, fig. 7) also shows a natural longitudinal section, but in this specimen it is seen from the dorsal side. It is not as well preserved, only about one-half of the final whorl remaining, and it s quite evident that the inner whorls have been eroded away, for at one point there is a faint suggestion of one of them. The apertural end intersects the margin of the fragment of rock and affords a good cross section of the ventral half of the whorl, which agrees very well with the section postulated for syntype A.

Neither specimen shows any trace of surface markings or gives any clue to the profile of the dorsal side. In neither one is there any definite trace of the septa that are so noticeable in certain species of this genus, notably in *Eccyliomphalus multiseptarius* Cleland.

Examples of this species collected by C. L. Dake and the writer show additional characters not shown by the types. Several show the initial spiral, and these indicate that the shell consists of about 1½ volutions and that the whorls are nowhere in contact. Other fragmentary specimens show that the whorl is oval in cross section, slightly flattened on the inner side, with the longer diameter parallel to the plane of coiling. None of the specimens observed show any trace of surface markings or of septa.

The dimensions of the types are, syntype A, diameter 31 millimeters, width of whorl near aperture 8 millimeters, width of whorl one-half volution from aperture 3.5 millimeters; syntype B, slightly larger, diameter 36 millimeters, width of whorl near aperture 8.5 millimeters, width of whorl one-half volution from aperture 5 millimeters.

Most of the specimens in the United States National Museum are somewhat smaller, but some of them attain the size of Roemer's specimens. The diameters of the whorl of a large fragment are 7 and 8.5 millimeters; those of a smaller specimen are 5 and 6 millimeters.

OCCURRENCE

The types came from the locality on the San Saba River about 20 miles below the old Spanish fort which has already been discussed in connection with *Ophileta polygyrata*, and in 1934 the writer collected both species in this same general locality (p. 242). The matrix is a dense fine-grained creamy-white to yellowish, almost lithographic limestone which is known to occur at three horizons, at least, in the Ellenburger.

The limestone carrying *E. gyroceras* is the lowest of the three white limestones above noted. It is the basal portion of the Gasconade division of the Ellenburger. Several specimens were collected near the top of this zone along the Mason-Brady highway about 1.45 miles north of the bridge at Camp San Saba. In this section it is about 100 feet above limestone carrying an Upper Cambrian fauna.

The species has also been collected in the extreme southwestern part of the Llano uplift from outcrops along the White ranch road about 7 miles southwest of the bridge across the Llano River. At this locality these white limestones are the oldest rocks exposed and are directly overlain by the Trinity sand, although the Roubidoux beds of the Ellenburger are exposed along this road in the vicinity of the Llano River.

Eccyliomphalus gyroceras appears to be fairly common and seems to mark a very definite horizon in the Ellenburger limestone; it should therefore prove to be an extremely valuable index fossil in the Llano region.

Lecanospira sanctisabae (Roemer)

Plate 67, figures 5a, b; plate 70, figures 1–5

1849. *Euomphalus sanctisabae* Roemer, Texas, p. 421.
1852. *Euomphalus sanctisabae* Roemer, Die Kreidebildungen von Texas, p. 91, pl. 11, figs. 5a, b.
1889. *Straparollus sanctisabae.* Miller, North American geology and paleontology, p. 426.
1915. *Straparollus sanctisabae.* Bassler, U. S. Nat. Mus. Bull. 92, p. 1198.
1932. *Lecanospira sanctisabae.* Bridge, in Dake and Bridge, Geol. Soc. America Bull., vol. 43, p. 741, pl. 12, figs. 13, 14.
1933. *Lecanospira sanctisabae.* Bridge, in Sellards, Adkins, and Plummer, Texas Univ. Bull. 3232, p. 234, pl. 2, figs. 13, 14.

ORIGINAL DESCRIPTIONS

9. *Euomphalus sanctisabae*, n. sp. *Shell 1''2''' in diameter, flat on the upper surface, whorls about six, increasing perceptibly in width, convex above, vertical cross section of the whorl oval.*

Common in the white cherty Silurian limestone that forms the barren uplands on both sides of the San Saba River in the middle portion of its course. (See p. 339.)—Texas, p. 421.

8. Euomphalus sanctisabae

Plate 11, figures 5a, b

Euomphalus sanctisabae F. Roemer, Texas, p. 421.

Diameter 1''8''', height 3'''

Shell flat above, discoidal, sinistrally coiled, whorls about six, gradually enlarging, slightly rounded, vertical section of whorl ovate, subrectangular; spire not elevated, concave beneath.

The shell is disk-shaped, sinistrally coiled, almost plane above. The whorls separated by a furrow, moderately numerous (about six), increasing slowly in breadth, on the upper side flat-arched, almost plane, in cross section oval, almost rectangular.

The single example before me is in the form of an internal mold and shows only traces of the enclosing shell in the form of white silica rings. In the specimen under discussion only the upper side is visible, but from the cross section of the whorl it is plainly seen that the under side is shallowly concave.

The almost plane upper side of the shell and the slowly increasing [diameter] of the whorl does not allow this form to be confused with any other.

Occurrence: The described specimen was found in bright-gray cherty limestone which contains many small cavities lined with druses composed of quartz crystals that glitter in the sun. [The limestone is] probably of Silurian age and forms the barren cliffs on both sides of the San Saba River in the middle portion of its course. (See above, p. 7.) In this limestone the species is not uncommon.

Explanation of the figures: Figure 5a, view from above; figure 5b, view seen from side opposite the aperture.—Kreidebildungen, p. 91.

REMARKS

The type specimen (no. 12) is an internal mold preserved in the dense white lithographic limestone that occurs in at least three well-defined zones in the Ellenburger limestone. The shell itself was partly silicified, and traces of it remain. The base of the shell (dorsal side of Roemer) is exposed and shows seven whorls coiled in a plane. Two sections are broken out from the final half of the body whorl, but enough remains to determine the position of the aperture with a fair degree of certainty. The opposite side of the specimen is almost completely covered by the white-limestone matrix, but the dorsal keel of the body whorl is plainly visible for about one-third of the length of the whorl. Some of the matrix was removed, revealing the keel of the penultimate whorl and showing plainly that the spire is depressed, but it was not advisable to attempt to clean the entire specimen. This keel is median. The cross section of the whorl, which is well exposed where the final whorl is fractured, is pentangular, with all the angles rounded except the one formed by the dorsal keel. The whorls are in contact to about one-half of the height of the outer one and about three-fourths of the height of the inner one. The whorls do not overlap sufficiently to form a smooth concave spire, the summit of each whorl being separated from adjoining whorls by a sharp V-shaped groove, which carries the suture.

There is a very perceptible and regular increase in the width of the whorls, the ratio being 3:2 in any adjoining pair.

The surface markings and aperture are not preserved.

The depressed spire with its elevated dorsal keel and the flat or gently concave base are all characteristic of the genus *Lecanospira,* and this species is referred to it without question.

The maximum measurable diameter of the holotype is 40 millimeters; the computed diameter of the restored specimen is at least 47 millimeters; the diameters of the body whorl at the point where the first fracture occurs are, width 9 millimeters, height 10 millimeters; the diameters of the triangular fragment of the body whorl at a point estimated to be 20 millimeters from the aperture are, width 11 millimeters, height 12 millimeters.

The species appears to be intermediate between *Lecanospira compacta* (Salter) and *L. biconcava* Ulrich and Bridge. The dorsal keel is median as in *L. compacta,* but the whorls are narrower and enlarge more slowly than in that species. They are broader and more rapidly expanding than those of *L. biconcava,* and the base is flat, not slightly concave as in *L. biconcava.*

OCCURRENCE

The locality from which the holotype was obtained is not at all definite, but from the narrative it was collected on the return trip from the San Saba River. As nearly as can be determined from his map, Roemer's route lay close to the meridian 98°50′. This meridian crosses the great plateau underlain by the Ellenburger limestone, which bounds the north edge of the Llano uplift at about the line of the present road from Pontotoc to San Saba. At several places along this road, particularly on the plateau around the headwaters of Wallace Creek, the present writer found ledges of dense white lithographic limestone carrying fragmentary specimens of *Lecanospira sanctisabae,* and it may well be that the holotype came from this general locality.

Several poorly preserved examples of what appears to be the same species were collected in 1931 by C. L. Dake on the high bluff on the north side of the Llano River about half a mile northwest of the concrete ford on the White ranch road. At this locality the first specimens were found in a prominent ledge on the southeast face of the hill about 165 feet above the flood plain of the Llano River, and above this point scattered specimens were found ranging through a zone at least 100 feet thick. In the upper part of this zone they are associated with a species of *Roubidouxia.*

The white limestone containing these fossils is the middle one of three such zones in the Ellenburger limestone and is to be correlated with the Roubidoux sandstone of Missouri, with the Longview limestone and Nittany dolomite of the Appalachian Valley, and with an unnamed bed in the Arbuckle limestone of Oklahoma.

CARBONIFEROUS SPECIES

By George H. Girty

Roemer cited five species from rocks of Carboniferous age. Four of these (*Orthis arachnoidea, Terebratula pugnus, Productus flemingii,* and *Productus cora*) were identified with described species; the fifth (*Spirifer meusebachanus*) was described as new. *Terebratula pugnus* and *Productus cora* were not figured, and there was, effectively, no text for *Terebratula pugnus.*

As regards geologic horizon, the four species first mentioned are stated to have been found in association. The horizon is undoubtedly in the Bend group, but whether it is Smithwick or Marble Falls is not so certain. Among the numerous collections from those formations at my disposal there is one especially (station 2602) which seems to have the same fauna and the same rock characters as Roemer's specimens. The horizon of this collection is given as Smithwick(?). *Spirifer meusebachanus* appears to have been found at a different locality and a different horizon from the rest. Bridge informs me that the rocks at the locality where he believes that specimen to have been collected are mapped as Canyon by the Texas Geological Survey.

The material examined as representing Roemer's collection comprises (1) the holotype of *Spirifer meusebachanus,* a free specimen (pl. 70, figs. 18–21); (2) a small slab purporting to contain the specimen figured as *Productus flemingii* (pl. 70, figs. 14 and 15); (3) another small slab purporting to contain the same original (pl. 70, figs. 16 and 17); (4) a large slab containing at one end the original of one of the figures of *Orthis arachnoidea,* together with specimens of *Terebratula pugnus* and more specimens of *Productus flemingii* (pl. 70, fig. 12); (5) a small slab split off from the large one last mentioned, which contains on its upper or outer surface a fragment from which was drawn the enlargement showing the surface characters of *Orthis arachnoidea* (pl. 70, fig. 13) and on its under side the reverse of the other specimen illustrated as *Orthis arachnoidea.*

Roemer's original plate is reproduced as plate 67 of this report; photographic reproductions of his original material are given on plate 70 as just described. As regards text, the species are taken up in the same order as in Roemer's report, and his text is reproduced in full (translations by Bridge), followed by such comment and discussion as seem suitable.

Spirifer meusebachanus Roemer

Plate 67, figures 7a–c; plate 70, figures 18, 19, 20, 21

ORIGINAL DESCRIPTION

Spirifer meusebachanus F. Roemer, Texas, p. 420.

Width 2''3''', thickness 1''5''', length 1''9'''

Shell large, inflated, transverse, scarcely alate, radially plicate; with numerous plications, rounded, arranged in bundles; with the dorsal [ventral] *valve ornamented with a deep median sinus and two lateral depressions; with the beak sharply incurved; with an area 3''' in height, with distinct vertical striations; with the ventral* [dorsal] *valve ornamented by a high median plication.*

The shell is large, inflated, wider than high, almost triangular, slightly winged; the outer surface ornamented with many rounded branching costae, which are grouped into bundles containing three or four. These are crossed by widely spaced growth lines which occur only near the margins of the shell.

The dorsal [ventral] valve is provided with a broad, deep median sinus, as wide as the side [lateral slope] of the valve. Its broad, rounded, tonguelike point extends deeply into the ventral [dorsal] valve. On each side of the valve is a broad, shallow depression, which, when taken with the median sinus, causes the latter to appear to be bordered by a broad rounded ridge. The ventral [dorsal] valve is likewise strongly arched and is elevated in the middle into a high rounded fold, which is also ornamented with costae. The anterior margin is deeply notched for the reception of the tongue-shaped lobe of the dorsal [ventral] valve. The hinge line shows a moderately high area with plainly defined vertical striations.

The foregoing description and the figures are of a single, very beautiful and entirely complete specimen which was collected and presented to me by Mr. O. von Meusebach, the former general commissioner of the Association for the Protection of German Immigrants in Texas. He collected it while on our joint expedition in the San Saba Valley in the spring of 1847, from gray Carboniferous limestone at a locality about 20 miles below the old Spanish fort. (See F. Roemer, Texas, p. 314: ante, p. 7.)

I name this species for its discoverer, who had made scientific contributions before his emigration to America, as is witnessed by the collections of fossils from the glacial drift of the Mark of Brandenburg and Pomerania, which he has deposited in the Mineralogical Museum at Berlin, and who later on most cheerfully and unselfishly assisted me in pursuit of my geologic journey's goal in Texas.

Besides the specimen in question, which was used by preference as the basis for the description, there are before me a number of imperfect specimens which I collected at the same locality and which correspond [to it] in all respects.

The inequality and strong branching of the costae shows plainly that this is one of the Carboniferous species which is characterized by the fasciculate arrangement of the costae on the outer surface.

A comparison with similar species in the genus shows a close relationship to *Spirifer tasmani* Morris,[61] from Van Diemen's Land [Tasmania]. This last resembles the Texan species in the fasciculate arrangement of the costae and the general outward form of the shell but differs in the finer costae which ornament the sinus and fold and in the more limited depth of the sinus. *Spirifer condor* D'Orbigny,[62] from Bolivia, is very close to the Texas species according to D'Orbigny's figure; but according to De Koninck, who has examined the original specimen, it is indistinguishable from *Spirifer striatus* Sowerby.

Explanation of the figures: Figure 7a, View of the outer surface of the dorsal [ventral] valve; figure 7b, view of the outer surface of the ventral [dorsal] valve; figure 7c, view from the side.—Kreidebildungen, p. 88.

REMARKS

The holotype is a fine specimen, and though it is somewhat idealized in the figures, a good idea of its characters can be had from them. Imperfections are present which are glossed over in the illustrations but are brought out in the photographs—for instance, the top of the fold and part of the sides are decorticated and also the arches that enclose the sinus. The dorsal view (fig. 7b) is somewhat misleading, for the fold is narrower, higher, and more strongly rounded on top than one would judge from the figure.

The surface markings are not well shown. They seem to consist of fine sublamellose incremental lines, some of which are stronger than the rest. These stronger lines vary in size and spacing; apparently only those that are especially pronounced are mentioned by Roemer. No fine radial striations have been observed, but if they were very fine they may originally have been present.

Roemer has mentioned the fasciculation of the costae, a feature which is in fact conspicuous. The fascicles are but slightly prominent, even near the hinge line, and farther forward they are essentially flat. They catch the eye because they are outlined by striae stronger than the rest.

S. meusebachanus has commonly been cited as a synonym of *S. cameratus* Morton. It is so treated by both Schuchert and Weller. At that time, however, *S. cameratus* was also made to include *Spirifer triplicatus* Hall. If the characters shown by the holotype are constant, *S. meusebachanus* is probably distinct from both the species mentioned. *S. triplicatus* is not so gibbous; it has finer and more numerous costae, and the fascicles are arched or subangular. Compared with *S. cameratus* (for example, the specimens which I figured from Putnam Hill, Ohio), *S. meusebachanus* is larger and much more gibbous, and it has a much more strongly developed fold and sinus. Large size, high convexity, and strength of fold and sinus are characters that are likely to accompany each other in specimens of any species, and it may be that smaller and younger specimens of *S. meusebachanus* would not be readily distinguished from *S. cameratus*.

The suggestion is carried on another page that the horizon of *S. meusebachanus* is probably higher than the Bend group, supposedly the Canyon group. As bearing upon this point, Spirifers of this general character are abundant in the Bend group, but none of those which I have seen are comparable to the

[61] Physical description of New South Wales and Van Diemen's Land, by Count Strelecki, p. 250, pl. 15, fig. 2. Leopold von Buch, Die Bären-Insel nach Keilhau geognostisch beschrieben, p. 11, figs. 3a, b (a beautiful illustration of a specimen now in the Berlin Museum).

[62] Voyage dans l'Amérique méridionale, par A. D'Orbigny, tome 3, 4ème partie, Paléontologie, p. 46, pl. 5, figs. 11–14.

holotype of *S. meusebachanus* in perfection of preservation. They commonly occur as disconnected valves and are likely to be much exfoliated. They are more of the character of *S. cameratus* and regularly differ from Roemer's species in being much less gibbous. This evidence, for what it is worth, would suggest either that *S. meusebachanus* was not a Bend group species or else that the holotype is not really a representative specimen. Furthermore, some of the matrix still remaining in the cardinal area is a yellowish earthy rock—another piece of evidence that should be weighed cautiously.

Orthis arachnoidea Phillips

Plate 67, figures 9a, b; plate 70, figures 11, 12, 13

ORIGINAL DESCRIPTION

Orthis arachnoidea Phillips, Paleozoic fossils, p. 67, pl. 27, fig. 114.
Spirifera arachnoidea Phillips, Geology of Yorkshire, vol. 2, pl. 11, fig. 4.

The illustration shows the dorsal valve of a young specimen. The outline and the size and number of the branching, radiating, granular costae agree in all respects with those in specimens of *Orthis arachnoidea* Phillips, from the Carboniferous of England. However, I do not consider this identification to be indisputable, because there are not a sufficient number of specimens showing the various growth stages available [to make detailed comparisons].

Occurrence: In black, indubitable Carboniferous limestone, which also contains *Productus flemingii* Sowerby, *Productus cora* D'Orbigny, and *Terebratula pugnus* Sowerby, occurring in a tributary valley of the San Saba Valley.—Texas, p. 318; ante, p. 7.

Explanation of the figures: Figure 9a, View of a dorsal valve from above; figure 9b, a portion of the outer surface greatly enlarged.—Kreidebildungen, p. 89.

REMARKS

Synonymists have placed this citation under *Derbya crassa*, and such are its general but not, probably, its precise relations. Roemer has given us two figures of the species—one showing a valve in full, the other an enlargement of the surface. These two figures are based on different specimens. In one of the foregoing paragraphs it was remarked that the collection comprised two slabs that fit together, one small and one relatively large (pl. 70, figs. 11, 12). The specimen figured in full is on the large slab and is an internal mold of a brachial valve. It is nearly flat over most of its surface, but it is warped rather strongly downward near the lower right-hand margin. It was brought to light by breaking off the small slab, which on its lower side contains the interior of the same specimen, but its upper side exposes the specimen from which was drawn the enlargement to show the surface characters. The latter specimen, which is also a dorsal valve, is considerably larger than the other (nearly 30 millimeters in length), gently but irregularly convex, and in a poor state of preservation, being rather fragmentary and partly exfoliated.

As both specimens are dorsal valves, the generic position of the species is indeterminable, though the probabilities point to *Derbya*, or possibly *Orthotetes*. I have a pedicle valve, probably of the same species, from station 2902 (see p. 264), which shows the interior and affords evidence that the generic relations are in fact with *Derbya*. My specimen occurs in the same fauna as Roemer's, but this fact is not decisive. If Roemer's species can be referred to *Derbya* on these grounds, it differs from *D. crassa* in being more finely striated, and other differences may come to light when a more varied assortment of specimens representing both valves is brought together. The difference in the striation is conspicuous between Roemer's fossil and most specimens, possibly the more characteristic specimens, of *D. crassa*, but that species varies materially in the details of its surface sculpture, and the difference is not noticeable if some of the more finely striated specimens of *D. crassa* are used. Until the species from Texas is better known it would more prudently be cited as *Derbya crassa* var.

Terebratula pugnus Sowerby

Plate 70, figure 12

A small but indubitable example of this widely distributed Carboniferous species frequently occurs in the Carboniferous limestone of the San Saba Valley in association with the preceding species.—Kreidebildungen, p. 89.

As Roemer does not figure the species so designated nor give any of its characters save that it is small, I question whether his citation is a fit subject for inclusion in synonymy. Schuchert omits it; Weller cites it under *Pugnax utah*. Although it seems desirable to say a little more about the species in this place, the present citation also would probably best be ignored.

Roemer's material contains several specimens evidently representing the species which he identified as *Terebratula pugnus*, all fragmentary or partly buried in matrix I have hesitated to take the necessary steps to determine the relations of this form, for that could not be accomplished without ascertaining its internal characters. The likelihood of any definite result in that direction seemed poor, and it is deemed wiser, at the present time, to leave the species in much the same state in which it comes from Roemer, except, of course, that any close relation to *Terebratula pugnus* cannot be admitted.

The best specimen is a dorsal valve, partly covered by matrix. It is strongly transverse and probably about 15 millimeters in width. The fold bears four plications and the lateral slopes about four each. The plications are large, rounded, and not traceable to the beak, the one nearest the hinge on each side being very faint. Internally the dorsal valve has a median septum which is short but of unknown height.

Presumably this species belongs in the genus *Wellerella*, if that genus is worth recognizing, but as compared with *W. osagensis* (the *Pugnax utah* of former days), it is materially larger and somewhat more numerously plicated, the normal arrangement in *W. osagensis* being three on the fold and three on each side.

Marginifera roemeri Girty, n. sp.

Plate 67, figures 8a, b; plate 70, figures 12, 14, 15, 16, 17

ORIGINAL DESCRIPTION

Productus flemingii Sowerby, Min. Conch., vol. 1, p. 154, pl. 68, fig. 1.

De Koninck, Monographie des genres *Productus* et *Chonetes*, p. 95, pl. 10, figs. 2a–l, fig. 3h.

Productus sp. ind. F. Roemer, Texas, p. 421, no. 7.

I have at hand several well-preserved specimens, none of which differ markedly in size from the one figured and which are therefore smaller than the customary size of this European species. According to De Koninck's own study of the Texas specimens, there is no doubt that they are conspecific with *Productus flemingii* Sowerby, the synonymy of which has been carefully worked out by De Koninck. Morever, there is a great similarity of outward form to young specimens of *Productus semireticulatus* Fleming—in fact, these two species, which are the most widely distributed [members] of the whole genus, are very closely related. The shell is comparatively thick, and on the inner surface [there are] deep small pits, which appear as coarse grains on the surface of internal molds. The dorsal [ventral] valve of a single specimen shows a sudden upward bending such as frequently occurs in *Productus semireticulatus.* Well-defined spine bases are scattered singly over the entire surface of the dorsal [ventral] valve, especially over the lateral slopes.

Occurrence: Several examples were found in association with the foregoing species in a tributary valley of the San Saba Valley, in black Carboniferous limestone in which this species seems to be the most abundant fossil.

Explanation of the figures: Figure 8a, external surface of the dorsal [ventral] valve; figure 8b, [the same] from the side.—Kreidebildungen, p. 89.

REMARKS

Roemer's two figures of this species are presumably different views of the same specimen, but some doubt surrounds the determination of the original. The species is obviously abundant, for it is represented by several specimens on each of the two small slabs and by a number of specimens on the large slab already mentioned several times. Accompanying labels indicate that both of the small slabs contain the specimen figured. One slab (pl. 70, figs. 14, 15) contains a specimen which is uncovered (though partly by me) and agrees closely with the figures. It is, however, very slightly smaller and is imperfect at one side, whereas the figure shows an unbroken specimen. The other slab (pl. 70, figs. 16, 17) contains three specimens, two of which can be rejected as subjects of the illustrations. One (fig. 17, upper left) is too small, too finely striated, and in fact may belong to a different species; the other (fig. 17, lower left) is compressed and partly covered by matrix. The third specimen is on the edge of the slab and is not shown by figure 17, but a posterior view is shown by figure 16. It is almost the counterpart of the specimen on the other small slab, but it is slightly wider and so in more exact agreement with the original figure. It is, however, partly concealed by matrix, and its surface characters are not so clearly shown as those of the other specimen. If either specimen alone is the original of the drawing, it is this one, but more probably the drawing is a composite picture of both. The broken specimen clearly shows evidence of *Marginifera* structure.

Schuchert includes Roemer's citation in the synonymy of *Productus longispina*, but with it he also includes *Productus* (*Marginifera*) *splendens* and *Productus* (*Marginifera*) *wabashensis.* Weller, too, includes Roemer's citation in the synonymy of *Productus longispina* and with it *Productus* (*Marginifera*) *splendens. Productus* (*Marginifera*) *wabashensis* he recognizes as a distinct species. The affinities of Roemer's form prove to be nearer to *M. wabashensis* than to *M. splendens*, but I regard it as distinct even from *M. wabashensis* and have it described in manuscript as *Marginifera roemeri* on specimens from my own collection (station 2602, 11 miles west of San Saba, Tex.). These specimens are to be regarded as the types of this new species. The associated fauna appears to be the same as that in which "*Productus flemingii*" occurs, and my specimens, which are numerous, agree with Roemer's.

Productus cora D'Orbigny

ORIGINAL DESCRIPTION

Productus cora D'Orbigny, Voyage dans l'Amérique méridionale, Paléontologie, p. 55, pl. 5, figs. 8, 9, 10 (male).

De Koninck, Monographie des genres *Productus* et *Chonetes*, p. 50, pl. 4, figs. 4a, b; pl. 5, figs. a–d.

Productus sp. ind. F. Roemer, Texas, p. 421 (no. 6).

As a result of the investigations in western Texas, an entirely new locality is established for this well-known and widely distributed species,[63] which in North America is often confused with *Productus scoticus* Sowerby and *Productus comoides* Sowerby. According to D'Orbigny, who named the species, it was found at several places in the highlands of Bolivia. E. de Verneuil [64] has observed it at many places in the States of Kentucky, Ohio, Illinois and in New Scotland. The Texas specimens, so far as their incomplete preservation permits comparisons to be made, agree perfectly with specimens from Illinois, and in particular, the very fine costae that ornament the outer surface are the same in both. Moreover, the specimens are just as close to the European forms in size as those from Illinois, in that they are all scarcely more than 1 inch wide.

Occurrence: Common in association with the previously described species in the black Carboniferous limestone in a valley tributary to the San Saba Valley.—Kreidebildungen, p. 90.

REMARKS

Roemer does not figure the species which he refers to *P. cora,* and he does not describe it sufficiently for any

[63] See De Koninck, op. cit., pp. 52, 53.

[64] Note sur le parallélisme des dépots paléozoïques de l'Amérique septentrionale avec ceux de l'Europe (extrait du Bull. de la Soc. géol. de France, 2ème série, tome 4), p. 61.

one to verify his identification. It is doubtful, therefore, whether his citation is substantial enough for synonymic recognition. In this respect it stands upon essentially the same plane as his citation of *Terebratula pugnus*. Accordingly, Roemer's citation is omitted by Schuchert but is placed in the synonymy of *P. cora* by Weller. It is true that Roemer discusses the relations of *P. cora* at considerable length, but if perchance the different forms that he mentions (including the one from Texas) do not prove to belong to the same species, his discussion only contributes to confuse the subject.

I am in a measure estopped from commenting upon the *P. cora* of Roemer because among his fossils there is none which by any possibility could be referred to that species. I may say, however, that the faunas of Pottsville age in both Arkansas and Texas contain specimens of "*Linoproductus*" in more or less abundance, but I doubt whether *P. cora* is represented among them. Certainly the great majority of specimens where a decision could be reached do not belong to that species; they are more nearly allied to *P. ovatus*. Careful work may disclose grounds for distinguishing them from *P. ovatus* also, but as between that species and *P. cora*, the identification would lie with *P. ovatus*. These remarks are presumably applicable to the form that Roemer cited as *P. cora*.

PLATES 67–70

PLATE 67

Reproduction of plate 11, Kreidebildungen von Texas, 1852. Numbering of figures as in the original plate; page references refer to the present paper.

FIGURE 1. *Pterocephalia sanctisabae* Roemer (p. 246): a, Cranidium seen from above, the free cheeks wanting; b, cranidium in profile seen from the side; c, pygidium seen from above; d, pygidium in profile seen from the side.

FIGURE 2. *Elvinia roemeri* (Shumard) (p. 251): a, Cranidium seen from above; b, cranidium in profile seen from side.
Idahoia? sp. (p. 256): c, pygidium (cranidium) seen from above; d, pygidium (cranidium) in profile seen from the side.

FIGURE 3. *Elvinia roemeri* (Shumard) (p. 251): a, Pygidium seen from above; b, same in profile from the side.

FIGURE 4. *Ophileta polygyrata* (Roemer) p. 257): a, Shell seen from above; b, apertural view.

FIGURE 5. *Lecanospira sanctisabae* (Roemer) (p. 260): a, Shell seen from above [below]; b, apertural view.

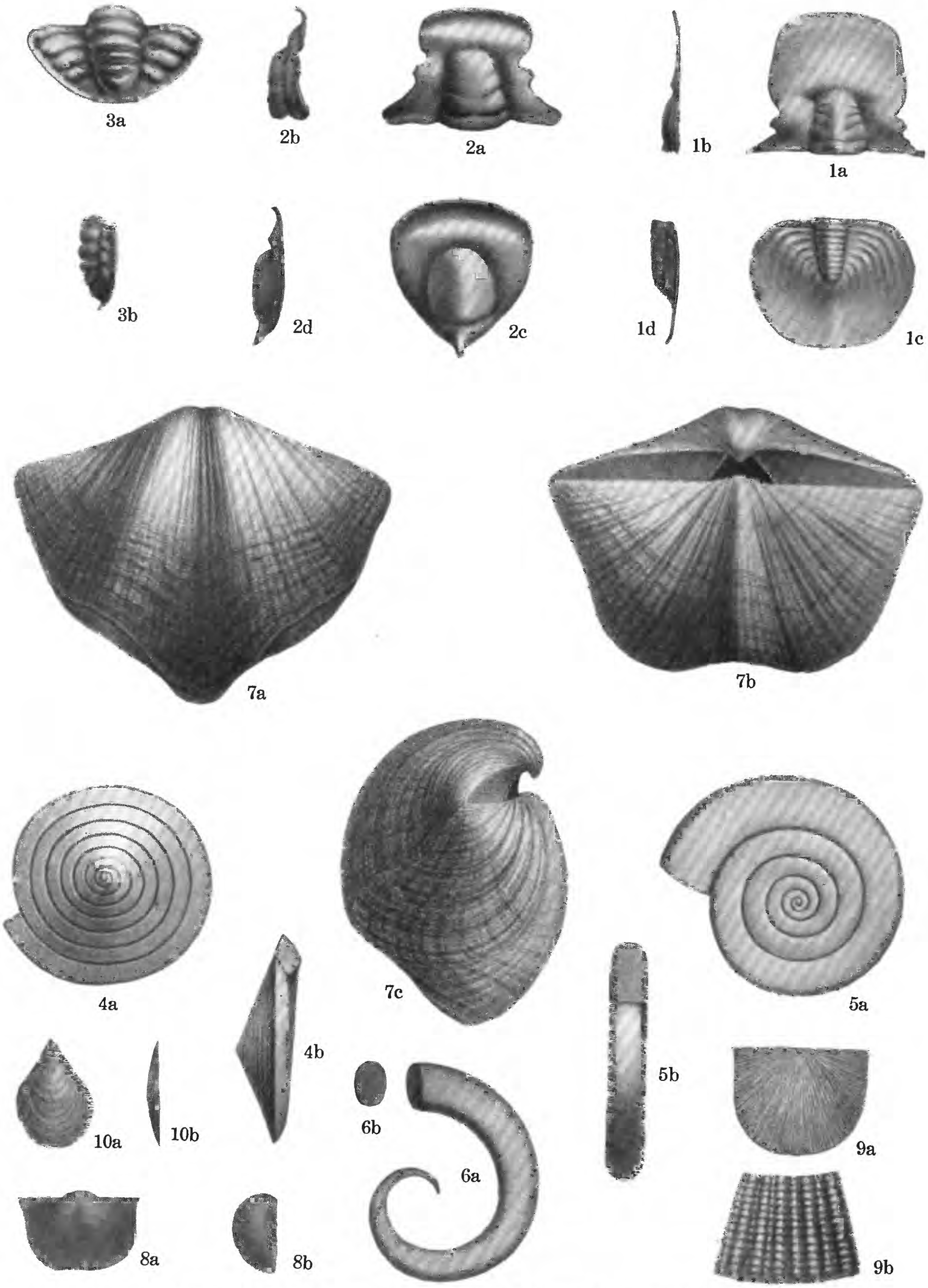
FIGURE 6. *Eccyliomphalus gyroceras* (Roemer) (p. 258): a, Shell seen from above; b, cross section of the whorl.

FIGURE 7. *Spirifer meusebachanus* Roemer (p. 262): a, View of the dorsal [ventral] valve; b, view of the ventral [dorsal] valve; c, profile seen from the side.

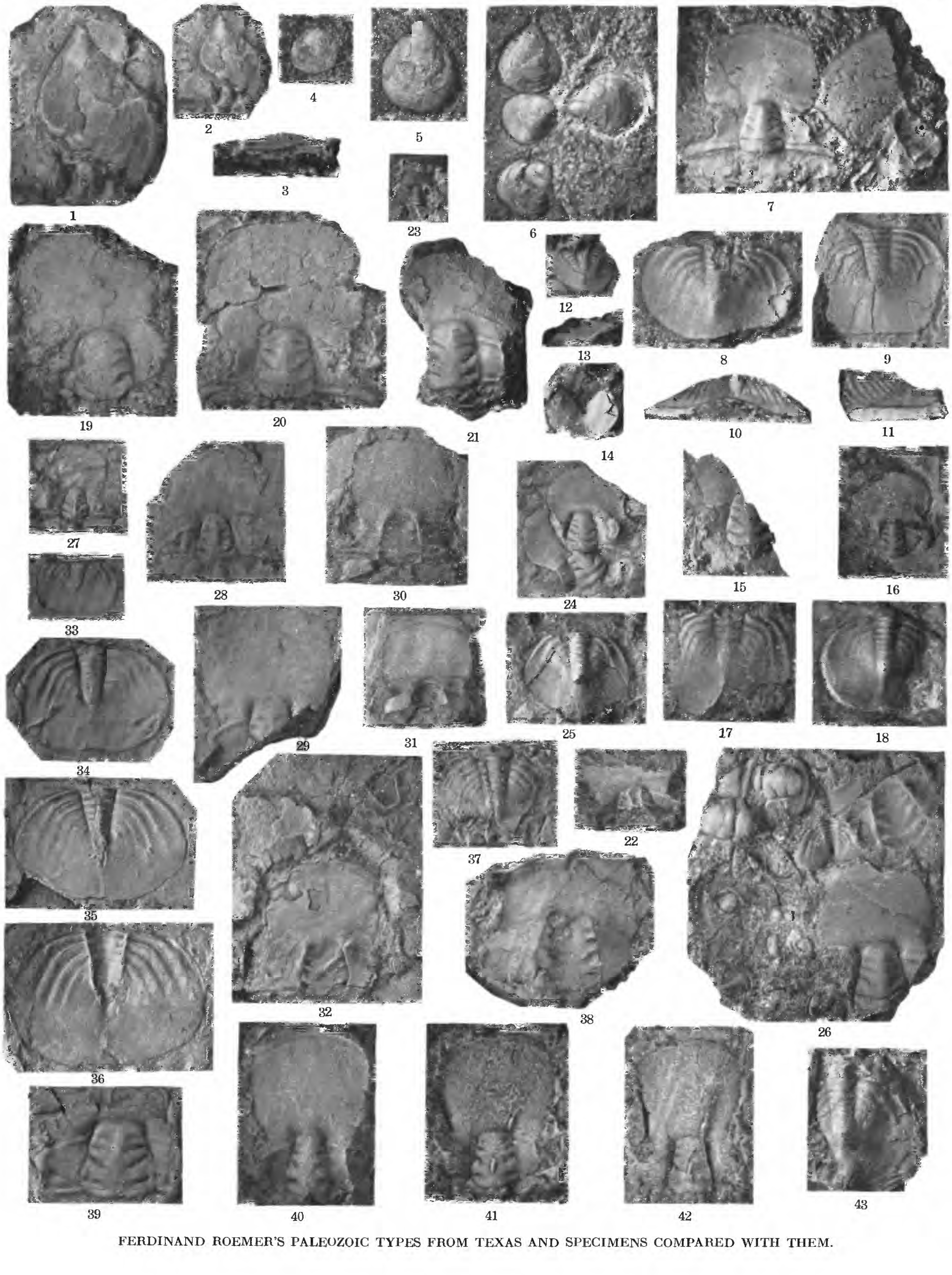
FIGURE 8. *Marginifera roemeri* Girty (p. 264): a, View of the dorsal [ventral] valve from above; b, same from the side.

FIGURE 9. *Orthis arachnoidea* (Phillips) (p. 263): a, View of the dorsal valve; b, a portion of the surface enlarged.

FIGURE 10. *Lingulepis acutangula* (Roemer) (p. 244): a, View from above; b, same from the side.



FERDINAND ROEMER'S PALEOZOIC TYPES FROM TEXAS AND SPECIMENS COMPARED WITH THEM.



FERDINAND ROEMER'S PALEOZOIC TYPES FROM TEXAS AND SPECIMENS COMPARED WITH THEM.

PLATE 68

FIGURES 1–6. *Lingulepis acutangula* (Roemer) (p. 244):

1. Ventral valve, the holotype, $\times$ 4.

2, 3. Ventral and profile views of the holotype, natural size. Locality 353, Wilberns formation, near Camp San Saba, Tex. Museum of Geology and Paleontology, University of Bonn, Germany.

4, 5. Dorsal and ventral valves from the Hickory (?) sandstone one-fourth mile east of Sandy post office, Blanco County, Tex. U. S. Nat. Mus. 93009.

6. Owen's types of *Lingulepis pinnaformis*. Eau Claire formation, St. Croix Falls, Wis. U. S. Nat. Mus. 17860.

FIGURES 7–43. *Pterocephalia sanctisabae* Roemer (p. 246):

7. Exterior and interior of two cranidia, the syntypes.

8, 9. Dorsal views of two large pygidia, paratypes A and B.

10, 11. Posterior and lateral views of paratype A.

12, 13. Dorsal and lateral views of a small pygidium, paratype C.

14. Under surface of another small pygidium, paratype D.

Specimens shown in figures 7–14 are Roemer's types, from locality 353, *Camaraspis* zone of the Wilberns formation, from the San Saba River near Camp San Saba, Tex. Originals in the Museum of Geology and Paleontology, University of Bonn, Germany.

15, 17. Cranidium and pygidium from Wilberns formation. Locality 70, near Morgans Creek, Burnet County, Tex. Plesiotypes. U. S. Nat. Mus. 93010.

16, 18. Cranidium and pygidium from Wilberns formation. Locality 353, San Saba River, half a mile east of highway bridge at Camp San Saba (pl. 1, *B*), McCullough County, Tex. Topotypes. U. S. Nat. Mus. 93012.

19. Cranidium from the Honey Creek formation, locality 9–1–2, northeast of Big Baldy Mountain, Wichita Mountains, Okla. U. S. Nat. Mus. 93014.

20. Cranidium from the Honey Creek limestone, locality 91–a, West Timbered Hills, Arbuckle Mountains, Okla. U. S. Nat. Mus. 93015.

21. Cranidium from the Honey Creek formation, locality 9–q, Blue Creek Canyon, 15 miles northwest of Fort Sill, Wichita Mountains, Okla. U. S. Nat. Mus. 93016.

22. Fragmentary cranidium showing the eye lines and the radial markings on the brim. Honey Creek formation, locality 89–v, West Timbered Hills, NE¼ sec. 9, T. 1 S., R. 1 W., Murray County, Okla. U. S. Nat. Mus. 93017.

23. Small cranidium from the Davis formation, locality 11–e, southwest of Potosi, Washington County, Mo. U. S. Nat. Mus. 93018.

24–26. Cranidia and pygidia from the Davis formation, locality 11–k, near shaft of Federal No. 4 mine, Flat River, St. François County, Mo. U. S. Nat. Mus. 93019. Figure 26 shows association with *Elvinia roemeri* (upper left).

27–30, 32, 39. A series of cranidia from shale in the Deadwood formation, north wall of Whitewood Canyon in the northern ern part of Deadwood, S. Dak. 27, 29, 30, 39, Museum of the Department of Geology, University of Iowa; 28, 32, U. S. Nat. Mus. 93020. Figure 32 shows characteristic association with *Elvinia roemeri.*

31. Counterpart of figure 22, with an unusually well preserved brim. U. S. Nat. Mus. 93017.

33–36. A series of pygidia from shale in the Deadwood formation; same locality as figures 27–30, 32. 33, 34, Museum of Department of Geology, University of Iowa; 35, 36, U. S. Nat. Mus. 93020.

37. Cast of the pygidium of *Dikelocephalus multicinctus* Hall and Whitfield. Upper Cambrian, Eureka district, Nev. U. S. Nat. Mus. 24640. (The original specimen is a natural mold.)

38. Cast of natural mold of fragmentary cranidium, locality 60, across canyon from dump of Old Richmond mine, Eureka district, Nev. U. S. Nat. Mus. 93021.

40. Cranidium of *Pterocephalia "laticeps"* Hall and Whitfield. Upper Cambrian, lowest beds on west side of Pogonip Mountain, White Pine district, Nev. U. S. Nat. Mus. 24562.

41. Cast of a cranidium in the type lot of *Pterocephalia laticeps* which agrees in all respects with syntype B (fig. 7). The original specimen is a natural mold. U. S. Nat. Mus. 24562.

42. The same cast after slight lateral compression, showing the development of the characters of *P. laticeps*.

43. Cast of pygidium of *P. laticeps*. The original is a natural mold. Same locality as figures 40–42. U. S. Nat. Mus. 24561.

PLATE 69

FIGURES 1–21. *Elvinia roemeri* (Shumard) (p. 251):

1–8. Roemer's types. All specimens from the Wilberns formation, locality 353, San Saba Valley, near Camp San Saba, McCullough County, Tex. Originals in the Museum of Geology and Paleontology, University of Bonn, Germany.

1–3. Dorsal, frontal, and profile views of the larger cranidium, paratype A.

4, 5. Dorsal and profile views of the smaller cranidium, paratype B.

6, 7. Dorsal and profile views of the larger pygidium.

8. Dorsal view of the smaller pygidium.

9. Large cranidium selected by Walcott to replace Shumard's lost type. Wilberns formation, locality 70, near Morgans Creek, Burnet County, Tex. Plesiotype, U. S. Nat. Mus. 70259.

10. Pygidium, assigned to this species by Walcott. Wilberns formation, locality 68, top of west peak of Packsaddle Mountain, Llano County, Tex. U. S. Nat. Mus. 70261.

11. Cranidium figured as the type of *E. "matheri"* (Walcott), upper part of Potsdam sandstone, locality 110, near Whitehall, N. Y. U. S. Nat. Mus. 58585.

12, 13. Dorsal and profile views of cranidium from the Davis formation, locality 11–k, near shaft of Federal No. 4 mine, Flat River, St. François County, Mo. U. S. Nat. Mus. 93011.

14, 16. Two cranidia from limestones about 100 feet above the sandstones at the base of the Deadwood formation, locality 88–a, in the northern part of the town of Deadwood, S. Dak. The larger specimen preserves much of the test and consequently appears to be broader across the glabella than other specimens of equal size (figs. 9, 11, 12, 18) from which the test has been removed. U. S. Nat. Mus. 93024.

15. Cranidium from the Wilberns formation, locality 68, top of the west peak of Packsaddle Mountain, Llano County, Tex. U. S. Bat. Mus. 93013.

17. Type of *Crepicephalus unisulcatus* Hall and Whitfield. This is the specimen from which the original figure was drawn. From "limestone in the Potsdam group, Eureka, Nev." Unfortunately, the occipital ring was cut off when the print was mounted. U. S. Nat. Mus. 24574.

18. Cranidium identified as *Crepicephalus unisulcatus* by Walcott. Secret Canyon shale, locality 63, northeast of Adams Hill, Eureka district, Nev. U. S. Nat. Mus. 24574.

19–21. Cranidium and two pygidia from the Honey Creek limestone, locality 89–v, NE¼ sec. 9, T. 1 S., R. 1 W., West Timbered Hills, Arbuckle Mountains, Okla. U. S. Nat. Mus. 93025. Figure 20 shows a mold of the outer surface.

22. Cranidium doubtfully referred to this species, locality 32–t, Upper Cambrian limestone in Fandango Spring Canyon, east side of Dugway Range, Tooele County, Utah. U. S. Nat. Mus. 93026.

FIGURES 23–26. *Aphelaspis depressa* (Shumard) (p. 255):

23. Roemer's specimen, a mold of a cranidium. Top of Cap Mountain formation, San Saba Valley, somewhere between Voca and Camp San Saba, McCullough County, Tex.

24. Frontal view of a squeeze made from the preceding.

25, 26. Cranidia selected by Walcott to replace Shumard's lost type. Locality 67, near Potatotop, Burnet County, Tex. U. S. Nat. Mus. 90172.

FIGURES 27, 28. *Idahoia?* sp. (p. 256). Dorsal and profile views of Roemer's specimen. Wilberns formation, locality 353, San Saba River, about half a mile east of highway bridge at Camp San Saba, McCullough County, Tex. Original in the Museum of Geology and Paleontology, University of Bonn, Germany.

FIGURES 29–34, 36, ?35. *Ophileta polygyrata* (Roemer) (p. 257):

29, 30. Dorsal and profile views of the holotype. Limestone of Gasconade age near base of Ellenburger limestone, on San Saba River about 20 miles east of Menard, presumably about half a mile east of the Mason-Menard County line, Mason County, Tex. Original in the Museum of Geology and Paleontology, University of Bonn, Germany.

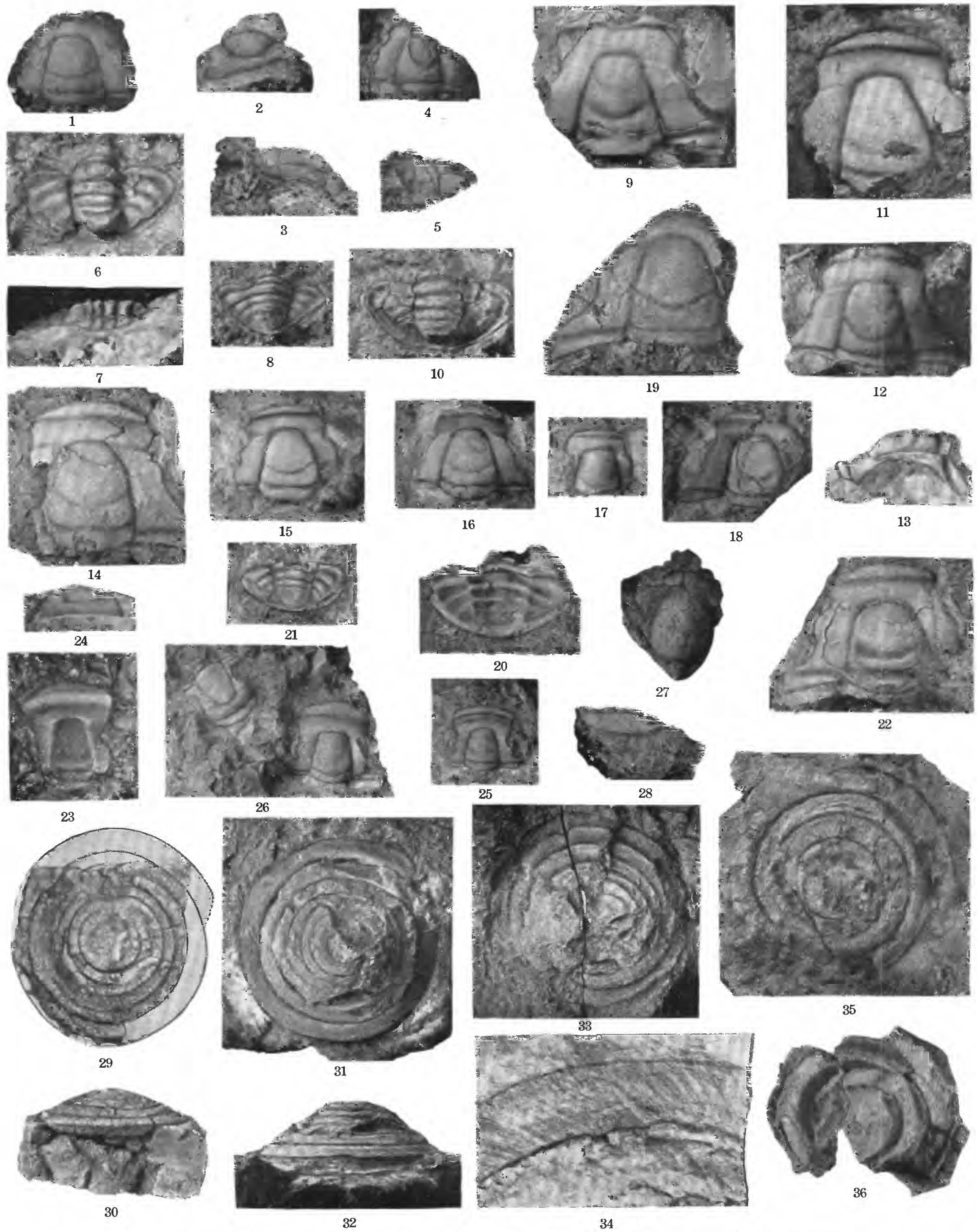
31, 32. Dorsal and profile views of the type of *"Pleurotomaria hunterensis"* Cleland. Tribes Hill formation, Fort Hunter, N. Y. Original in Museum of Cornell University, Ithaca, N. Y.

33. Dorsal view of the type of *Polygyrata sinistra* Weller. The healed fracture (p. 258) shows in the figure and intersects a recent fracture near the apex of the shell. The growth lines are best shown at the bottom of the figure to the right of the recent fracture. Specimen from the Kittatinny limestone, Columbia, N. J. Original in the New Jersey State Museum, Trenton, N. J.

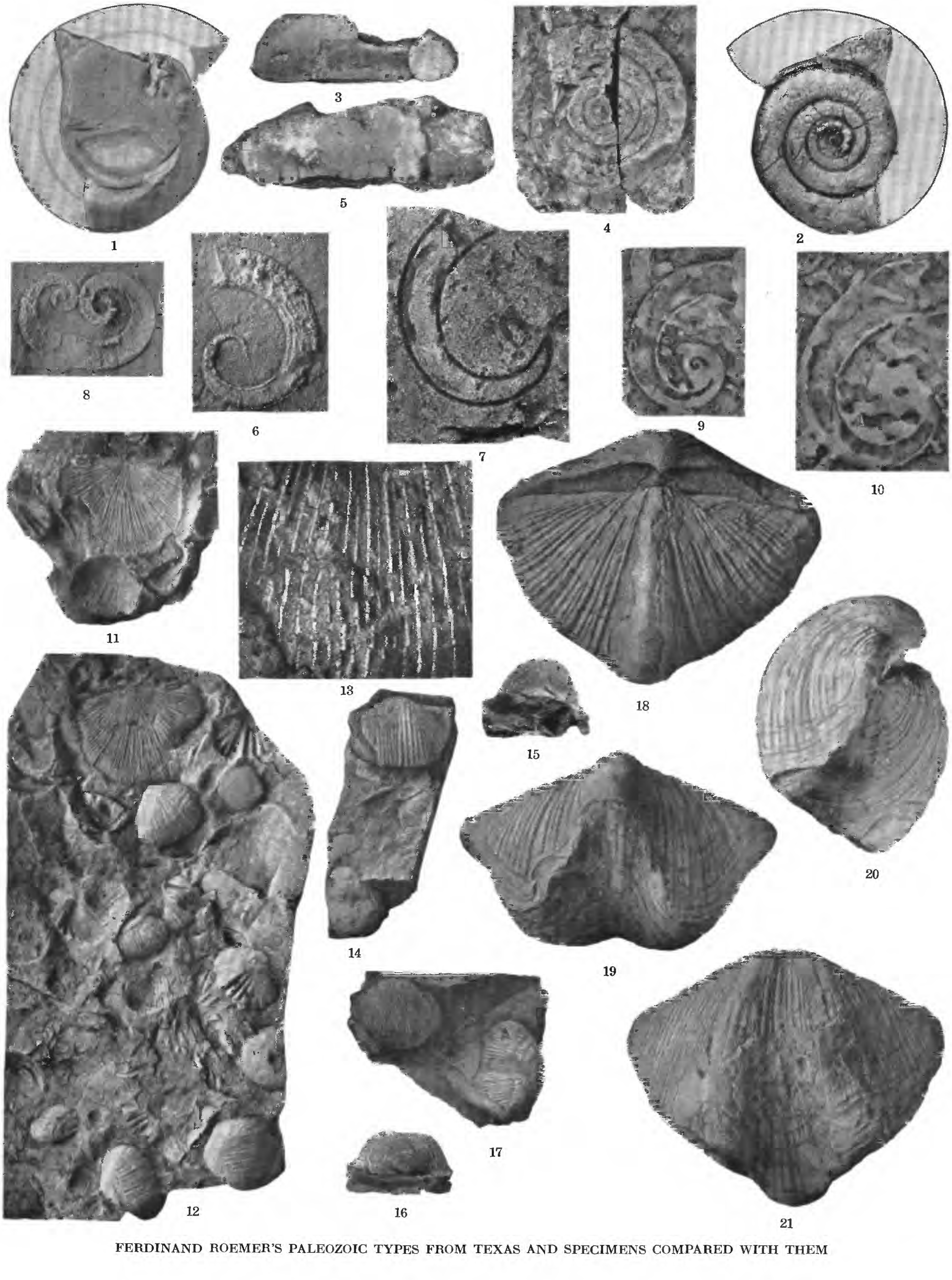
34. Portion of the outer whorl of specimen shown in figure 33, × 4, to show growth lines. This is the same portion mentioned in the description of figure 33, but it has been rotated 180°. The irregular right-hand margin is the artificial fracture. Photograph by J. Brookes Knight.

35. A large fragmentary specimen doubtfully referred to this species. White limestone of Gasconade age, near the base of the Ellenburger limestone, in side valley on south side of San Saba River about half a mile east of the Mason-Menard County line, Mason County, Tex. U. S. Nat. Mus. 93027.

36. Another specimen from the same locality. U. S. Nat. Mus. 93027.



FERDINAND ROEMER'S PALEOZOIC TYPES FROM TEXAS AND SPECIMENS COMPARED WITH THEM.



FERDINAND ROEMER'S PALEOZOIC TYPES FROM TEXAS AND SPECIMENS COMPARED WITH THEM

PLATE 70

FIGURES 1–5. *Lecanospira sanctisabae* (Roemer) (p. 260):

1–3. Dorsal, ventral, and lateral views of the holotype. Figure 3 shows the cross section of the whorl at the bottom of figure 2. Original from beds of Roubidoux age in the Ellenburger limestone from southwestern part of San Saba County, Tex. Specimen in the Museum of Geology and Paleontology, University of Bonn, Germany.

4. Ventral view of a specimen from the same horizon, location 469–b, north side of Llano River, 1½ miles west of the mouth of Honey Creek and 265 feet above river level, Mason County, Tex. U. S. Nat. Mus. 93022.

5. Cross section of the specimen shown in figure 4, showing the outline of the whorls, the depressed spire, and the slightly concave base.

FIGURES 6–10. *Eccyliomphalus gyroceras* (Roemer) (p. 258):

6, 7, Roemer's types. His figure was clearly drawn from the specimen shown in figure 6. White limestone of Gasconade age at the base of the Ellenburger limestone in the San Saba Valley a short distance east of the Mason-Menard County line, Texas. Originals in the Museum of Geology and Paleontology, University of Bonn, Germany.

8. Two specimens from the same horizon, locality 471–e, 1½ miles north of Camp San Saba, McCullough County, Tex. U. S. Nat. Mus. 86949.

9, 10. Two specimens from the lower part of the Ellenburger limestone, west bank of Honey Creek, 2 miles south of the Mason-London road. U. S. Nat. Mus. 93023.

FIGURES 11–13. *Orthis arachnoidea* (Phillips) (p. 263). The specimen at the top of the slab (fig. 12) is an internal mold of a dorsal valve, the original of figure 9a in Roemer. The slab shown by figure 11 was split off from the large slab and on its under surface, here in view, shows the interior of the same specimen. A large, imperfect dorsal valve on the upper surface of the same slab is the original of Roemer's figure 9b, an enlargement showing sculpture. Figure 13 of this plate is a photographic enlargement (×4) of part of the same shell.

FIGURES 11–17. *Marginifera roemeri* Girty, n. sp. (p. 264). Specimens of this species are seen on all the four slabs represented by figures 11, 12, 14–17, but Roemer's figures (8a, 8b) are probably a composite representation of specimens on the slabs shown by figures 14 and 17 of this plate. One of these is the upper specimen of figure 14, of which a side view is shown by figure 15. The other specimen is situated on the side of the slab represented by figure 17, and it does not appear in that figure. Figure 16 is a posterior view of this specimen. Roemer's figures, on the other hand, may represent either of these specimens singly, supplying the broken part if the original of figure 14 of this plate was used, or the part covered by matrix if the original of figure 17 of this plate was used. The specimen shown at the left in figure 17, though partly covered by matrix, is in good condition. It does not enter into this question, however. It is too small, too finely striated, and may not belong to the same species.

FIGURE 12. *Terebratula pugnus* (Sowerby) (p. 263). Roemer does not figure the species which he referred to *T. pugnus*, but several specimens are represented on the slab shown by this figure. The dorsal valve midway on the right side of the slab is the subject of Girty's comments.

FIGURES 18–21. *Spirifer meusebachanus* Roemer (p. 262). Four views of the holotype. Roemer did not give an anterior view corresponding to figure 19.