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OSTRACODA OF THE SIMPSON GROUP OF OKLAHOMA

By

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Preface

The author, Dr. R. W. Harris, has been engaged upon research on Simpson ostracodes since 1928. His studies to 1937 were submitted as his doctoral dissertation at Harvard University and he has continued his research on the group as Professor of Geology at the University of Oklahoma. As geologist on the Oklahoma Geological Survey in the summer of 1956 he brought his results into manuscript form.

Dr. Harris is the authority on microfossils of the Simpson group. The rocks of the Simpson are important petroleum reservoirs and the ostracodes are the best age indicators in well samples. This bulletin is published as a service to the people of Oklahoma in assisting geologists to find more oil and to micropaleontologists in general as a monographic treatment of a sequence of Middle Ordovician ostracodes in an important geologic section.

Carl C. Branson

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ABSTRACT

Part 1 involves a resumé of Simpson research during the period 1902 to 1956. Supplementing the resumé are text figures depicting stratigraphy, lithology, and correlation of the Simpson group.

The establishment, type section, thickness, lithology, relationship, age, correlation, and Ostracoda of each of the five standard formations of the Simpson group (Joins, Oil Creek, McLish, Tulip Creek, and Bromide) are discussed in detail. A new topmost Simpson formation, the Corbin Ranch, is proposed and discussed in Part 1.

In Part 2 the habitat and anatomy of living Ostracoda are discussed, as well as the structure, shape, surface, orientation, and classification of the living and fossil ostracodal carapace.

Eleven families, 42 genera, 116 species, nine subspecies, and one variety of Ostracoda are described and illustrated; their stratigraphic ranges are noted through four type Simpson sections of the Arbuckle Mountains and Criner Hills of Oklahoma.

Four ostracodal range charts of four type Simpson sections portray thickness, lithology, numbered zones, and formational contacts in the sections, as well as occurrence and range of the Ostracoda therein. An additional General Range Chart, compiled from analyses of the aforementioned four separate charts, presents comparative geologic ranges of the Simpson Ostracoda through the four type Simpson sections, and notes in separate columns the occurrence of certain species in miscellaneous wells and outcrops.

The publication includes a brief summary, as well as selected bibliographic references for both Simpson stratigraphy and Simpson Ostracoda.

FOREWORD

No other system of rocks in Oklahoma supplies such varied and valuable natural resources as does the Ordovician. The massive Arbuckle and Viola limestones are quarried for road ballast; the former especially is crushed for rock aggregate. Portland cement is manufactured from outcrops of Viola limestone and Sylvan shale. The clean, pure, quartz sand of the Simpson is used in the manufacture of glass; washed sands and gravels are employed in construction work. Locally the Simpson sands constitute aquifers, and the thin-bedded limestones, building blocks.

Of ranking economic import, however, are the subsurface Simpson "Wilcox" oil and gas sands of many of the deeper producing fields of the state. Many structures experiencing failing production in younger horizons have discovered a veritable "fountain of youth" in the deeper "Wilcox" reservoirs. Such has been the history of Tonkawa, Cushing, Fox, Seminole, and other oil fields. Additional structures presenting no more than a "rainbow" from upper horizons have proved exceedingly productive in the "Wilcox", a notable example being the Oklahoma City uplift. The declining supply of oil from the shallow sands and the promising production from the Simpson "Wilcox" has resulted in deeper exploratory drilling in Oklahoma and bordering states. The impetus of such deeper drilling has demanded more than ever before the establishment of many lithologic and paleontologic datum horizons within the Paleozoic section; and the ability to recognize these datum beds as encountered by the drill is currently a "must" with the mid-continent economic geologist.

Microscopic fossils are maintaining their status as admirable criteria in the identification of stratigraphic horizons. In the case of fossiliferous strata, not only are zones recognizable and correlative because of their fossil content per se, but the fossils also reveal information concerning ecology, depositional environment, geologic history, and age of the sediments. Indeed, applied micropaleontology constitutes a classic example of the adaptation of pure science to the realm of economic research.

Foraminifera are employed predominantly in identifying subsurface Mesozoic and Cenozoic marine strata. So abundant and diversified are the Foraminifera in post-Paleozoic strata, that in themselves they offer ample evidence for microfaunal zonation. Such is the case in the coastal regions of the Gulf of Mexico and California, where subsurface foraminiferal "first-occurrence" horizons have long been standardized. Other microfossils, such as Ostracoda, Diatomacea, Bryozoa, pollen, and spores are rarely employed in logging and zoning post-Paleozoic marine samples that contain abundant Foraminifera.

This apparent oversight of the associated fauna should not be considered a reflection upon their value as potential "index" fossils, however. On the contrary, so characteristically ornate are the aforementioned groups within limited vertical ranges, that they are adapted admirably for correlative purposes. More familiarity with the neglected fauna will effect increased efficiency in "running" samples in any laboratory. Thalmann (1955, p. 1197) disclosed that more than 30 different groups of microfossils may now be employed in establishing the age, stratigraphic subdivisions, and depositional and paleogeographic environments of geologic strata.

Only during Mississippian, Pennsylvanian, and Permian periods of the Paleozoic era did endothyroid and fusuline Foraminifera become abundant and structurally developed to the extent that their remains have become practical implements in stratigraphic research. A few arenaceous Foraminifera are recognizable as "index" fossils in insoluble residues of the older Paleozoic strata, but, generally speaking, the older Paleozoic Foraminifera are either too rare or too primitive to constitute practical implements of correlative value. Conodonts and Bryozoa, though of stratigraphic significance when identified in Paleozoic strata, are either too scarce or too fragmentary for consistent and general usage in micropaleontological research.

On the other hand, Ostracoda are both abundant and diagnostic in pre-Mississippian systems to the extent that they constitute the prevailing organic evidence employed by the micropaleontologist in identifying such older subsurface strata. The current and justifiable impetus in research with such micro-microfossils as spores, pollen, and Dinoflagellata, however, may well result in their becoming as significant as Ostracoda in the examination of older Paleozoic rocks.

The six formations of the Simpson group contain abundant Ostracoda, many of which are diagnostic. Limestones and shales particularly may be crowded with these crustaceans; the sandstones are less fossiliferous, though not uncommonly containing ostracodal shells and casts among those of Mollusca and conodonts.

Following introductory elements of foreword, acknowledgment, and abstract of this publication are the two parts of the text proper:

Part 1. The Simpson Group

Part 2. The Simpson Ostracoda

Part 1. The Simpson Group, involves essentially: 1) A review of Simpson investigation; 2) Description of the formations of the Simpson group.

Part 2. The Simpson Ostracoda, involves: 1) Habitat, anatomy, carapace, and classification of living and fossil Ostracoda; 2)

Description, illustration, and stratigraphic range of Simpson Ostracoda.

Bibliographic references, summaries, and ostracodal range charts are incorporated as natural results of the research.

MCZ Type Numbers

The MCZ type numbers refer to the Museum of Comparative Zoology at Harvard University, where the type specimens are deposited. A set of paratypes and hypotypes are deposited in the micropaleontological collections of the University of Oklahoma.

ACKNOWLEDGMENTS

First and foremost among those who encouraged and assisted the writer in this ostracodal research is Dr. C. E. Decker, University of Oklahoma. Dr. Decker not only suggested a study of Simpson Ostracoda as a timely research project, but he also accompanied the writer in field excursions, assisted in identifying the Simpson zones, and aided in collecting the microfaunal samples from outcrops in the Arbuckle Mountains and in the Criner Hills. The writer is indeed grateful to this eminent scientist for many years of inspiring association, as well as for his cooperation and assistance in the practical aspects of this publication.

The writer is grateful to Mr. Rex McGehee, Shell Oil Company, of Denver, Colorado, and Mr. Norval Ballard, consulting geologist of Oklahoma City, Oklahoma, for their participation in collecting the Simpson samples utilized in this research.

To various associates and assistants who collaborated in preparing the outcrop samples for study, appreciation is also extended. In this respect the writer is grateful to Dr. Alfred R. Loeblich and his wife, Dr. Helen Tappan Loeblich, of the U. S. National Museum, for assistance in picking out and properly mounting many Ostracoda upon microfaunal slides. A species is established in recognition of this assistance and of subsequent Simpson research by Dr. Loeblich.

An ostracodal genus is established in partial expression of appreciation for assistance in laboratory research and classroom instruction by Mr. W. J. Hilseweck, of Blackwood and Nichols Oil Company, Dallas, Texas.

As a gesture of appreciation for supplying type ostracodal specimens, species are named in honor of Mr. M. E. Upson and Mr. L. R. Moore, paleontologists for Gulf Oil Company of Fort Worth, Texas; and another, for Mr. M. R. Teis, geologist for Delta Petroleum Corporation of Tulsa, Oklahoma.

Likewise, a species is named in honor of Colonel L. E. Brooking, U. S. Civil Aeronautical Board, Washington, D. C., in acknowledgment of assistance in collecting ostracodal species.

To the late Dr. P. E. Raymond of Harvard University, the writer is grateful for guidance in directing the doctoral thesis involving Simpson Ostracoda, and for aid in the identification of Simpson fossils.

To Dr. H. B. Whittington, Curator of the Museum of Comparative Zoology at Harvard University, the writer extends appreciation for the gracious loan of type fossils previously deposited in the museum.

The writer is grateful to Dr. L. I. Price, Divisao de Geologia e Mineralogia, Avenida Pasteur, Praia Vermelha, Rio de Janeiro, Brazil, South America, for assistance in drawing and mounting ostracodal illustrations preparatory to photographing the finished plates.

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The writer appreciates the cooperation and assistance of Mrs. Lucy Finnerty, Librarian of the School of Geology of the University of Oklahoma, and her assistants, in obtaining proper references regarding Simpson stratigraphy and Ostracoda.

For the drafting of the five ostracodal range charts of the publication gratitude is presented Mrs. Helen Anderson and Mr. Roy Davis of the Oklahoma Geological Survey.

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PART I

THE SIMPSON GROUP

A detailed report of distribution, stratigraphy, structure, and paleontology of the Simpson group is beyond the scope of this publication. The topic as presented herein consists of:

Introduction
Review of Simpson Investigation
Formations of the Simpson Group

INTRODUCTION

Approximately two and one-half miles of marine strata are exposed below the Mississippian Sycamore limestone, which constitutes the outermost escarpment on either flank of the Arbuckle Mountains.

The major and central portion of the Arbuckle plateau is composed of 4,000 to 7,000 feet of Arbuckle limestone, cropping out either as grass-covered ranchland, or as harder dolomitic ledges in "tombstone" relief.

Beneath the mile and one-half Arbuckle limestone section is a maximum thickness of 460 feet of semi-quartzitic ferruginous Reagan sandstone that rests unconformably upon pre-Cambrian granite. The lower portion of the Arbuckle limestone and the Reagan sandstone is Cambrian (Ulrich 1911, pl. 27) in age; the upper part is Beekmantown (Decker 1936a, p. 305), as evidenced by graptolites and other invertebrates. The topmost 1,000 feet of the Arbuckle limestone contains a well-preserved and diagnostic Ostracoda fauna distinctly differing from that in the overlying Simpson Joins formation.

Unconformably overlying the Arbuckle limestone is the Simpson group, some 2,300 feet (Decker and Merritt 1931, table 4) of conglomerates, sandstones, shales, and limestones. As generally accepted, the Simpson group consists of Joins, Oil Creek, McLish, Tulip Creek, and Bromide formations.

In a detailed study of brachiopods, Cooper (1956, pp. 120-122) subdivided the Bromide into two members (ascending), Mountain Lake and Pooleville. The upper part of the Pooleville is apparently Ulrich's Webster (pre-empted) Edson 1935b, p. 1122); its topmost limestone and shale section is termed herein the Corbin Ranch formation.

Ulrich also established the Falls formation (of approximate McLish age); herein the Falls is considered simply a more clastic facies of the McLish formation and, accordingly, the name is not employed for a Simpson formation.

Each formation of the Simpson group contains abundant varied and diagnostic Ostracoda, ranging in age from Chazyan in lower Simpson; to Lowville-Black River in middle and upper; to lower Trenton in topmost Simpson Corbin Ranch limestone.

Disconformably overlying the Simpson group is a section of 1,100 feet of fossiliferous Viola-Fernvale (Wengerd 1948, p. 2201) and green Sylvan shale, of Trenton and Richmond ages, respectively.

Approximately 1,300 feet of Silurian, Devonian, and lower Mississippian strata (essentially nonclastic) rest upon the Ordovician in unconformable relationship, thus completing the pre-Meramecian Mississippian two and one-half mile section in the Arbuckle plateau (Ham 1955, tab. 1), emended as follows:

		Maximum thickness
Mississippian		
Sycamore limestone		350
Devonian-Mississippian		
Woodford shale and chert		560
Devonian		
Frisco limestone		
Bois d'Arc cherty limestone	H	
Haragan marl and limestone	U	
	N	375
Silurian	T	
Henryhouse shale and limestone	O	
Chimneyhill limestone	N	

Ordovician			
Patterson Ranch group			
Sylvan shale	335		
Fernvale limestone	99		1,134
Viola limestone	700		
Simpson group			
Corbin Ranch formation	24		
Bromide formation	412		
Tulip Creek formation	395		
McLish formation	535		2,410
Oil Creek formation	750		
Joins formation	294		
Cambrian-Ordovician			
Arbuckle group (eight formations)			6,700
Upper Cambrian			
Timbered Hills group			
Honey Creek limestone	235		695
Reagan sandstone	460		
Pre-Cambrian		Total	12,224
Colbert porphyry			

Ordovician and younger systems occur also in the Ouachita Mountains to the southeast, where local names are assigned the various formations: the Arbuckle limestone being equivalent (in part) to the Mazarn graptolitic shale; the Simpson, to the Blakely sandstone and Womble shale; the Viola, to the Big Fork chert; and the Sylvan, to Polk Creek graptolitic shale (Decker 1935b, p. 699). From the Ouachita and Arbuckle Mountains of Oklahoma, Ordovician strata are traceable in subsurface into Texas along the western border of Llanoria as far southward as the Rio Grande, and thence westward into the Marathon Mountains. In this area of west Texas and New Mexico the Arbuckle limestone is termed Ellenburger; the Simpson remains as such (with recognizable formations and local Waddell and McKee producing sands); and the Viola is termed Maravillas or Montoya. Detailed lithology, as well as Ostracoda faunules, of the subsurface Ordovician samples of this southwestern area are remarkably similar (where not identical) to those of the Ouachita geosyncline. In this respect attention is directed to the coarsely crystalline texture of subsurface Texas Ellenburger and Oklahoma Arbuckle dolomites; the rounded frosted sand grains and green shales of the Simpson of the two areas; and the brownish to resinous chert with included short black spicules and brown flecks, so characteristic of the Texas Montoya-Maravillas and the Oklahoma Viola (incidentally, observed also in equivalent subsurface Trenton samples of northern Mississippi). Likewise, the rugose cryptophyllid and coarsely porate paraschmidtellid Ostracoda of the Oklahoma Joins and Oil Creek are excellent index fossils of lower Simpson subsurface strata of the Permian Basin; while the Black River schmidtellids, ctenobolbines, leperditellids, and primitiopsids of the Tulip Creek and Bromide of Oklahoma occur in upper Simpson subsurface strata of west Texas and New Mexico. Adams (1954, p. 4) noted the remarkable similarity in thickness and lithology of sediments in the Oklahoma and West Texas basins bounding the buried Texas Peninsula . . . "Geologists working with basinal middle Paleozoic formations would never suspect the presence of an intervening land barrier between the two embayments. A balanced sequence of tectonic movements and erosion in the land areas and an open shelf-sea connection around the southeast tip of the Texas Peninsula must be postulated to explain the close similarities."

From the Arbuckle Mountains, Simpson strata have been traced northwestward and northward in subsurface or outcrop through central and northern Oklahoma, around the Ozark Dome, into the central interior states of southeastern Colorado, Kansas, Nebraska, Missouri, Iowa, Minnesota, Illinois, Wisconsin, Indiana, and Ohio (Dapples 1955, p. 499). Furthermore, Simpson equivalents are reported from the Cordilleran area of Nevada; and from the Appalachian areas of Alabama, Tennessee, Kentucky, New York, and Canada. Ver Wiebe (1932, p. 505) presents classical charts displaying distribution and thickness of Ordovician strata deposited in the various states and provinces of North America while submerged by the many widespread epicontinental seas of the Ordovician period.

REVIEW OF SIMPSON INVESTIGATION

Dr. Charles E. Decker, Professor Emeritus of Oklahoma University, is considered the outstanding stratigrapher of Simpson research.

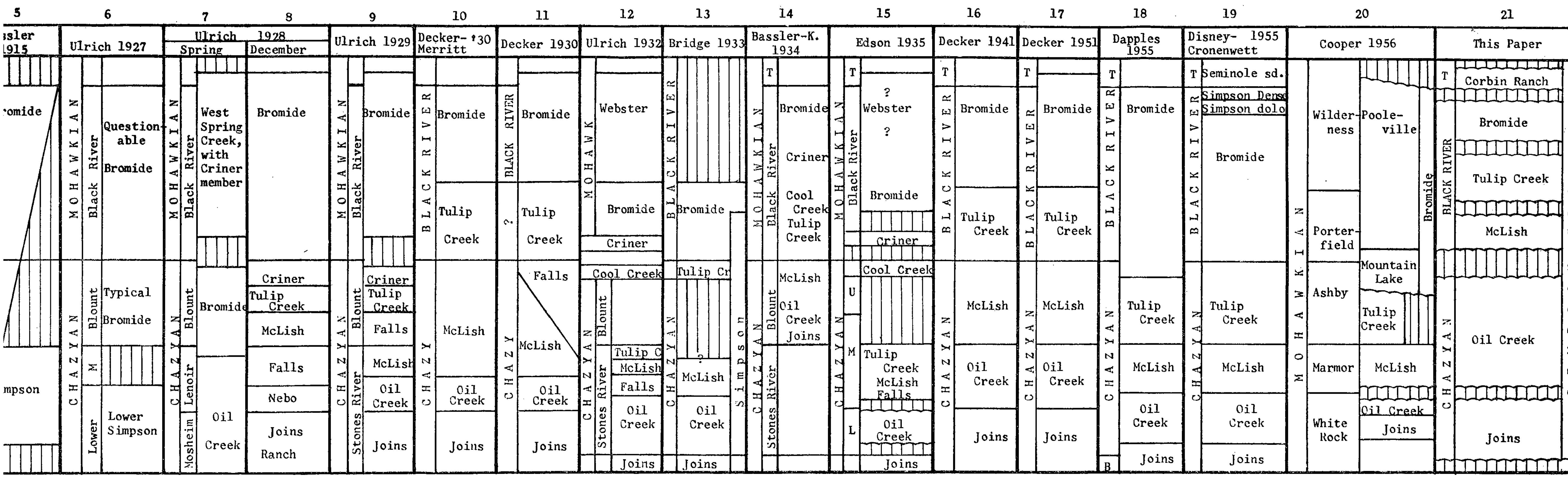
Though members of the U. S. Geological Survey, J. A. Taff and E. O. Ulrich, initiated investigation of the Simpson and named its formations, it was Decker who emphasized the status of the Simpson group, standardized the five formations, and established boundaries as generally accepted. Perhaps his most significant contribution to knowledge of the Simpson group involved the measuring, zoning, and mapping of its formations as they occur in the Arbuckle and Wichita Mountains and in the Criner Hills of Oklahoma.

J. A. Taff was one of the first geologists of record to devote appreciable time and research to Paleozoic outcrops of southern and eastern Oklahoma.

During the seven-year interval, 1897 to 1904, Taff studied and named the units of the Paleozoic section of the Arbuckle Mountains. He also established many of the Ouachita formational names after having studied outcrops in and about the Ouachita Mountains.

In 1902 Taff (1902, p. 3) erected the Simpson formation and published the first map displaying Simpson exposures in Oklahoma. The Simpson formation included the Arbuckle Mountain section of fossiliferous sands, shales, and limestones in the interval between the Arbuckle and Viola limestones (column 1, Fig. 1). An estimated thickness of 1,200 to 2,000 feet was suggested for the section, and the age of Lower Silurian (Ordovician) was ascribed thereto. The topmost 400 to 500 feet of limestones and shales were regarded as transitional beds between the Simpson and the Viola, though admittedly more closely related to the Simpson as a whole.

In 1903 Taff (1903, p. 3) reported three variable sandstone beds in the Simpson section, the middle being most uniform in thickness and lithology. He observed that some 400 feet of basal Simpson was missing in the Falls Creek section on the northwestern side of the mountains; where he, accordingly, established unconformable relationship with the underlying Arbuckle limestone. A faulted contact has since been observed at this locality;



LATIONS ON THE SIMPSON GROUP

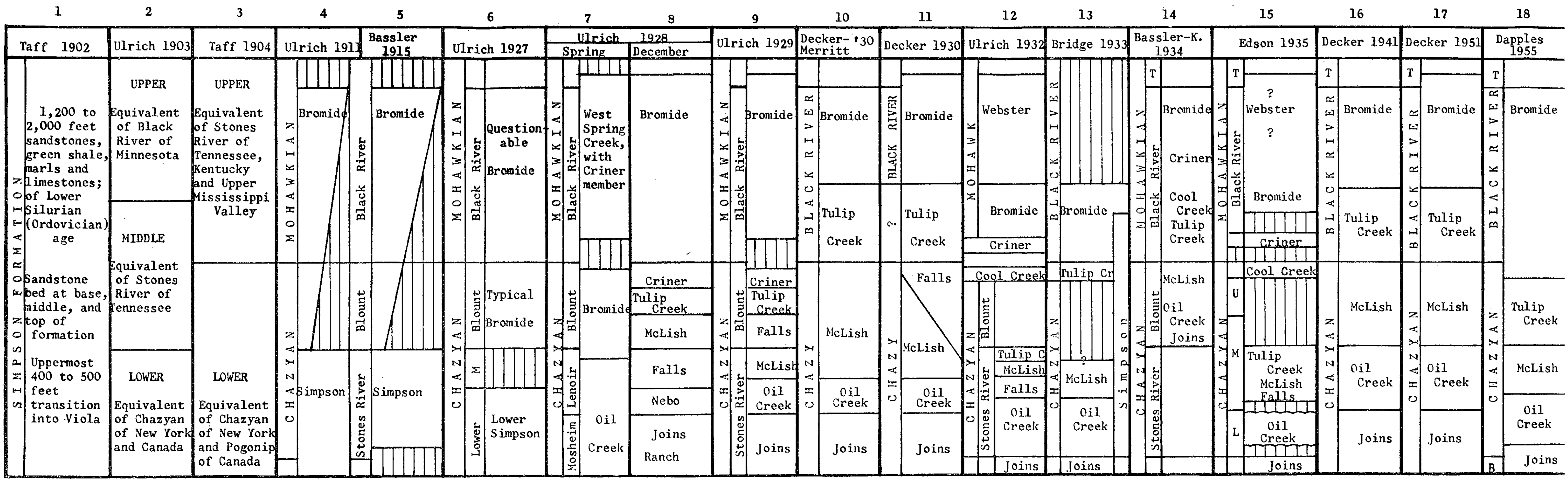


FIGURE 1. COMPARATIVE CORRELATIONS ON THE SIMPSON GROUP

nevertheless, Taff was correct in postulating the unconformable Arbuckle-Simpson relationship. Upon fossil evidence supplied by Taff, Ulrich correlated the lower part of the Simpson with Chazy of New York and Canada; the middle part with the upper Stones River of Tennessee and Kentucky; and the topmost part with the Black River of Minnesota (column 2, Fig. 1). Ulrich postulated the Simpson fauna to have appeared earlier in Oklahoma than in Minnesota, though later he (1930, p. 77) contended that the Bromide fauna invaded from the north. Two species of *Leperditia* Conrad (now *Eoleperditia* (Conrad) Swartz), the first Simpson Ostracoda reference, were included in Ulrich's Chazyan faunal list (selected) as follows:

Lower Simpson (Chazy)	Upper Simpson (Stones River-Black River)
Orthis costata Hall	*Receptaculites* n. sp.
Orthis pogonipensis Hall & Whitfield	*Plectambonites sericeus* (Stones River var.)
Amphion nevadensis Walcott	*Rafinesquina minnesotensis* Winchell
Leperditia bivia White	*Orthis tricenaria* Conrad
Leperditia cf. *fabulites* Conrad	*Hebertella bellarugosa* Conrad
	Rhinidictya nicholsoni Ulrich
	Pholidops trentonesis Hall

In 1904 Taff (1904, p. 23) published the Simpson section as exposed in outcrops west of the Washita River on the southern side of the mountains. Ostracoda were noted in the lower part of the section:

		Feet	
1.	Thin limestones with green shales interstratified. In the lower part the limestone is subcrystalline, resembling beds lower in the formation; higher it becomes fine and argillaceous, resembling Viola.	400	Upper Simpson
2.	Sandstone	90	
3.	Limestone and shales interbedded. Some highly fossiliferous; *Orthis tricenaria*, *O. deflecta*, monticuliporoid bryozoans, highly ornate cystid plates. *Ctenodonta* sp.	400	
4.	Sandstone	100-200	
5.	Shaly limestone. Lower 50 feet highly fossiliferous, containing Ostracoda, numberous Bryozoa, and bases of crinoid columns, making fauna sufficiently peculiar to be easily recognized.	195	
6.	Sandstone	33	Lower Simpson
7.	Thin-bedded limestone and interstratified shale. Contains fossils in great abundance; large and small Ostracoda, numerous gastropods, pelecypods, brachiopods, and trilobites.	295	
8.	Greenish shale with few thin limestone layers	245	
9.	Granular thin-bedded crystalline limestone. Abundance of Ostracoda (*Leperditia*) and other rare fossils.	350	
10.	Thin limestone and shales with occasional thin sands	29	
11.	White to brown sandstone (locally occurring)	100	
	Total	1,928 feet	

Taff observed sandstone bed No. 4 of the Washita River section to be more persistent in characteristics and thickness than others of the section, thus serving as a convenient datum for reference and for dividing the Simpson section into lower and upper divisions of approximately equal thickness (column 3, Fig. 1). This sandstone is now recognized as the basal sandstone of the McLish formation. That Taff was correct in considering the sandstone bed near the middle of the Simpson section is attested by the fact that in Decker's (Decker and Merritt 1931, tab. 3) West Spring Creek measured Simpson section this sandstone body occurs as Bed 34, 150 feet in thickness, with its base 1,009 feet below the top of a Simpson section that is 2,233 feet in thickness. Additional evidence of detailed research by Taff is reflected in his observation that the Simpson section is thinner on the northern than on the southern side of the mountains (due chiefly to the absence of several hundred feet of basal Simpson beds), and that a much farther eastward exposure of the Simpson may be observed on the northern side of the mountain. . . . . "Where, in the valleys of Blue River and Delaware Creek, the Simpson attains a thickness of only 1,200 feet, with the sand relatively more abundant than on the same side of the mountains farther west". Taff made extensive fossil collections and, with the assistance of Ulrich, listed (Taff 1904, p. 24) many invertebrate forms from the lower and upper Simpson (including the same two leperditian Ostracoda previously listed from the lower Simpson).

Ulrich again concluded that the fauna of the lower division was decidedly similar to that of the Pogonip of Nevada and Chazy of New York and Canada; while the fauna of the upper division was considered closely related to the upper Stones River of Tennessee and Kentucky and equivalent strata in the upper Mississippi Valley.

Ulrich confirmed his opinion that the lower Simpson fauna was of western origin in the statement that it compared to that of Nevada (as well as to that of New York and Canada) and of it he remarked, "Considering these east and west connections it is surprising to note the lower Simpson fauna contains none of the prolific fauna of the lower division (Murfreesboro) of the Stones River group in middle Tennessee, which is believed to be of equivalent age." Such a discovery, undoubtedly, was a surprise to Ulrich, for at the time he apparently considered the Rome Barrier of eastern Tennessee (Ulrich 1901, pl. 9) as the only barrier during the Chazyan epoch that might possibly separate the Arbuckle basin from that of the Appalachians. Several other possible reasons in explanation of the anomaly are readily apparent, however. It is possible, for instance, that the Ouachita-Appalachian connecting trough lay south of Tennessee (a positive area), as illustrated by Ulrich (1911, p. 293). Again, possibly a north-south barrier west of the Rome Barrier and nearer the Arbuckle basin, such as the rising Cincinnati axis, could have served temporarily to prevent free intermingling of Oklahoma and Tennessee species. Ulrich (1927, p. 26) postulated the effect of such a local barrier in the Spavinaw axis . . . "The rocks of the Ouachitas were deposited in a subsiding basin that lay a hundred or more miles to the south of their present position. To the south of this original Ouachita basin lay an older foreland . . . Llanoria . . . . subsequently . . . . . the deposits of the Ouachita basin were thrust over the northern boundary of the basin into the middle and eastern parts of the geosyncline, in the western part of which the Arbuckle sequence of almost entirely different deposits were laid down. The eastern half of this geosyncline was at times separated from the western Arbuckle half by the north-south trending Spavinaw axis."

Another possible barrier is suggested in the peculiar lithology and fauna of the Ouachita Mountain facies intervening between Oklahoma and Tennessee. The lithology and fauna of Ouachita Simpson equivalents (Blakely sandstone and Womble shales) suggest a plausible explanation for the western complex of the lower Simpson fauna. Since graptolites constitute essentially the only invertebrate fauna preserved in these Ouachita Simpson equivalents, it appears that the muddy waters of the Ouachita basin might have served as an intervening barrier to discourage and prevent free and direct intermingling of Oklahoma invertebrates with those of the southern Appalachian area to the east.

In 1905 Taff shifted his locus of geologic research from the Arbuckle Mountains of southern Oklahoma to the Ozark area of northeastern Oklahoma. Here he named the Ordovician sequence of rocks. The section equivalent to the Simpson involved a 100-foot massive brown Burgen sandstone, overlain by 60 to 100 feet of Tyner green shales and sandstones, with two limestone beds at the top (the lower, cherty; the upper, bluish and fine-grained, and later named Fite by Cram (1930a, p. 20). From a Tyner faunal suite supplied by Taff, Ulrich identified two Ostracoda, *Leperditia* cf. *fabulites* Conrad and *Leperditia* sp. (5 mm long).

In 1909 Grabau (1909, pp. 223, 225) observed that the Beekmantown-Chazy hiatus in the Arbuckle Mountains was marked by a basal sandstone in 2,000 feet of Simpson (Chazy). His paleogeographic map portrayed Ozarkia rejuvenated as an island at the end of Chazyan time.

In 1911 Ulrich's "Revision of the Paleozoic System" portrayed three correlation tables of Paleozoic formations. In the Cambro-Ordovicic table Ulrich (1911, pl. 27) correlated through 49 stratigraphic time equivalents (with standard formational names) the section through thirteen states of central and eastern United States. In the Arbuckle Mountain column the Simpson, of lower Chazy (Stones River) age, was undifferentiated in unconformable contact with the underlying Arbuckle, and in similar relationship with a newly established overlying formation, the Bromide, of Mohawkian (Black River-Trenton) age (column 4, Fig. 1).

The correlation chart of Bassler (1915, pl. 2) was fashioned after the aforementioned chart of Ulrich. He presented 27 columns of Cambro-Ordovicic correlations for as many different geographic districts in Europe and North America. He employed for the Oklahoma column Ulrich's Simpson section of 1911; i. e., displaying the lower part of the section, the Simpson formation (Stones River), at the base, overlain by the Bromide formation (Blount-Black River age) (column 5, Fig. 1). Bassler depicted the Simpson formation limited to the Stones River, while Ulrich had portrayed it as upper Beekmantown and Stones River.

Willis (1912, p. 159), in discussing Simpson stratigraphy, summarized the 11 lithologic units of Taff's (1904, p. 23) Washita River section into three subdivisions:

890 feet thin limestones and shale
100 to 200 feet sandstone
1,250 feet thin-bedded limestone and shale

Buttram (1913, pp. 42-76) made noteworthy contributions concerning the stratigraphy and distribution of the Simpson in his study of glass sands of Oklahoma.

Five detailed Simpson sections (with sand emphasis) from localities on the southern flank of the Arbuckle Mountains were presented in cross-sectional correlative fashion (Fig. 2). The sand bodies of the sections were divided into Basal, Lower, Middle, and Upper beds. He described and mapped these beds in seven Arbuckle Mountain areas from Delaware Creek to Davis.

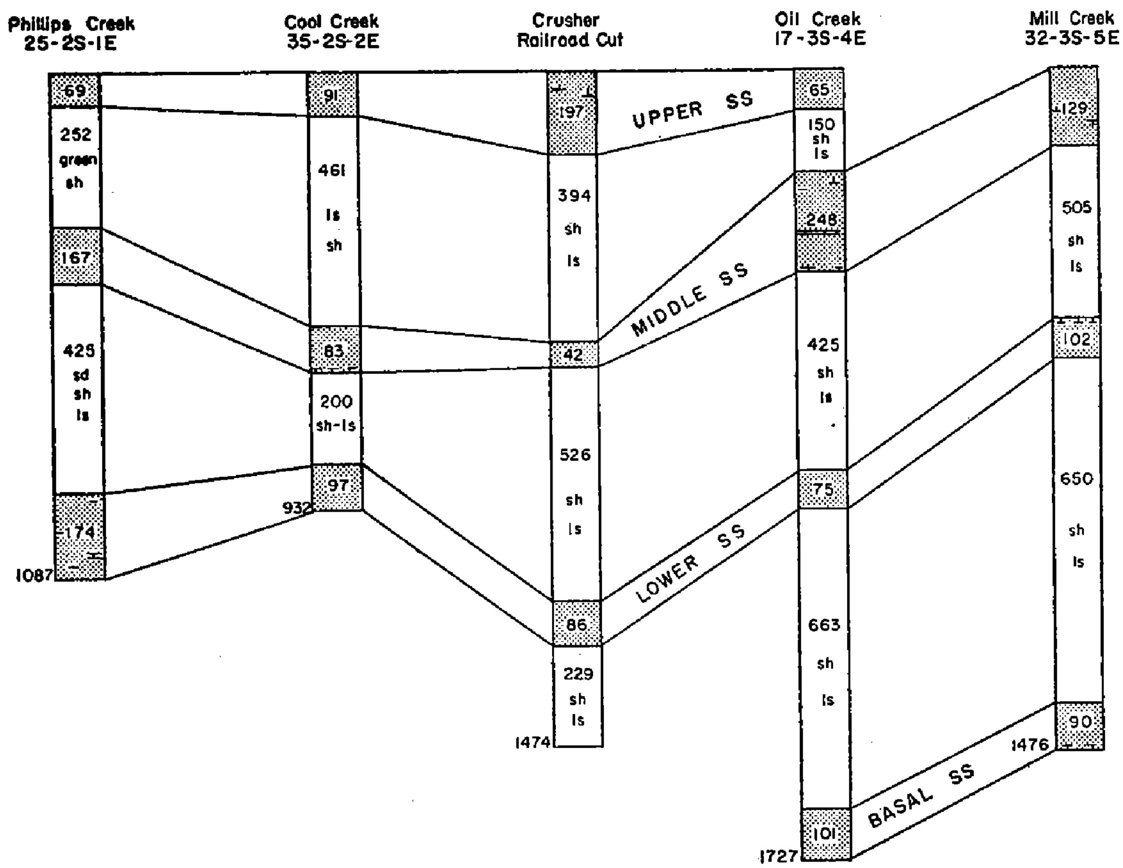


Figure 2. Sandstone Beds in the Simpson Section, Buttram 1913

Trout in 1913 presented a Master's thesis to the University of Oklahoma in which he described (without illustration) some 42 invertebrate fossils from the upper division and some 26 species from the lower division of Taff's Simpson formation. Though the thesis is unpublished, nevertheless, it constitutes a tool of research in identification and range of Simpson fossils.

Of the half dozen Ostracoda mentioned by Trout, the writer discovered but one, *Eoleperditia fabulites* (Conrad) Swartz.

In 1919 Coryell (1919, p. 306), in describing five dozen species of Bryozoa from the Stones River Group of Tennessee, correlated the Oklahoma Simpson with the Stones River section of the Mississippi Valley and Appalachian districts. Two paleogeographic maps depicted the lower Mississippi Valley (including Oklahoma) submerged by middle and upper Stones River invasions of the Gulf of Mexico.

Dake (1921, pp. 1-224) published an outstanding report regarding the St. Peter sandstone, a treatise involving 224 pages of text, plates, and photographs, distribution maps, correlation chart, cross-section, faunal lists, and formational and mineralogical descriptions. So plausible was the reasoning of this brilliant scholar and so relevant is his research to Simpson geologic history that a brief review is apropos. Dake postulated the Canadian Shield as the source of St. Peter and older sandstones of the underlying Beekmantown limestones . . . . . sands deposited in mid-continental Ordovician seas with shore-lines in Wisconsin and Minnesota. The early Beekmantown New Richmond and Roubidoux limestones contain considerable sand; the later Beekmantown Jefferson City, Cotter, and Shakopee-Powell contain less, though the supply was maintained apparently from the north. Following the Powell (close of Beekmantown) occurred a long period of pre-St. Peter erosion . . . . longer than the time required to deposit the St. Peter sand upon the eroded surface . . . . . . an erosional hiatus comparable to that of the Eden-Maysville in late Ordovician. The marked relief of the Beekmantown surface, the extensive erosion of formations to the north (locally removing Shakopee, New Richmond, Oneota, and even some Jordan sandstone), and residual soils beneath the St. Peter, all indicate that the more northern areas were longer out of the sea in the tilting action toward the south. The pure St. Peter sandstone was deposited upon the old Beekmantown surface in a sea advancing from the Ouachita geosyncline, from which it may never have retreated. After the seashore had progressed northward past central Missouri and possibly as far as Iowa and Illinois, closing the period of Everton deposition, a warping occurred to cause the emergence of the Ozark region (the emergence more pronounced to the south), thus effecting erosion of uppermost Everton limestone. It is possible that this emergence exposed from the sea considerable new sand to be reworked with that supplied by the Canadian Shield. This

Everton emergence appears to have been followed by a tilting which submerged the area to the south and uplifted the source of supply, and it was following this episode that the great bulk of St. Peter sandstone was deposited. A possible explanation for the absence of shale facies in the St. Peter sandstone postulated Ordovician dust storms that conceivably picked up the lighter dust, carried it eastward, and dumped it into the Atlantic Ocean . . . . leaving the wind-rounded and frosted sand grains for fluviatile deposition in the sea to the south. It is believed that the sea in which St. Peter was deposited entirely submerged the Ozark region and that the St. Peter once entirely covered that area. As the shoreline (and sand deposition) gradually advanced northward, the Joachim limestone of Arkansas and Missouri was deposited as off-shore non-clastic facies of upper St. Peter in northern regions.

At the close of St. Peter-Joachim time there was emergence of Ozarkia, as witnessed by the erosional surface of Joachim unconformably below Plattin. With readvance of the sea, in came the Plattin-Platteville (Lowville-Black River) fauna very widely over the Missouri-Arkansas and upper Mississippi valleys, respectively. The lowlying northern land mass in Black River time allowed the sea to advance far to the north. Following Decorah time there seems to have been an even wider advance of the sea, covering the Canadian Shield about Hudson Bay, and entirely covering the Ozark Region to the south. The Mississippi Valley area subsequently emerged, and remained land during most of Eden-Maysville time. During uppermost Ordovician Richmond time widespread submergence allowed the deposition of the Fernvale limestone and Maquoketa shale.

Dake portrayed the undifferentiated Simpson of Oklahoma as essentially Chazyan in age, and correlated it with the Burgen and lower Tyner of northeastern Oklahoma. The St. Peter was indicated as Chazyan in age.

Howell (1922, pp. 413-425) was the first to report the presence of Simpson strata in the subsurface of Granite, Gotebo, and Gladys Belle oil fields of the Wichita Mountain area, for in an inverted stratigraphic section he displayed sandstone, green and gray shale, and impure limestones in the undifferentiated Simpson section between Viola and Arbuckle formations.

Honess in discussing the geology of the Ouachita Mountains in 1923 made no direct mention of Simpson strata, though his remarks regarding apparent source of the Ouachita facies are of interest (1923, pp. 38, 54). A southwesterly source, short transportation, and rapid deposition is indicated in the 14-foot conglomerate at the base of the Crystal Mountain sand of Beekmantown age, for this conglomerate is 14 feet thick (with 8-inch boulders) at Glover Creek locality, though it pinches out altogether eastward beyond Lukfata Creek. The entire Crystal Mountain formation (with its associated Mazarn shale) thins northeastward and pinches out west of Hochatown. The disappearance of the superjacent Blakely sand (lower Simpson equivalent) in the area north and east of Glover Creek locality would also indicate a southwesterly source. Finally, the failure of shale to appear in the Womble sand of southeastern Oklahoma, while the same Womble is composed of shale in toto to the east in Arkansas would indicate a southwesterly source for the Womble (upper Simpson equivalent). Honess theorized that a new and prolific source of sand and mud occurred in Womble time, the uniformity of the sand and the absence of conglomerates, however, indicating a comparatively distant source in rising lands to the south and southwest. The author possibly considered the northern nose of Llanoria as this southwestern land mass.

Morgan (1924, p. 25) recognized in the Stonewall Quadrangle 25 square miles of Simpson exposures appearing as faulted discontinuous bands paralleling the Arbuckle Mountains. He apparently was the first to note that Taff's type locality for the name, Simpson, was obtained from the townsite of the same name in the northeastern corner of T. 1 S., R. 6 E., Oklahoma. Morgan presented Taff's list (1924, pp. 24-25) of invertebrate fossils from the Simpson, though he considered the undifferentiated formation of middle Ordovician age in his columnar section.

Merritt and McDonald (1926, p. 10) mentioned unconformities below and above the subsurface Simpson of Creek County, dividing the formation into the five units as did White (1926b, p. 8). A log of McComb Well No. 1, sec. 10, T. 17 N., R. 11 E., revealed 291 feet of Simpson section, which was divided into three formations, Burgen, Tyner, and Wilcox.

Ulrich (1927, pp. 14-28) discovered in the fossiliferous boulders of the Caney shale 90 "reworked" invertebrate species (including 13 Ostracoda) of Chazyan, Blackriverian, and Trentonian ages. The fossils were comparable to those of the Chambersburg-Martinsburg of Pennsylvania and Virginia, the Blount of Tennessee, Little Oak of Alabama, and Bromide and Viola of Oklahoma. He expressed surprise in the absence of lower Simpson fossils in the boulders.

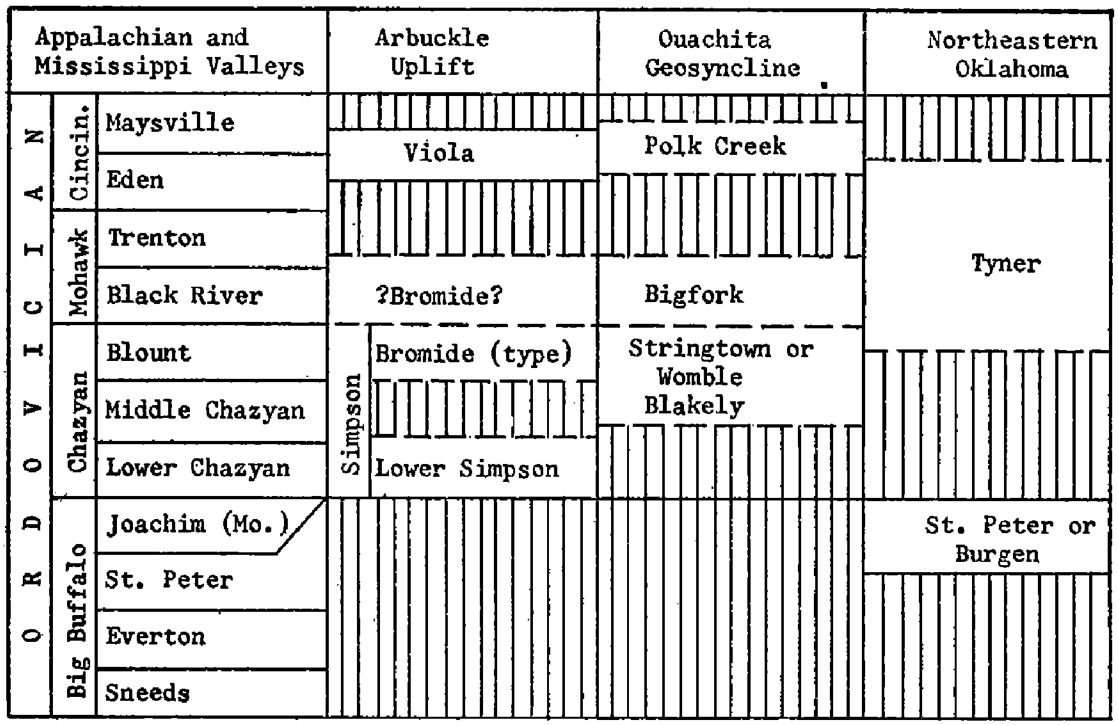


Figure 3. Correlation of Oklahoma Formations, Ulrich 1927

Ulrich noted that Taff's original Simpson formation contained at least three faunas of diverse origin: (1) the lower, of Pacific origin and comparable only with the upper Pogonip of Nevada; (2) a succeeding lower Bromide fauna of Atlantic complex that has not been found in northern Arkansas and whose path must be covered by Ouachita overthrusts; (3) the closing stage, provisional Bromide, containing Decorah-Prosser faunas of Minnesota, and representing a far north or Arctic invasion. The St. Peter (faunally, lithologically, and diastrophically pre-Simpson) is not present in the Arbuckles (Fig. 3; and column 7, Fig. 1). Ulrich's reference to the Bromide marked the first reference to the formation since the name appeared in Bassler's bibliographic index of 1915. In this Caney boulder report, Ulrich postulated the typical Bromide as late Chazyan in age, though shortly thereafter and until his death he considered it Black River-Trenton in age.

Edson (1927, p. 969) published a commendable Ordovician correlation chart for Oklahoma and Missouri (after Dake) (Fig. 4). For the Arbuckle section she considered the Simpson formation of Stones River (lower Chazy) age unconformable upon the Arbuckle and questionably transitional into the overlying Bromide formation of Blount (upper Chazy) and Lowville age. The Bromide in turn is ,conformable with the overlying Viola of Black

STANDARD DIVISIONS	OKLAHOMA ARBUCKLE SECTION	OKLAHOMA MID-CONTINENT SECTION	OKLAHOMA TAHLEQUAH SECTION	MISSOURI (After Dake)
RICHMOND	FERNVALE LS. (Upper Viola)	FERNVALE LS (Upper Viola)	TYNER FM. (Richmond member)	MAQUOKETA SH. FERNVALE LS.
MAYSVILLE AND EDEN	Hiatus	Hiatus	Hiatus	Hiatus
TRENTON	VIOLA LS. (Middle)			KIMMSWICK LS.
BLACK RIVER AND LOWVILLE	UPPER BLACK RIVER (Lower Viola)	LITHOGRAPHIC LS. (Lower Viola)	TYNER FM. (Lithographic member)	DECORAH(?) PLATTIN LS.
	BROMIDE FM.	BROMIDE FM. (Post-Wilcox)	TYNER FM.	JOACHIM LS.
UPPER CHAZY OR BLOUNT	?	TRUE WILCOX SS.	BURGEN SS.	ST. PETER SS.
LOWER CHAZY OR STONES RIVER	SIMPSON FM.	"TYNER" Green shale series	?	Hiatus
		"HOMINY" SS.	?	EVERTON SS.
BEEKMANTOWN OZARKIAN	ARBUCKLE LS.	SILICEOUS LS.	?	POWELL LS. COTTER LS. JEFFERSON CITY ROUBIDOUX

Figure 4. Ordovician Correlation in Oklahoma, Edson 1927

River-Trenton age. Such was the interpretation of the Bromide when Ulrich (1911, pl. 27) established the formation in 1911. The Arbuckle Mountain Bromide was correlated with "post-Wilcox" subsurface beds, and with that part of the Tahlequah Tyner formation lying between Burgen and Viola limestone equivalents. The basal Bromide sand outcrops of the Arbuckle Mountains were considered correlative with the true "Wilcox" sand of the subsurface, with the Burgen near Tahlequah, and with the St. Peter of Missouri and elsewhere. The writer tentatively agrees with such conception, provided the aforementioned "basal Bromide sand" be that of the present McLish (or possibly Tulip Creek) formation, not the present Bromide. Edson correlated the main body of the Arbuckle Mountain Simpson section with the subsurface pre-Wilcox section of green shales, sand, and limestones, and considered it probably pre-Burgen in age.

Edson reported the massive lithographic limestone of topmost Tyner, Cram's Fite (1930, p. 20) of northeastern Oklahoma, developing to the extent of 200 feet in the subsurface. She considered the member of upper Blackriverian age, and correctly depicted it unconformably between the Tyner and overlying Fernvale. The writer favors the age of Trenton for the Fite limestone.

Levorsen (1928, p. 30) presented a subsurface Simpson section of Seminole County, Oklahoma, introducing the name, Seminole sand, for the unit previously termed "First Wilcox" sand (Disney and Cronenwett (1954, p. 211) and Maravich and Morrisey (1956, p. 1155) depicted Levorsen's Seminole sand or "First" Wilcox of the Seminole area as Viola in age, occurring between the overlying Viola "dense" limestone and the underlying Simpson "dense" limestone). Five subsurface members were involved in Levorsen's section, in thickness ranging from 575 to 900 feet, the main or true 500-foot "Wilcox" sand at the base, and overlain by four members that comprised the "post-Wilcox" Simpson of White (1926, p. 8). Levorsen directed attention to the fact that the Viola limestone (500-600 feet thick in Arbuckles) is absent in the subsurface of Seminole County, where the topmost Simpson dense limestone is overlain unconformably by the coarsely crystalline Fernvale limestone. Such a stratigraphic relationship in Seminole County is significant in the light of the writer's tentative conception that identical conditions obtain in northeastern Oklahoma. Here the Viola limestone is missing, the Fernvale being in direct unconformable contact with the underlying Fite (disconformably resting upon underlying Tyner and probably correlative equivalent of the subsurface Simpson dense limestone and topmost Simpson Corbin Ranch limestone of Arbuckle Mountain outcrops). In post-Fite-pre-Fernvale time (Viola) the Ozark uplift, then, extended as a positive nose at least as far southwestward as the Seminole area, to be eroded and later submerged by the Fernvale sea.

Levorsen's map (top Ordovician datum) reflects such extension of Ozarkia.

Standard section		Arbuckle Mountains
Cincinnatian	Maysville	
	Eden group	Viola limestone
Mohawk	Trenton	
	Black River	West Spring Creek (Criner member)
Chazy	Blount	
	Lenoir	Bromide
	Mosheim	Oil Creek
Buffalo River	Joachim	
	St. Peter	
	Everton	
	King River	
	Sneeds	

Figure 5. Part of Tentative Correlation Chart of Ulrich 1928

In a correlation chart of 1928 Ulrich (Decker 1930, p. 1495) subdivided the Simpson into three formations, Oil Creek, Bromide, and West Spring Creek (with Criner member). The Oil Creek and Bromide were considered Chazyan in age; the topmost West Spring Creek, Black River-Trenton (Fig. 5; and column 7, Fig. 1). The name, West Spring Creek, was abandoned as a Simpson term the following year. Ulrich correctly indicated disconformable relationship of the Simpson and overlying Viola sections.

At the Geological Society of America meeting in New York in 1928 Ulrich (1929a, pp. 85-86) presented in manuscript chart a seven-part subdivision of the Simpson: Joins Ranch, Nebo, Falls, McLish, Tulip Creek, Criner, and Bromide, which Decker (1930, p. 1495) published in 1930. The name, "West Spring Creek," of the previous year's chart was abandoned here (later employed in the Arbuckle section); the Criner member was elevated to rank of formation, in position below the Bromide, rather than above it (as in the 1928 chart). The suffix, Ranch, (of Joins Ranch) is discovered abandoned the following year; and the preoccupied formational name, Nebo, likewise abandoned in favor of Ulrich's previously established name, Oil Creek. Thus, by 1928, the original lower and upper divisions of Taff's Simpson formation have been expanded by Ulrich into seven formations (column 8, Fig. 1).

In 1929 Ulrich (1929b, p. 73) discussed Ordovician trilobites and correlation of American and European Ordovician formations. In his correlation chart the Simpson is again divided into seven formations, with some significant changes observed in comparison with the aforementioned chart of 1928. The Joins Ranch becomes simply Joins; the preoccupied term, Nebo, of Ulrich's 1928 establishment, becomes Oil Creek; McLish precedes the Falls, whereas it succeeded it in the chart of the preceding year; Tulip Creek is followed by the Criner, which is disconformably overlain by topmost Bromide, in turn overlain disconformably by the Viola (Fig. 6; and column 9, Fig. 1).

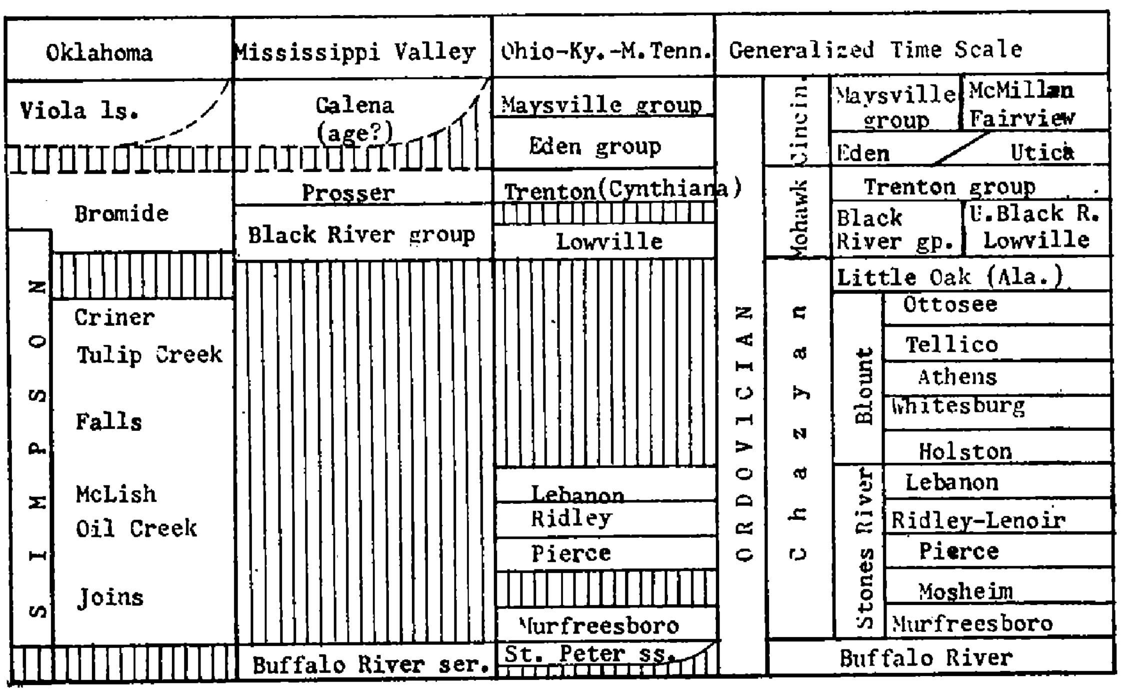


Figure 6. Suggested Correlations of American and European Formations, Ulrich 1929

Ulrich again postulated a Pacific origin for the lower Simpson Joins and Oil Creek fauna; whereas the McLish contains species of the Appalachian Lenoir, thus indicating an invasion from the east. The Falls contains species found only in Nevada and West Texas, again a Pacific invasion. The Tulip Creek compares closely with the Stones River of Tennessee; therefore, held by Ulrich to be an Oklahoma recurrence of a southern Blount fauna that failed to reach central Tennessee. The Criner contains a Blount-Chambersburg fauna. The Bromide has a Black River-Decorah fauna that invaded from the Baltics via Arctic or north Atlantic to interior North America as far as Minnesota and the Arbuckle Mountains.

A minimum of 12 to 15 publications concerning the Simpson may be discovered in various bulletins, journals, and periodicals of 1930, some of which are reviewed as follows:

Decker and Merritt (1930, table) presented an "advance" correlation table of Simpson formations, employing Ulrich's formational names of the preceding year, though omitting the terms, Falls and Criner. Thus, the abbreviated Simpson section of five formations was published for the first time (column 10, Fig. 1). This section of Joins, Oil Creek, McLish, Tulip Creek, and Bromide is more-or-less currently recognized as the standard Simpson section of the Arbuckle Mountains. Decker and Merritt considered the three lower formations Chazyan in age, and the two uppermost, Black River.

Roth (1930, pp. 228-230) reported subsurface Joins fossils from the so-called "Detrital Zone" of the Oklahoma City oil field, and, accordingly, was instrumental in the abandonment of the term, "Detrital Zone". Joins fossils included *Didymograptus artus* Elles and Wood, *Maclurea* sp., *Prioniodus* sp. and other conodonts, and Ostracoda of the genera *Eoleperditia* Swartz and *Leperditella* Ulrich.

Decker (1930, p. 1498) presented a second correlation chart (column 11, Fig. 1) involving the five formations (Joins, Oil Creek, McLish, Tulip Creek, Bromide) of the "advance" chart of the preceding month. A Beekmantown? conglomerate was portrayed at the base. A sixth formation, the Falls (of Ulrich), was assigned a position between the McLish and the overlying Tulip Creek. . .

"Falls is still retained for the western part of the area until it can be determined more definitely whether or not it represents a westward extension of the McLish"; however, in a footnote Decker decreed that the term, Falls, should be abandoned. The four lower formations were considered Chazyan in age (as in previous chart); the age of the Tulip Creek was questionable; and the Bromide was considered Black River-Trenton in age.

Stauffer (1930, pp. 121-128), (1932, pp. 257-264), (1935, pp. 596-620) described and illustrated many species of conodonts from the Decorah shale of Iowa, Minnesota, and Kansas. A few of these occur in the Tulip Creek of Oklahoma. The writer has discovered that *Prioniodus aculeatus* Stauffer particularly is a most trustworthy index fossil of the Tulip Creek, both in outcrop and subsurface.

Cram (1930, p. 263) published a 1500-foot subsurface section of undifferentiated Simpson in the Wichita Mountain area, Kiowa County, Oklahoma. The section involved 40 zones of detailed lithology, with the notation that the 1500-foot thickness may be excessive because of unknown subsurface dip. In comparing the section with that of West Spring Creek the writer postulates five or six feet of Corbin Ranch at the top; Bromide, to the approximate depth of 360; Tulip Creek, to 665; McLish, to 1,120; and an incomplete Oil Creek section, to 1,535.

Edson (1930, pp. 947, 1227) noted in the Oklahoma Simpson subsurface two angular unconformities with which most midcontinent stratigraphers are familiar. One of the unconformities is that separating Tulip Creek and Bromide (post-Chazy-pre-Black River); the other is that between the Bromide and overlying Viola (post-Black River-pre-Trenton). The writer also postulates an erosional hiatus having intervened between Tulip Creek and Bromide; between Bromide and Corbin Ranch; and between Corbin Ranch and overlying Viola. However, the Tulip Creek and Bromide are considered Black River in age; and the topmost Simpson Corbin Ranch is considered Trenton in age.

Decker discussed the Simpson of Arbuckle and Wichita Mountains and presented 12 Simpson sections (1930, tab. 9, 10) (Fig. 7) depicting formational subdivisions, thickness, and lithology. The Simpson was divided into the five standard formations in an east-

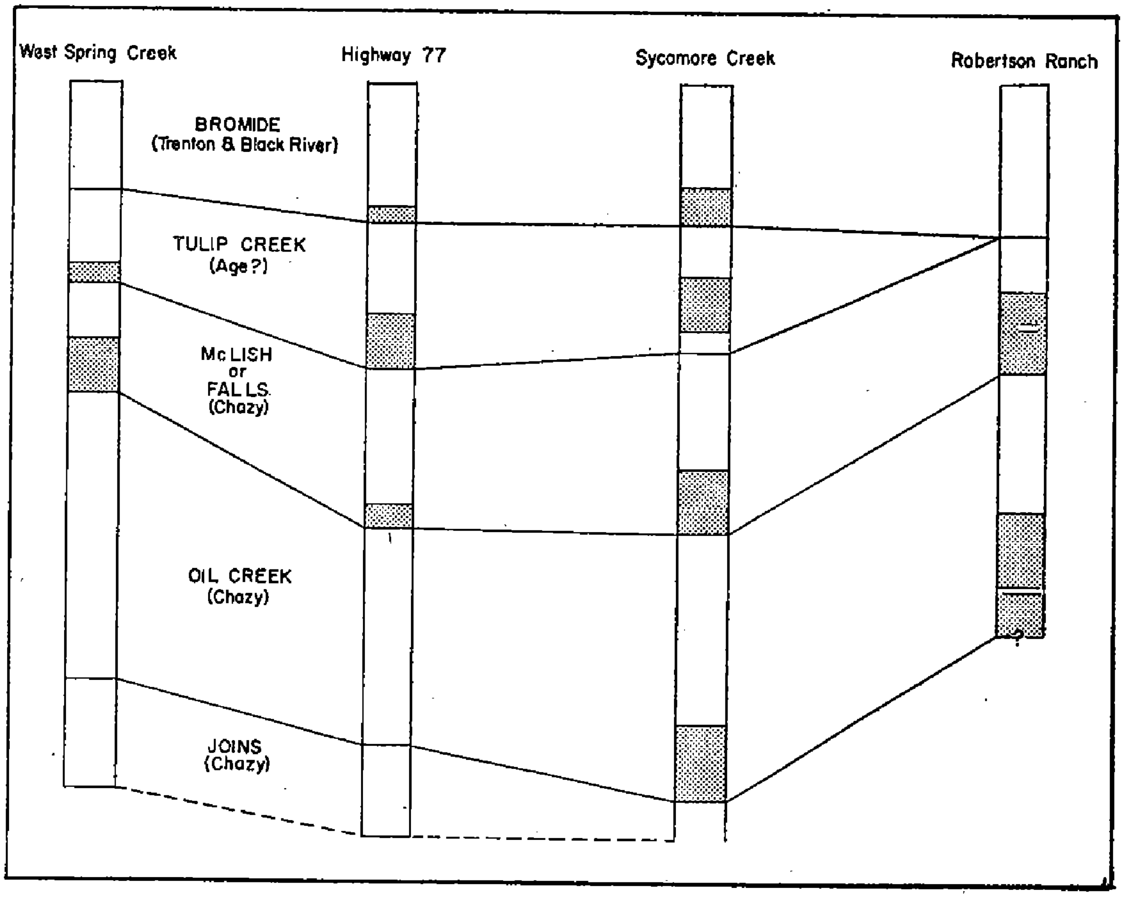


Figure 7. Simpson Sections in the Arbuckle Mountains, Decker 1930

west and two north-south cross-sections involving eleven separate sections. He revealed: (1) the thickest Simpson section in southwestern part of the Arbuckle Mountains in measured sections of West Spring Creek, U. S. Highway 77, and Sycamore Creek; (2) a thickening of Oil Creek sand from 8 feet (at western end) to 200 feet (on Sycamore Creek); (3) in upper Simpson more shales toward western end, with increase of limestones toward the east; (4) typical McLish "birdseye" limestone in north Criner Hills and none of the "birdseye" lithology some 20 miles northward at western end of the Arbuckle Mountains. Decker included a resumé of Simpson research.

Weirich (1930, p. 1512) disclosed that lateral gradation and southward divergence of Simpson subsurface strata are distinguishing characteristics of the section. Lithologically the exposures of the Arbuckles cannot be correlated southwestward with the subsurface section of Stephens County, or northeastward into the

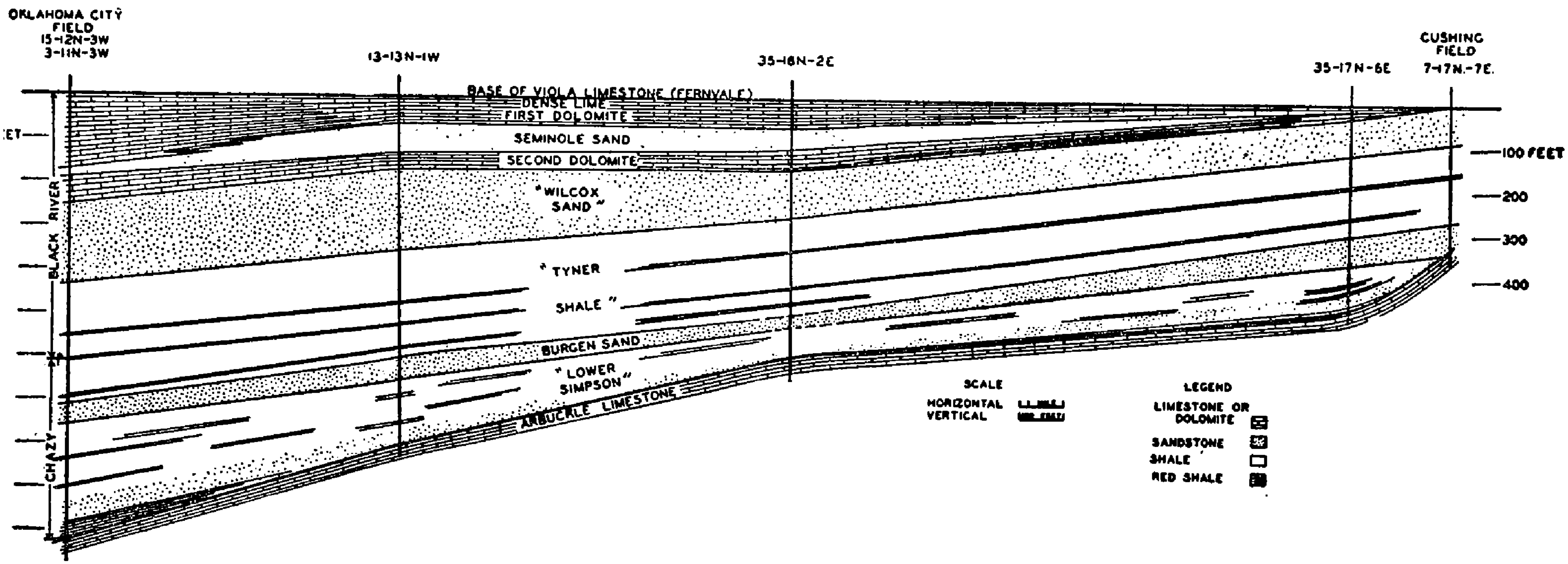


Figure 8. Subsurface Simpson from Oklahoma City to Cushing Field, Weirich 1930

Seminole district. The Oklahoma City section can be correlated with that of Creek County, provided one includes additional lower Simpson (pre-Burgen) section not present in Creek County. Complete erosion in northeastern and southwestern Oklahoma prevents determination of Simpson thickness, though the section is known to vary from 200 feet (near the Arkansas River) to 2,400 feet (on southeastern rim of the Arbuckle Mountains). An isopachous map of the Simpson is included revealing the Simpson missing in the Ozark region of northeastern Oklahoma and in the section overlying the Texas Peninsula (Adams 1954, p. 9) of southwestern Oklahoma, and thickening to 2,400 feet in the Arbuckle basin.

An excellent cross-section of the subsurface Simpson from Oklahoma City to Cushing field discloses the entire Simpson section thinning updip, and the "Lower Simpson" disappearing beneath onlap at Cushing (Fig. 8). Weirich employed the subsurface Simpson terms (ascending): "Lower Simpson", Burgen sand, Tyner shale, "Wilcox sand", Second dolomite, Seminole sand, and First dolomite.

Charles (1930, p. 1522) presented data concerning the Simpson of the Oklahoma City oil field. His illustration of the buried structure, with a prominent fault on the eastern side, revealed 670 to 755 feet of Simpson strata resting upon the Arbuckle limestone. The Simpson section consists of (ascending): sandy dolomite, Johnson-Kinter sand, undifferentiated lower Simpson, and "Wilcox" sand.

In June 1931 Decker and Merritt (with Ostracoda descriptions by Harris) published their excellent treatise on the Simpson group of Oklahoma, currently the most practical and authentic handbook of Simpson stratigraphy. Herein the group is divided into the five formations more-or-less standard in current usage: Joins, Oil Creek, McLish, Tulip Creek, and Bromide (column 10, Fig. 1). The formations are described in stratigraphic and paleontologic details, and megascopic and microscopic faunas are listed and/or illustrated. Nine detailed Simpson sections from the Arbuckle and Wichita Mountains were measured, zoned, and described; detailed mineralogical and ostracodal content of the formations were included. An east-west cross-section (1931, p. 16) depicted variation in thickness of Simpson formations in opposite ends of the mountain. No Tulip Creek was portrayed in the eastern part of the mountains, though it has since been recognized in that area. Fourteen species of Ostracoda and two conodonts are described and illustrated.

Before the Geological Society of America convention in December 1932 Ulrich (1932, chart) presented a Simpson chart, though it was not published (Edson 1935, p. 1122) until August 1935 (Fig. 9; and column 12, Fig. 1).

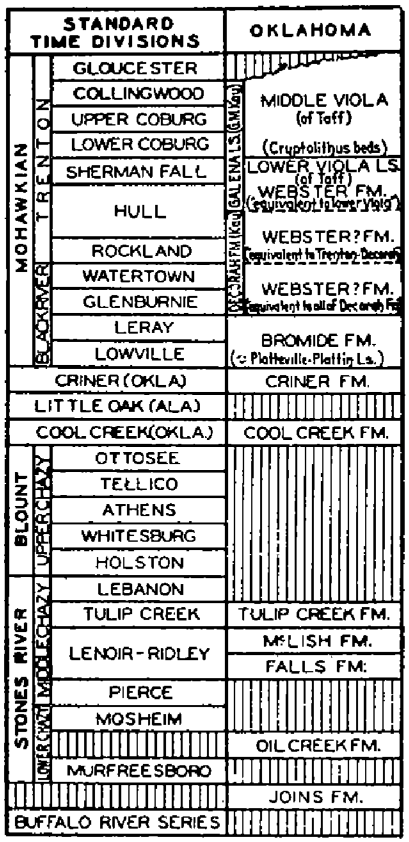


Figure 9. Simpson Group Divisible into Eight Formational Units, Ulrich 1932

In this chart Ulrich divided the Simpson group into eight formations, plus an additional new formation, the Webster, added above the Bromide, "for beds of late Black River and early Trenton age . . . . . beds that correlate with the Decorah of Minnesota and with Taff's lower Viola." In assigning the Webster to the stratigraphic position directly overlying the Bromide ("equivalents of Platteville-Plattin limestone"), then it follows that Ulrich's topmost Simpson Webster included the calcareous shales and dense limestones at the top of the section, the Corbin Ranch formation of this publication.

Reeside (1933, pl. 2) compiled for the 16th Geological Congress the stratigraphic nomenclature of the United States, based essentially upon a correlation chart by Josiah Bridge (column 13, Fig. 1).

The Simpson, with unconformable relationship with both the subjacent Arbuckle and superjacent Viola, was subdivided into Joins, Oil Creek, McLish, Tulip Creek, and Bromide. The Joins, Oil Creek, and McLish are Chazyan; Tulip Creek and Bromide, lower Black River, and correlative with Plattin-Platteville and Lowville. Of interest is the fact that the topmost Bromide is not considered within the Simpson Group.

Ulrich (1933, pp. 105-106) divided the Simpson group into eight formations (ascending): Joins, Oil Creek, Falls, McLish, Criner, Cool Creek, Tulip Creek, and Bromide. The Joins and Oil Creek were considered lower Chazyan in age; Falls and McLish, middle Chazyan; Tulip Creek, Cool Creek, and Criner, significantly without correlative counterparts outside Oklahoma; and Bromide, typically Plattin-Platteville of Missouri and Minnesota, and Lowville of Tennessee and Kentucky (all lower Black River).

Zavoico (1934, p. 423), in discussing the subsurface geology and geologic history of the Lucien oil field, mentioned innumerable minor unconformities in the subsurface Simpson section . . . . . . "probably as many as 40." The following Simpson section was presented:

Simpson dense limestone	0-20
Simpson dolomite	0-40
First Simpson or First Bromide sand	40-60
Marshall Green shale zone	5-160
Second Simpson or Second Bromide sand	80-100
(Including "Wilcox" sand at base)	

Bassler and Kellett (1934, p. 48) divided the Simpson group into eight formations (column 14, Fig. 1): Joins, Oil Creek, Falls, and McLish (all Chazyan in age), preceding the Black River Tulip Creek, Cool Creek, Criner, and Bromide (all Black River). Correlation charts and Ostracoda faunal lists of Ordovician (and other) strata were incorporated. Simpson Ostracoda published by Harris (1931, pp. 87-95) were listed.

Edson (1935b, table) presented essentially the same Oklahoma Simpson correlation table in the Bulletin of American Association of Petroleum Geologists (column 15, Fig. 1), as in the Kansas Ninth Annual Field Conference Guidebook (1935a, table). In both charts the Joins was portrayed in unconformable relationship with the Arbuckle and was designated pre-Chazyan in age. The Oil Creek was designated Chazyan in both charts. In the guidebook the McLish was designated "upper Chazyan", and essentially the same in the bulletin ("with Black River affinity"). The Tulip Creek was omitted, and the Bromide was depicted as Black River in both charts. The Webster of Ulrich was designated lower Viola Trenton in the subsurface of Oklahoma, and Black River-Trenton in outcrop (Kansas guidebook). An "un-named member of lower Prosser age" was depicted overlying the Webster, though beneath the Viola of the Arbuckle Mountains.

In the chart of the bulletin Edson included Ulrich's Simpson section as established in 1932 (Edson 1935b, p. 1122). This section included Joins, Oil Creek, Falls, McLish, Tulip Creek, Cool Creek, Criner, Bromide, and Webster.

That Edson was confused (as is the writer) regarding the exact stratigraphic position that Ulrich had visualized for the Webster is indicated in the chart of the bulletin, in which several possibilities are postulated, one of which involves correlation with the aforementioned "un-named lower Prosser" unit beneath the Viola. The Corbin Ranch (this publication) undoubtedly represents Edson's "un-named formation of lower Prosser age"; it is also the topmost unit of Ulrich's Webster (pre-empted).

Decker (1935, pp. 239-243) in discussing Simpson graptolites, again portrayed a five-fold subdivision of the Simpson group and presented significant graptolitic correlations.

He stated that all five formations are present in the western part of the Arbuckle Mountains, but Joins and Tulip Creek were portrayed wedging out in the central part of the mountains, thus resulting in but three members in the extreme eastern end (he later amended this viewpoint to include Tulip Creek in the eastern end of the mountains).

Graptolites have been reported from Arbuckle, Joins, Bromide, Viola, Sylvan, and Henryhouse formations. Only two horizons of the Simpson have produced graptolites, one near the base of the Joins, the other, near the top of the Bromide. A two- to eight-inch zone of *Didymograptus artus* Elles and Wood occurs from

42 to 102 feet above the base of the Joins in the Arbuckle Mountains and in the Criner Hills, and at a depth of 6,302 feet in Foster No. 1 oil well at Oklahoma City. *Diplograptus maxwelli* Decker, originally described from a Bromide locality west of Nebo store, was also recovered from the Bromide at Rock Crossing in the Criner Hills. *Didymograptus artus* Elles and Wood together with *D. bifidus* (Hall) effect correlation of lower Joins with Black Rock of Arkansas, Deepkill of New York, Chazy of Nevada, middle and upper Arenig of British Isles, and lower Ordovician of Australia, Baltics and Bohemia. The *D. maxwelli* Decker zone relates the Bromide of Criner Hills, Nebo, and Sycamore Creek areas.

Decker (1936, pp. 301-311) stated that the zone of *Didymograptus artus* Elles and Wood, reported as provisional topmost Arbuckle Beekmantown by Ulrich (1911, p. 663), is actually lower Joins Beekmantown, and is associated with the well-known *D. bifidus* (Hall) of America, Great Britain, Europe, and Australia. He later portrayed the Joins as Chazyan in age. *Diplograptus maxwelli* Decker and *Dicellograptus mensurans* Ruedemann were listed from the upper Bromide and basal Stringtown of Oklahoma, the Womble of Arkansas, and basal Normanskill of New York.

Ireland in August 1936 published results of insoluble residue research with pre-Mississippian strata of Oklahoma. Six zones (insoluble residue) were described in the interval of Fernvale, Simpson "Dense", Bromide, to Tulip Creek; and upon the basis of the study he correlated (1936, tab. 1) the subsurface "Wilcox" and overlying green shales with the Burgen and Tyner, respectively; and the Bromide "Dense" with the Fite of northeastern Oklahoma outcrop (Fig. 10) (Ireland was the first to correlate the "dense" with the Fite), an age of Black River was assigned the upper Simpson Tulip Creek and Bromide, and the age of Chazy was assigned the Joins, Oil Creek, and McLish (Fig. 11).

Decker (1936b, pp. 1252-1257, table 1) again indicated an age of Beekmantown for Joins formation; Chazyan for Oil Creek and McLish; and Black River for Tulip Creek and Bromide (Fig. 12).

In November 1936 Decker and Harris displayed zones, thickness, and lithology of the West Spring Creek Simpson section (Okla. Geol. Surv., Bull. 55, Table 3). Some three dozen species

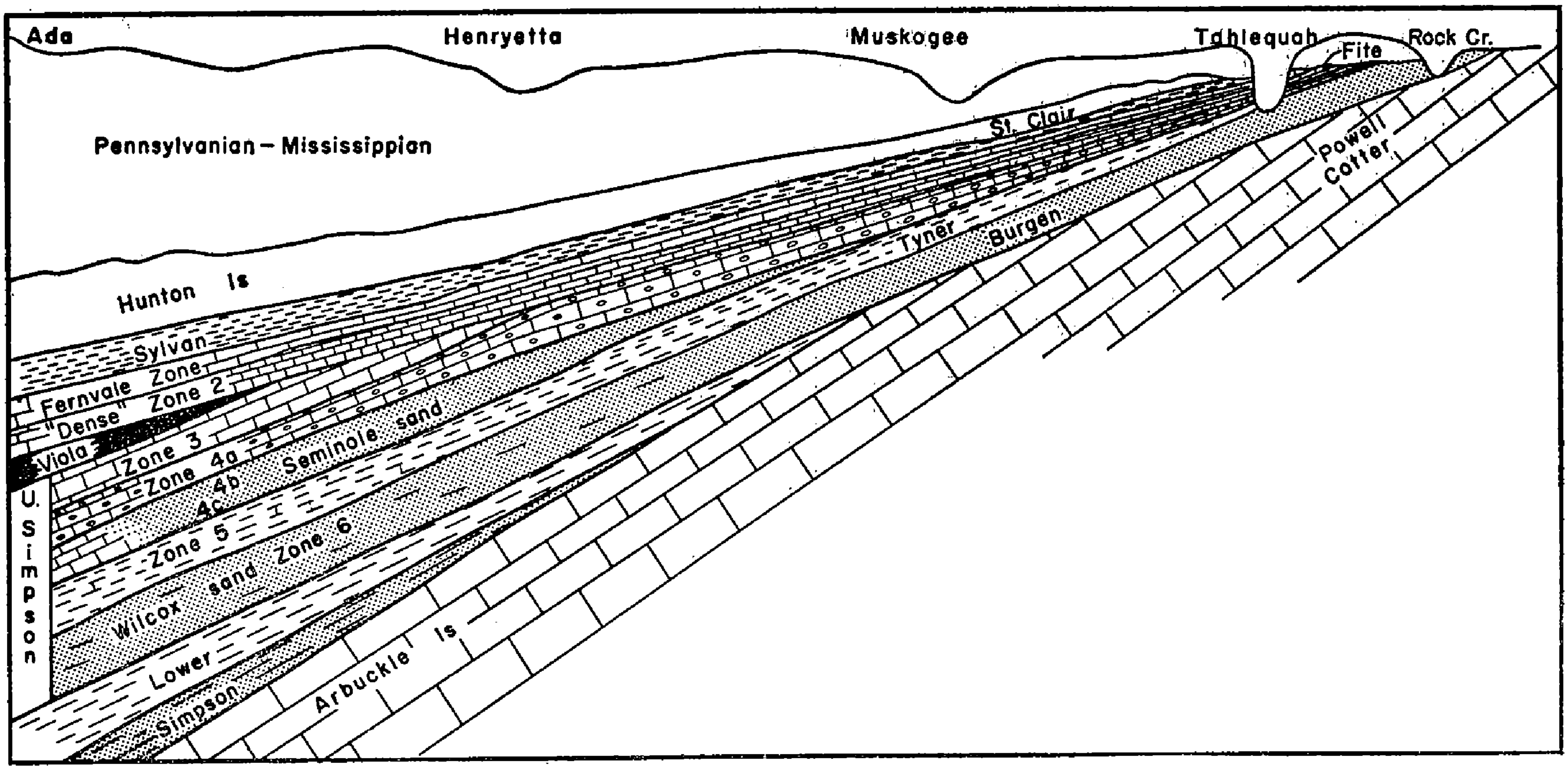


Figure 10. Diagrammatic Section from Ada, Oklahoma to Arkansas Line, Ireland 1936

Age		Arbuckle Mountains	Central Okla. (Subsurface)	Subsurface by Residues	S. W. Ozark Region	S. E. Missouri
Mississippian						
Upper Devonian						
Middle Devonian	Hamilton					St. Laurent ls. Beauvais ss.
	Onondaga				Sallisaw ss.	Grand Tower ls.
Lower Devonian	Oriskany	Frisco ls. Bois d'Arc	Hunton fm.	Bois d'Arc ls.	Frisco ls.	Little Saline ls.
	Helderberg	Haragan ls. and sh.		Haragan ls.		Bailey ls.
Upper Silurian						
Middle Silurian	Niagara	Henryhouse ls. and sh.	Hunton fm.	Henryhouse ls.	St. Clair ls. (marble)	Bainbridge ls.
Lower Silurian	Alexandrian	Chimney Hill ls.		Chimney Hill ls.		Brassfield ls. Edgewood ls. Girardeau ls.
Upper Ordovician	Richmond	Sylvan sh.	Sylvan sh.	Sylvan sh.	Sylvan sh. (not exposed)	Maquoketa sh.
		(Fernvale)	Fernvale ls.	Fernvale ls. zone 1	Fernvale ls.	Fernvale ls.
		Viola ls.		Fite ls. "Dense" zone 2.	Fite ls.	
Middle Ordovician	Trenton					Kimmswick ls.
	Black River	Simpson fm. Bromide fm.	Simpson fm. "Dense" 1st. Dol. Seminole sd. 2nd. Dol. "Wilcox" sd.	Bromide fm. zone 3. zone 4. zone 5. zone 6.	Tyner fm.	Decorah fm.
		Tulip Cr. fm.			Burgen ss.	Plattin ls.
	Chazy	McLish fm. Oil Cr. fm. Joins fm.	Lower Simpson	McLish fm. Oil Cr. fm.		Joachim ls. St. Peter ss. Everton ls.
Lower Ordovician	Beekmantown (Canadian)	Arbuckle ls.	Arbuckle ls.	Arbuckle ls.	Cotter dol.	Powell ls. Cotter dol. Jeff. City dol. Roubidoux fm. Gasconade dol.
	Ozarkian				?	Proctor dol. Eminence dol. ? Potosi dol.
Upper Cambrian		Reagan ss.				Derby-Doerun dol. Davis dol. Bonneterre dol. ? Lamotte ss.
Middle and Lower Cambrian						
Pre-Cambrian		Tishomingo granite			Spavinaw granite	Pre-Cambrian

Figure 11. Use of Insoluble Residues for Correlation in Oklahoma, Ireland 1936

of Ostracoda were illustrated and their stratigraphic ranges indicated in the Bromide and Tulip Creek sections.

Decker and Harris (1937, section) displayed for a field conference the Norris Ranch, Oklahoma Highway 48 (now 99), and subsurface Fitts oil field Simpson sections. Some 75 Ostracoda were illustrated and their ranges indicated through the Oklahoma Highway 48 (now 99) section.

Thompson (1937, pl. B) portrayed in cross-section (Caddo County, Oklahoma, to Gulf of Mexico) undifferentiated subsurface Simpson tilted against both flanks of the Wichita Mountains.

Cordry (1937, p. 1575) reported in Gulf Oil No. 1 Waddell, Sec. 4, Blk. B-27, Crane County, Texas, a Simpson section in the interval of 5,875 to 6,316 feet. In this section three Simpson Ostracoda were observed, *Paraschmidtella perforata* (Harris) Swartz, *Schmidtella* sp., and *Cryptophyllus* sp.

Period		Arbuckle Mts., Oklahoma (Texas)	Ouachita Mts. and eastward, Oklahoma and Arkansas	Indiana	Wisconsin, Minnesota	Eastern New York	Great Britain
Silurian		Henryhouse shale	Blaylock sandstone	Mississinewa shale			Lower Ludlow Upper Birkhill Middle Birkhill
Ordovician		Sylvan shale	Polk Creek	Richmond	Maquoketa		Upper Hartfell
Ordovician		Fernvale Viola	---?----?---- Big Fork chert Stringtown-Womble			Lorraine Utica Trenton Black River Normanskill	Lower Hartfell Upper Glenkiln
Ordovician	Simpson	Bromide Tulip Creek McLish Oil Creek				Chazy	
Ordovician	Simpson	Joins	Black Rock limestone			Beekmantown-Deepkill	Upper Arenig-Skiddaw
Ordovician Cambrian	Arbuckle Ls.	780-900-foot zone (Marathon fm., Texas) ---?---?--- 4600-foot zone 7,000 - 8000 feet thick	Smithville limestone		Trempealeau	Deepkill	Skiddaw (subzone C of *D. extensus*) Tremadoc

Figure 12. Tentative Lower Paleozoic Correlation on Basis of Graptolites, Decker 1936

Cullison in May 1938 presented descriptions and illustrations of some Dutchtown fossils of Missouri, including the ostracode, *Isochilina varians* Cullison (1938, p. 225). Cullison considered the Dutchtown within the Buffalo River group; the conodonts perhaps older than those of the Simpson Oil Creek of Oklahoma.

Loeblich (1938, thesis) described 15 species of Bryozoa from Arbuckle Mountain McLish outcrops and concluded that they displayed no positive indication of Black River age . . . . possibly Chazyan, though without recognizable species previously described from Chazyan strata. Type sections for Ulrich's Falls and McLish formations were presented in detailed thickness and lithology. Though unpublished, the thesis constitutes a valuable tool of Simpson research.

Boyd (1938, p. 1563) presented a detailed subsurface Simpson section of Pontotoc and Coal Counties, Oklahoma; the section involved 370 feet of Oil Creek, 540 feet of McLish, and 210 feet of Bromide.

Mohr (1939, p. 1703) in a cross-section involving subsurface strata from Texas to Nebraska revealed the Simpson of Oklahoma and Kansas pinching out against the south side of the Barton Arch in Pawnee County, Kansas, and also a very thin Simpson section in Nebraska pinching out at the Kansas line on the north side of the Barton Arch.

DeFord and Lloyd (1940, figs. 1-2) published for the West Texas-New Mexico symposium a detailed index map portraying the regional structure of Oklahoma, Texas, and New Mexico. A five-column correlation chart for as many areas of West Texas and New Mexico portrayed the Simpson correlative with the El Paso of the Delaware Basin, and the Fort Peña of the Glass Mountains. Ostracoda indicate Oil Creek age for the Fort Peña.

Fritz and Fitzgerald (1940, p. 20) presented a cross section involving the subsurface Simpson of West Texas and New Mexico. Attention was directed to the similarity of the Simpson of West Texas and Oklahoma in the frosted sand grains, green and maroon shales, and interbedded limestones and dolomites, plus the fact of similar fossils. The Simpson section ranged in thickness from 25 to 1,270 feet in the cross-section.

Powers (1940, pp. 122-125) reported subsurface Simpson in the Sand Hills area of West Texas. Photograph and description of Ellenburger-Simpson contact reveals dolomite in contrasting contact with shale, respectively; though Powers observed no evidence of erosion at the contact. Detailed lithology of four Simpson Zones (involving 15 beds) through some 1,200 feet of section is included. *Didymograptus* sp. at the base of the section suggests the possibility of Joins, though no formational breaks were indicated in the article.

Decker (1941, pp. 650-667) presented an excellent summary of Simpson stratigraphy, including reasons for discarding the term, Falls. Six detailed measured sections (including revised West Spring Creek and Oklahoma Highway 99) were presented, with zones and thickness. A nine-column chart portrayed comparative proportionate amounts of basal sand and "birdseye" limestone. Finally, a graphic east-west cross-section of the Simpson depicts the section thrice as thick at the western end of the mountains as at the eastern end (Fig. 13; and column 16, Fig. 1). Some Tulip Creek was recognized in the eastern part of the mountains, where he had reported none previously.

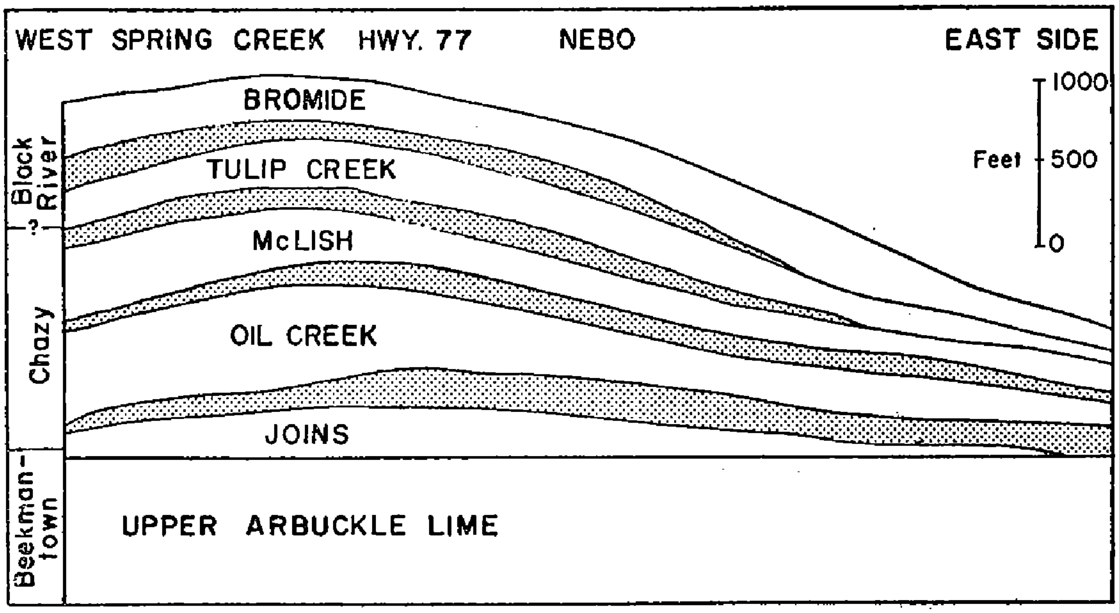


Figure 13. Graphic Section of Simpson Group in the Arbuckle Mountains, Decker 1941

Decker (1941b, p. 154) correlated the Mazarn shale and overlying Blakely sandstone of the Ouachita Mountains with topmost Arbuckle (West Spring Creek) of the Arbuckle Mountains, with Beekmantown of New York, and with Levis of Quebec. The Stringtown-Womble and Big Fork chert were correlated with lower Viola. No correlative unit of the Simpson was depicted in the Ouachita section of his chart, though the occurrence of Stringtown-Womble or Big Fork graptolites in lower Viola or upper Bromide is suggestive of contemporaneity. The Patterson Ranch Group was established for Viola, Fernvale, and Sylvan formations.

Loeblich (1942, p. 416) described 31 species of Bromide Bryozoa and presented the detailed type section of the formation, with thickness and lithology of 15 numbered beds. He considered the Bromide as the uppermost formation of the Simpson group of Ordovician age cropping out in Arbuckles, Wichita Mountains, and the Criner Hills of Oklahoma. He concluded that the bryozoan fauna of the Bromide closely resembles that of the Decorah of Minnesota, and, accordingly, is Trenton in age (provided the Decorah is of Trenton age).

King et al (1942, pp. 542-543) reported the subsurface Ellenburger of West Texas conformably overlain by the Simpson. The Simpson, varying in thickness from 880 to more than 1,850 feet, rests upon the Ellenburger with lithologic, but without erosional, break. Three persistent limestone members (basal, middle, and upper) are separated by thin sands, green shales, and limestones. The Simpson of the South Permian Basin and of Oklahoma were deposited in waters connected through the Llanorian geosyncline, but not across the Texas Peninsula.

Branson and Mehl (1943, pp. 374-387) reported some three dozen conodonts from basal Viola and Simpson outcrops along Oklahoma Highway 48 (now 99), three miles south of Fittstown. The basal Viola contains seven Plattin conodonts. The upper Bromide, 20 feet below the top (Decker Zone 15), and the "lower Bromide" (actually Tulip Creek from Decker Zone 48), 65 feet above top of the McLish, contains at least a half dozen species in common with the Joachim of Missouri; three, in common with Plattin. Ten or twelve topmost McLish species (Decker Zones 66 to 68) were described, four of which occur in the Dutchtown of Missouri, and one in the Harding of Colorado.

Ireland (1944, chart) presented an excellent cross-sectional study of Arbuckle (pre-Simpson) lithology in 21 wells across northeastern Oklahoma, southeastern Kansas, and western Missouri. Detailed lithology (with insoluble residue emphasis) and correlation of Arbuckle formations are displayed. Undifferentiated Simpson is indicated in several wells of Creek and Tulsa Counties, Oklahoma, some 300 feet of Simpson sandstone, green shale, and sandy dolomite being recorded in Central Commerce No. 3 Hay well in Creek County, with unconformable relationship with the subjacent Powell and the superjacent Chattanooga.

In discussing the geology and glass sand resources of the Arbuckles Ham (1945, tab. 1) recognized the five more-or-less standard formations of the Simpson group: Joins, Oil Creek, McLish, Tulip Creek, and Bromide; the Joins with basal conglomerate, and the four upper members with basal sands. The Oil Creek, McLish, and Bromide outcrops extend throughout the Arbuckle Mountains, but Tulip Creek and Joins are best developed in the western and southern parts of the Arbuckle anticline. An excellent description of the five Simpson formations (with sand emphasis) is presented; structural map of the Arbuckle Mountains is sketched, and seven local areas are discussed in detail; overthrust klippen masses explain Simpson outcrops in the Belton anticline and Sulphur syncline.

Berry and Harper (1948, p. 216) reported a maximum of 75 feet of subsurface Simpson in the Augusta Field of Butler County, Kansas.

Carver (1948, pp. 327, 332) subdivided the subsurface Simpson section of Oklahoma and Logan Counties and directed attention to the fact that though progressive thinning (over structure) obtained between Viola and "Second Wilcox", such thinning was most pronounced in the Marshall zone of the Simpson, and least pronounced in the topmost "Dense". He portrayed the following Simpson sections:

"Dense limestone"
"Dolomite"
"First Wilcox" sandstone
"Marshall zone"
"Second Wilcox" sandstone
Lower Simpson

Cram (1948, pp. 344-348) presented a detailed subsurface Simpson section of the Cumberland oil field of southern Oklahoma:

Bromide (Black River-Trenton)	630
McLish (Chazy-Crown Point)	500
Oil Creek (Lower Chazy)	860
Joins (Lower Chazy)	210
Total	2,200

Cram mentioned that the lower half of the Cumberland Bromide section (the section below the first sand) is the Tulip Creek of the Arbuckle Mountains outcrop. He considered it practical and logical to include it as an expanded basal Bromide sandstone section, since the significant stratigraphic break occurred at the base and not at the top; furthermore, it is the same age (Black River) as the Bromide. A significant citation of Cram's report is that involving 400 feet of basal Oil Creek sand.

Wengard (1948, p. 2183) zoned the Fernvale and Viola limestones on the basis of insoluble residues and published correlative chart displaying the more-or-less standard five Simpson formations: Joins, Oil Creek, McLish, Tulip Creek, and Bromide. The accompanying chart depicts the Oil Creek extending into Oklahoma as the correlative equivalent of the Burgen and Tyner; McLish and Bromide are depicted as successive southward offlaps.

Decker (1951a, p. 913) published a table of graptolite zones in the Ordovician of the Arbuckle Mountains (column 17, Fig. 1). Of the five more-or-less standard Simpson formations, the Joins, Oil Creek, and McLish were considered Chazyan; the Tulip Creek and basal third of the Bromide, Black River; and upper two-thirds of the Bromide and lower three-fourths of the Viola, Trenton . . . and exact age of the Athens shale. Decker listed graptolites of the Arbuckle, Simpson, and Viola formations. He also listed from the Tulip Creek the conodont, *Prioniodus aculeatus* Stauffer, and three Ostracoda, *Cryptophyllus simpsoni* (Harris) Levinson, *Primitiopsis bassleri* Harris, and *Schmidtella* sp. cf. *S. affinis* Ulrich.

Decker (1952a, pp 100, 136) published his report concerning Athens graptolites. He reported Bromide outcrops at the northwestern edge of the Ouachita Mountains, in sec. 29, T. 1 S., R. 12 E., along the north bank of Muddy Boggy Creek. The table of Simpson formations of the previous year (column 17, Fig. 1) was reprinted, and explanations offered for assigning the major part of the Bromide to Trenton, rather than to Black River: (1) the presence of three Athens (Trenton) graptolites in the upper Bromide; (2) conclusions by Loeblich (1942, p. 417) to the effect that Bromide Bryozoa appear Trenton in age, and closely allied to Decorah (Trenton?) of Minnesota; (3) that Trenton forms of *Ischadites* Murchison and *Receptaculites* Defrance occur in the Bromide; (4) observation by Willman and Templeton of the Illinois Geological Survey that several Bromide fossils are definitely of Trenton age. Decker also postulated an age of Trenton for the Plattin and Platteville formations, since *Diplograptus maxwelli* Decker, a Bromide and Athens (Trenton) graptolite, occurs therein.

The electrical strip log is an excellent implement for subsurface interpretation. During the past ten years increased proficiency in electrical logging and in the technique of interpreting the relationship, lithology, thickness, hardness, porosity, and content of subsurface strata by means of the electrical strip log has proved for the petroleum industry most practical in facilitating accurate subsurface research.

During the past several years the Oklahoma City and Tulsa Geological Societies in monthly issues (and in Digests) have published many research articles by practicing geologists, as well as theses by graduate students of Oklahoma's universities. The majority of the aforementioned publications were based essentially upon electrical log subsurface studies of oil fields or counties of Oklahoma. Simpson subsurface sections in various parts of the state are involved, some of which are reviewed among the references that follow.

Lang (1951, p. 7) portrayed some 2,000 feet of undifferentiated subsurface Simpson in an electrical log cross-section from Granite (Wichita Mountains) across the ancestral Anadarko Basin to Elk City. A pre-Pennsylvanian paleogeologic map reveals a Simpson band cropping out for more than a hundred miles along the southern flank of the Anadarko basin. Sandstones of this Simpson band constitute a potential objective for drilling to the depth of 23,000 to 25,000 feet.

Maher (1951, p. 128) records subsurface Simpson in easternmost Baca County, Colorado, that has not yet been traced to the Front Range. Nevertheless, the Harding sandstone (between the Fremont limestone and overlying Manitou limestone) is correlated with a part of the Simpson group, which it resembles lithologically.

Montgomery (1951, pp. 137-168) summarized geologic research of northeastern Oklahoma; expressed uncertainty concerning the exact age of the Burgen; considered upper Tyner of Blackriverian age; Fite and overlying Fernvale, of Viola age.

Sears in 1951 reveiwed the definition, history of development, stratigraphy, and geologic history of the Hollis Basin (south of Wichita Mountains), and portrayed 350 feet (1951, chart) of undifferentiated Simpson shale and limestone.

Frost and Crockett (1951, p. 18) listed four producing Simpson sands of the East Pauls Valley anticline:

First Bromide sand
Second Bromide sand
First McLish sand
Oil Creek sand

Wheeler (1951, pp. 4-17) presented geologic history, stratigraphy, paleogeologic study, and oil possibilities of the Anadarko basin, involving mid-Ordovician Simpson Oil Creek, McLish, and Bromide subsurface sandstones.

Bale and Williams (1951, pp. 18-20) discussed the oil pools of the buried Nemaha Ridge of north central Oklahoma, and presented the following Simpson section:

Mohawkian
- Trenton
- Bromide (Wilcox of northern Oklahoma)
- Tulip Creek (Hominy, Burgen, and Tyner)
- McLish

Chazyan
- Oil Creek
- Joins

Simpson

Decker (1951b, pp. 2431-2432) reported 16 species of graptolites from cores (dip 42 degrees) in the interval 9,106 to 9,107, and 9,111, in the State's Taylor well, sec. 31, T. 9N., R. 21 W., Beckham County, Oklahoma. Some 150 feet of Bromide Simpson and 150 feet of subjacent undifferentiated strata were penetrated ere the bit re-entered the lower Viola.

Huffman (1951, p. 115), in discussing the geology of the Ozark uplift, portrayed in a correlation chart the relationships of Burgen, Tyner, and Fite formations. The Burgen (0 to 100 feet) was reported Chazyan in age; the Tyner, essentially Blackriverian; and the Fite, Blackriverian, Nine columnar sections involving pre-Atokan strata (Cotter to Bloyd) are incorporated in a cross-section of the Ozark area from T. 19 N., R. 20 E., to T. 13 N., R. 23 E.

Decker (1952b, pp. 160-163) described several graptolite species from the Million shale of Kentucky, including *Diplograptus maxwelli* Decker, an upper Bromide species, and *Climacograptus typicalis* Hall var. *crassimarginalis* Ruedemann and Decker, a species commonly appearing in "nearly every section of the Viola limestone measured." Decker concluded that the Million shale is Trenton in age and correlative with the upper Bromide and lower Viola of Oklahoma, the Galena of Wisconsin, and Athens shale of the Appalachian Valley.

Disney, (1952, pp. 5-17) displayed details of subsurface Simpson in central Oklahoma in an electrical log cross-section of Cleveland and McClain Counties. Subsurface Simpson sections for northern, central, and southern Oklahoma were included (Fig. 14).

Northern Oklahoma	Central Oklahoma		Southern Oklahoma
Simpson Dense	Simpson Dense	(25)	Bromide Dense
Simpson dolomite	Simpson dolomite	(70)	Bromide dolomite
First Wilcox sand	First Wilcox sand	(12)	sandy dolomite
Second Wilcox sand	Second Wilcox sand	(240)	First Bromide sand
Tulip Creek fm.	Tulip Creek shale	(70)	Tulip Creek shale
	Tulip Creek sand	(50)	Tulip Creek sand
McLish formation	Upper McLish series	(210)	Upper McLish sand
			Middle McLish sand
	McLish sand	(40)	Lower McLish sand
Oil Creek fm.	Oil Creek shale and limestone	(150)	Oil Creek limestone
			First Oil Creek sand
	Oil Creek sand	(75)	Second Oil Creek sand
Joins formation			Joins sand
	Joins dolomite	(50-75)	Joins limestone

Figure 14. Tabulation of data from Disney 1952, Subsurface Simpson Correlations

Dannenberg (1952, pp. 9-10) recognized the following Simpson section in Coal County, Oklahoma: (electrical log study)

Bromide	Bromide dense	(60)
	Simpson dolomite	
	Bromide sand	(195)
McLish	Dense limestone and dolomite	(290)
	McLish sand	(110)
	Basal McLish ls., dol., sh., sd.	(140)
Oil Creek	Limestone, dolomite, shale	(240)
	Basal Oil Creek sand	(130)
Joins	Joins dolomite and sand	(63)

Hayes (1952, pp. 5-24) presented with the aid of electrical log strips a Comanche County, Oklahoma, subsurface Simpson section exceeding 2,000 feet in thickness, and reported three Ostracoda in the Oil Creek section of the area, *Leperditella bulbosa* (Harris), *Cryptophyllus magnum* (Harris) Levinson, and *Paraschmidtella perforata* (Harris) Swartz:

Bromide (463)	Dense limestone	(90)
	Green Shale	
	1st Bromide sand	(50-140)
	2nd Bromide sand	(120)
Tulip Creek (275)	Tulip Creek shale	(185)
	Tulip Creek sand	(90)
McLish (420)	McLish shale	(135)
	McLish sand	(105)
	McLish sdy sh., sh., ls.	(185)
Oil Creek (650)	Oil Creek limestone	
	Oil Creek lmy. sh. & sdy. sh.	
Joins (300)	Dolomite and limestone	

Atkinson (1952, fig. 3) reported from electrical log study subsurface Simpson strata tilted against the flanks of the pre-Pennsylvanian anticlinal fold of South Palacine field in Stephens County, Oklahoma. The five more-or-less standard Simpson formations are involved.

Grimes (1952, p. 10) reported 90 feet of undifferentiated Simpson shaly white dolomitic sands with shale and dolomite beds in Beaver County, Oklahoma, become thinner northwestward.

McKinney (1953, p. 7) recorded a Logan County, Oklahoma subsurface Simpson section as follows: (electrical log study)

Dense limestone	(13)
Dolomite	(10-25)
1st Wilcox sand	(40)
Marshal zone (sh., dol., ls.)	
2nd Wilcox sand	

Moore (1953, section) presented an electrical log cross-section involving the five more-or-less standard Simpson formations from Arbuckle Mountain outcrop to subsurface of Cleveland County, Oklahoma . . . the section thinning from the mountain outcrop thickness of 2,200 feet to 1,000 feet in Cleveland County.

Akmal (1953, p. 8) reported approximately 400 feet of subsurface Simpson section from Lincoln and Payne Counties, Oklahoma:

Dense lithographic limestone	(10)
1st dolomite	(less than 10)
1st Wilcox shaly sand	(5)
Marshall or 2nd dolomite	(15)
2nd Wilcox sand	(135)
Tyner green shale	(220)

Powell (1953, p. 12) reported with the aid of electrical logs some 600 feet of undifferentiated (upper ?) Simpson dolomite in the subsurface of Woodward County, Oklahoma.

Ham (1954, pp. 200-203) reported that the McLish of the Arbuckle Mountains is composed of a 50- to 250-foot basal sandstone member and an upper 100- to 400-foot limestone member. In the southern and western parts of the mountain the limestone is typically bioclastic echinodermal with interbedded shale; while northward beyond Mill Creek syncline (approximately center of mountains) the limestone loses its bioclastic echinodermal aspect and becomes "birdseye" in nature. Ham attributed the "birdseye" calcite flecks in the McLish limestone to encrustations of blue-green algae of the genus *Spongiostroma,* these plants having effected the openings and provided the carbonate of which the "birdseye" limestone is composed.

Wallace (1954, p. 10) recognized from electrical log strips and samples from the Chitwood Pool of Grady County, Oklahoma, a Simpson section involving Oil Creek, McLish, Tulip Creek, and

Bromide formations. A total of 1,600 feet of subsurface Simpson section was reported:

Bromide dense	(90-110)
First Bromide sand	
Second Bromide sand	
Tulip Creek shale and limestone	(50-60)
Tulip Creek salt-and-pepper sand	
McLish shale and limestone	
McLish sand	
Oil Creek dolomite, shale, sand	(450-600)

Allen (1954, p. 15) reported in electrical log study a maximum of 340 feet of Simpson section in Woods and Alfalfa Counties, Oklahoma. The article postulated that "First" and "Second" Wilcox sandstones of northwestern Oklahoma are subsurface equivalents of the Bromide of the southern basin . . . . that marine onlap at the base and truncation at the top of the Simpson section would explain the relatively thin section to the northwest. The following section was described:

Simpson Dense ....(0-100)	Best developed in southeasterly wells, where it is thin-bedded, tan, lithographic limestone, becoming increasingly dolomitic toward the base.
Simpson dolomite ....(12-100)	Dove-gray, fine dolomite grading into dolomitic sand near base . . . its porosity effects characteristic electrical log "curve".
First Simpson sand..........(0-80)	Tight, coarse, frosted glassy to white sand, with occasional green shale (Bryozoa) . . . shallow water origin.
Second Wilcox sand..............(75)	Loose, friable, glassy to white, medium, subrounded sand.
Simpson shale	Hard, green, waxy, dolomitic shale with thin dolomite and sand streaks.
Lower Simpson sand............(20)	Medium, tight, frosted sand.
Lower Simpson shale	Green shale.

Dana (1954, p. 10) reported from an electrical log study that the subsurface Simpson of Grant County, Oklahoma ranges in thickness from 160 feet (northeast) to 330 feet (southwest), the section consisting of:

Simpson Dense
Simpson Dolomite
First Wilcox
Marshall Zone
Second Wilcox
Simpson green shale

Ford (1954, p. 10) subdivided with the aid of electrical log strips the subsurface Simpson section of Logan County, Oklahoma, as follows:

Simpson dense limestone	(50)
White chert	(10)
First Wilcox sand	(70 dolomitic sand)
Second Wilcox sand	(200 sandy dolomite and dolomitic sand)
Tulip Creek shale	(120 shale, limestone, dolomite)
McLish formation	(90 salt/pepper sand with shale)
Oil Creek formation	(90 shaly gray sand with mottled limestone and dolomite)

In December 1954 Branson published more than 50 pages of names of stratigraphic units in the subsurface of Oklahoma. On 20 pages of the publication are discovered more than two dozen names (1954, pp. 167-222) of Simpson equivalents, with reference of origin and data regarding occurrence and correlation.

Dietrich (1955, pp. 5-9) described in detail the five more-or-less standard formations of the Simpson group, included comparative photographs of the various sands, portrayed a north-south electrical log cross-section from central Oklahoma to the Kansas line, and an east-west cross-section from north central Oklahoma through the "panhandle" of the state. In the electrical log cross-sections the Simpson section was subdivided as follows:

Upper Bromide
Lower Bromide
Tulip Creek
McLish
Oil Creek
Joins (included for practical reasons with underlying Arbuckle dolomite)

In Garfield County the subsurface Simpson section varies in thickness from 360 feet to 480 feet, except where removed by erosion from the subsurface Garber structure. Cary (1955, p. 9) divided in electrical log study the Simpson (Champlainian) section of Garfield County, Oklahoma, as follows:

		North South
Bromide	Simpson dense	(20 to 40)
	Simpson dolomite	(20 to 50)
	First Wilcox sand	(20 to 40)
	Marshall zone	(25 to 70)
	Second Wilcox sand (Dietrich's Lower Bromide)	(avr. 110)
Tulip Creek formation		(avr. 100)
McLish formation		(20 to 30)

A well penetrated the Simpson section of Canadian County, encountering 1,178 feet of section. Kimberlin (1955, p. 9) divided in electrical log study the subsurface Simpson of Canadian County as follows:

Simpson dense	(80-100)
First Wilcox sand	(4-40)
Second Wilcox sand	(200)
Tulip Creek formation	(70)
McLish upper sand	
McLish middle sand	(225)
McLish basal sand	
Oil Creek limestone	
Oil Creek sand	(160-180)
Joins	(80)

Kimberlin attributed the frosting of the "golfball" Simpson sand to corrosion in shallow Simpson seas, the seas oscillating frequently, exposing the sands to eolian action, which further rounded and frosted (pitted) the grains.

In Field Conference Guidebook Ham (1955, p. 29) depicted the eastward thinning of the Simpson section of the Arbuckle Mountains. Eastward the Tulip Creek intergrades by facies change into the lower Bromide; the McLish formation grades from bioclastic calcarenite into "birdseye" limestone; the Joins is missing beyond Mill Creek syncline because of truncation at the base of overlying Oil Creek formation. His cross-section reveals the aforementioned relationships, as well as detailed lithology of Simpson formations of five separate areas of the Arbuckle Mountains. Attention is directed to the thickest sands of the Oil Creek in vicinities of Mill Creek syncline and Belton anticline, while the younger Tulip Creek sands are thickest farther west in the Arbuckle anticline, though in this area the Oil Creek sands are missing (Fig. 15).

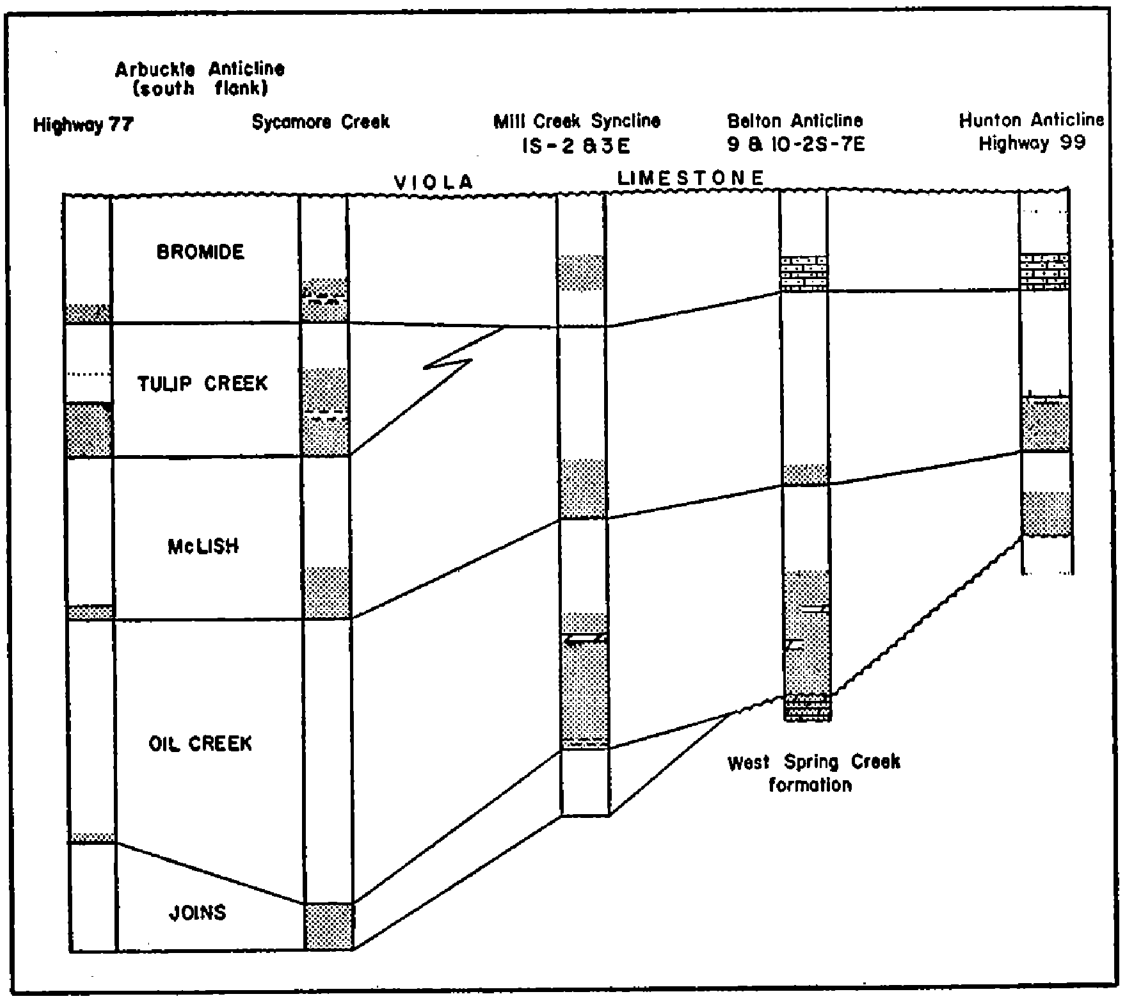


Figure 15. Regional Stratigraphy of Simpson Group in Arbuckle Mountains, Ham 1955

Roth (1955, p. 428) portrayed paleogeological conditions about the buried Texas Peninsula of southwestern Oklahoma and adjacent Texas area. He considered the Simpson limited to Chazyan age.

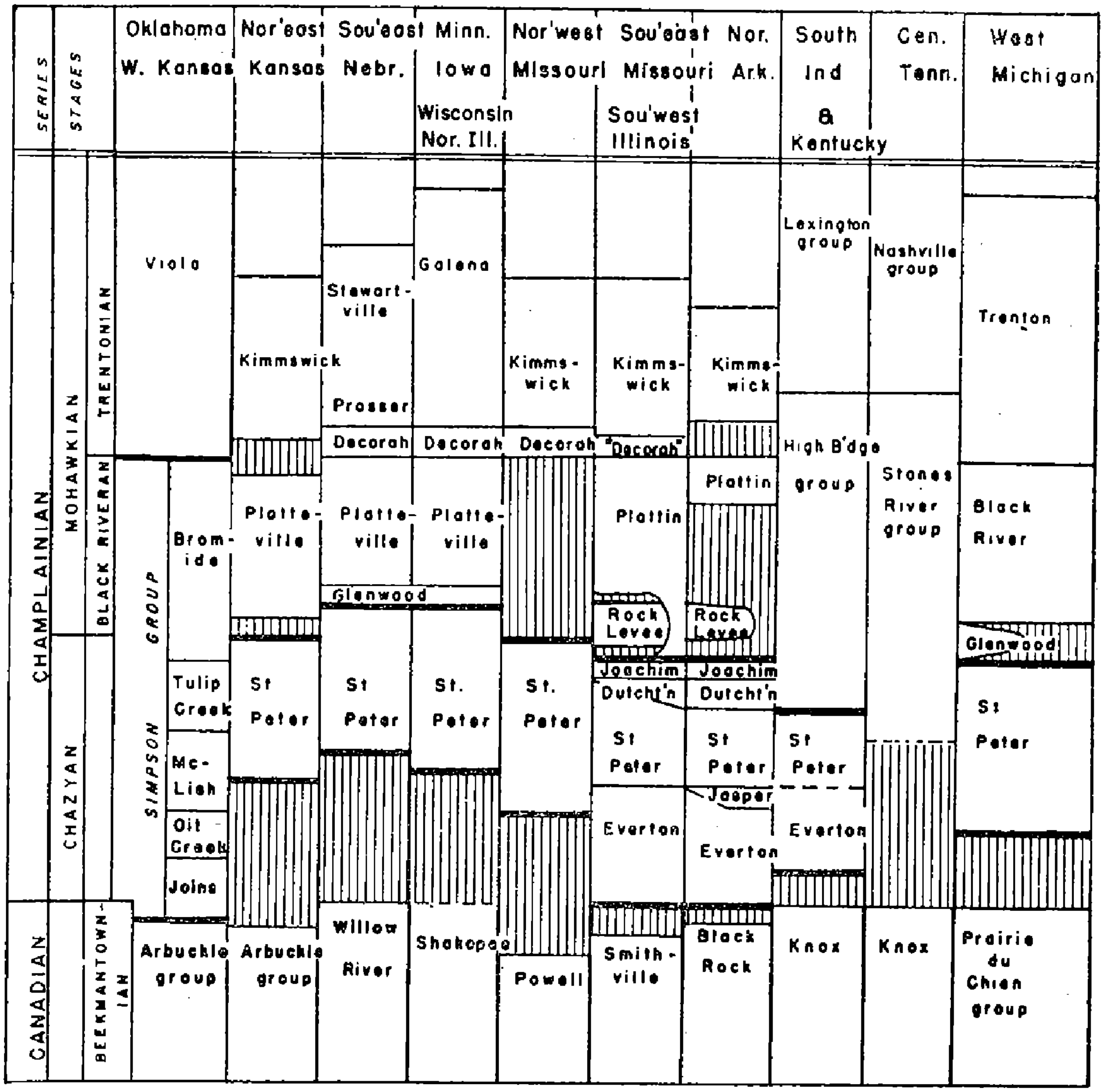


Figure 16. Stratigraphic Correlation Chart of the Simpson Group, Dapples 1955

Dapples (1955, p. 447) presented correlation chart (Fig. 16; and column 18, Fig. 1) involving the St. Peter and the Simpson in 16 to 18 states of central interior North America. The St. Peter, essentially of upper Chazyan age, was correlated with the McLish and Tulip Creek (and possibly basal Bromide) formations of the Simpson; the Joins was considered topmost Beekmantown-basal Chazyan in age; the Oil Creek was considered lower Chazyan. The Ozark dome was essentially a positive area and the Oklahoma basin a locale of current energy dissipation during St. Peter-Simpson time. Dapples, as did Dake, postulated that the Canadian Shield supplied the St. Peter sand for interior North America.

Ireland (1955, pp. 468-483) presented a pre-Cambrian topographic map of northeastern Oklahoma, displaying an isopach of original thickness of pre-Simpson (essentially Arbuckle) strata. The Tulsa Mountains, Spavinaw, Wagoner, and Cushing domes, and western Wagoner County valley were prominent pre-Simpson topographic features of the area . . . at least seven igneous peaks of the Tulsa Mountains were projecting as islands during Simpson deposition. A post-Hunton paleogeological map portrayed Arbuckle limestone deposited generally over Oklahoma and over the Ozark dome. The Burgen, Tyner, "Wilcox", and younger beds were depicted in semi-concentric bands of outcrop about an Arbuckle "core" of the Ozark dome and dipping toward the Arbuckle Basin. If Simpson strata ever covered the Ozark Dome, the veneer was probably thin, so that post-Simpson and pre-Mississippian erosion removed it ere the Mississippian sea once again submerged the dome. A table of subsurface Simpson formations of northeastern Oklahoma revealed Burgen, Tyner, and "Wilcox" resting unconformably upon Cotter or Powell dolomite.

Smith (1955, p. 11) in electrical log study recognized subsurface Simpson strata in Kay County, Oklahoma. The section consisted of Tulip Creek overlain by Bromide "Second" Wilcox, and varied in thickness from zero (northern edge of county) to 180 feet (southern edge). The loss of section northward was explained by onlap at the base and truncation at the top of the section.

Page (1955, p. 10) in an electrical log study described the subsurface Simpson of Noble County, Oklahoma. Southern Noble County, as part of the shelf area during Simpson times, experienced shallow water deposition accompanied by frequent emergences and submergences. The following Simpson section was presented:

Bromide	Simpson dense	(20)
	Simpson dolomite	(30)
	First Wilcox	(40)
	Marshall zone	(50)
	Second Wilcox	(150)
	Tulip Creek formation	(100)
	McLish formation	(40)
	Oil Creek formation	(40)

Disney and Cronenwett (1955, pp. 107-115) described the subsurface Simpson of central Oklahoma. In an electrical log study the five more-or-less standard formations of the Simpson group were recognized, with additional topmost units of Simpson dolomite (Marshall zone) and Simpson Dense. In correlation chart (Fig. 17; column 19, Fig. 1) the Oil Creek was correlated with the Burgen of northeastern Oklahoma; the McLish, with Tyner; the upper Viola, with the Fite. A structural contour map of Oklahoma (top Arbuckle datum) revealed maximum depth of a basin of Simpson deposition in and south of the Arbuckle Mountain area. The basin trended northwestward and was flanked, particularly on the northern side, by a shallowing shelf area. A noteworthy contribution of the publication is a type electric strip log of Cleveland County that depicts detailed lithology and formations of the Simpson section.

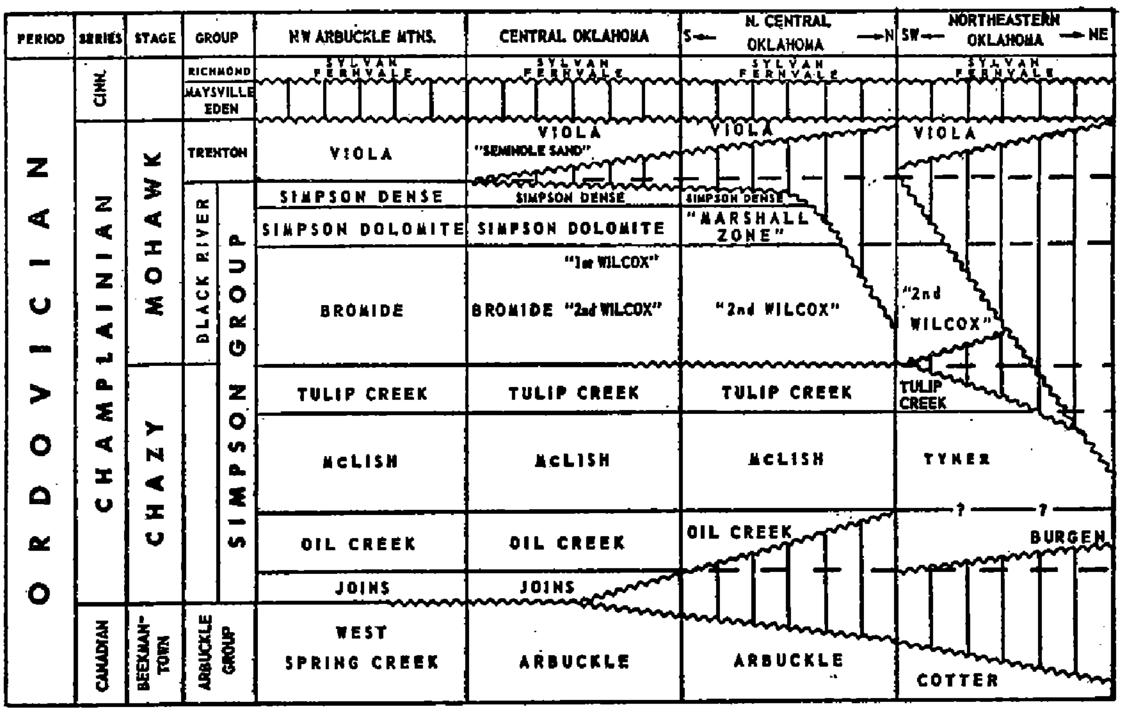


Figure 17. Correlation of the Simpson of Oklahoma, Disney and Cronenwett 1955

Pitt (1955, p. 18) described the Crystal Mountain sandstone at the type locality in the Crystal Mountains of Montgomery and Garland Counties, Arkansas. He compared the Crystal Mountain sandstone with that of the McLish of Oklahoma . . . "both composed of pure quartz and both appear in approximately the same stratigraphic position."

Cronenwett (1956, thesis) portrayed in a graduate thesis at the University of Oklahoma the five more-or-less standard Simpson formations. As in a previous publication with Disney, Cronenwett again depicted the "Seminole" sand of eastern Oklahoma as Viola, rather than Simpson, in age.

Maravich and Morrisey (1956, p. 1155) published a generalized stratigraphic column for the state of Oklahoma. The five standard Simpson formations were depicted as lower Ordovician in age; the Marshall zone, and Hominy and 2nd "Wilcox" sands were correlated with the Bromide; and the 1st "Wilcox" sand, Dolomite, and Dense were correlated with the Viola.

In June, 1956, G. A. Cooper, Curator of Geology and Invertebrate Paleontology of the U. S. National Museum in Washington, D. C., described and illustrated approximately 1,000 species of Brachiopoda from Chazyan and related strata of North America.

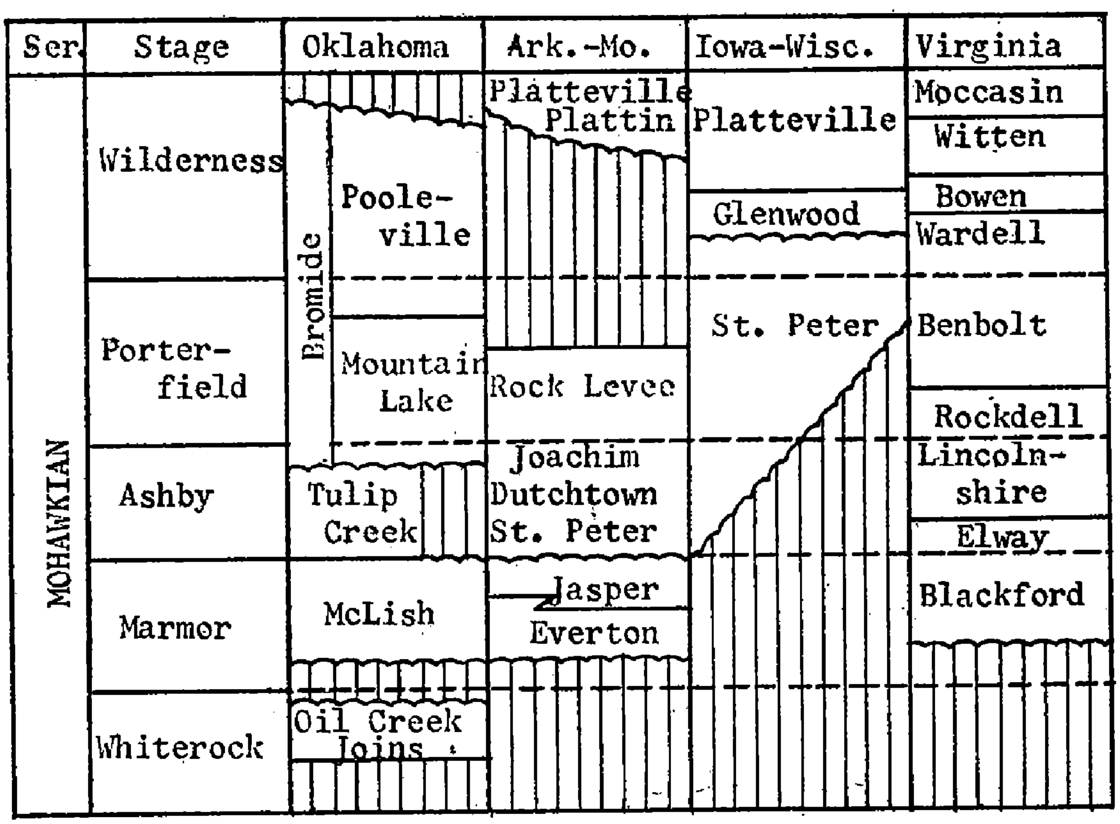


Figure 18. Correlation upon Basis of Brachiopods, Cooper 1956

In the text Cooper abandoned the long-established terms, Chazy and Black River, and employed instead an all-inclusive epoch-series term, Mohawkian, for five ages-stages (ascending): Whiterock, Marmor, Ashby, Porterfield, and Wilderness.

In discussing the brachiopods and stratigraphy of the Simpson of Oklahoma, Cooper employed the five formational names of the Simpson as generally accepted, though dividing the topmost Simpson Bromide into two members, Mountain Lake and overlying Pooleville. The Mountain Lake included essentially Ulrich's Cool Creek (Edson 1935b. p. 1122); the Pooleville included essentially Ulrich's Criner and Webster (name pre-empted). Cooper assigned the Joins and Oil Creek to upper White Rock; the McLish, to the Marmor; the Tulip Creek and basal Mountain Lake, to the Ashby, upper Mountain Lake and lower Pooleville, to Porterfield; upper Pooleville, to Wilderness (Fig. 18; and column 20, Fig. 1)

FORMATIONS OF THE SIMPSON GROUP

Following the establishment of the undifferentiated Simpson formation by Taff in 1902, no subdivisions thereof were named until 1911, when Ulrich (1911, pl. 27) proposed a second formation, the Bromide. The Bromide embraced "beds of Black River and Trenton age" at the top of Taff's Simpson formation.

Not until 1928 was the Simpson section further subdivided. At that time Ulrich (1928, table) divided the Simpson into three formations (ascending): Oil Creek, Bromide, and West Spring Creek (the latter with a Criner member).

The following year Ulrich (1929a, table) depicted in a correlation chart the Simpson as a group that included seven formations (ascending): Joins Ranch, Nebo, Falls, McLish, Tulip Creek, Criner, and Bromide.

Later in the year Ulrich (1929b, p. 73) revised the seven Simpson formations as follows (ascending): Joins, Oil Creek, McLish, Falls, Tulip Creek, Criner, and Bromide.

Decker and Merritt (1930, table) (1931, table 2) further revised the Simpson group, reducing it to the five formations more-or-less standardized in current usage (ascending): Joins, Oil Creek, McLish, Tulip Creek, and Bromide.

In 1932 Ulrich (Edson 1935b, p. 1122) divided the Simpson section into nine formations (ascending): Joins, Oil Creek, Falls, McLish, Tulip Creek, Cool Creek, Criner, Bromide, and Webster. This same section (excepting the Webster) was employed by Bassler and Kellett (1934, p. 48).

Cooper (1956, pp. 120-121), though employing the five more-or-less standard Simpson formations, subdivided the Bromide into two members, the Mountain Lake and overlying Pooleville. The Mountain Lake is essentially the Cool Creek that Ulrich (Edson 1935b, p. 1122) first established in 1932. The Pooleville appears to be essentially Ulrich's Criner formation plus his Webster (name pre-empted).

The Corbin Ranch formation is erected in this publication to include topmost Simpson dense limestone (with shale breaks), in stratigraphic position between the underlying Bromide Pooleville member and the overlying Viola limestone. This new formation appears to be the exact equivalent of Edson's "un-named formation of lower Prosser age" (1935, fig. 4); it is the topmost limestone of Ulrich's Webster formation (name pre-empted) (1932, table); it comprises the topmost 15 to 20 feet of Cooper's 250-foot Pooleville member.

Follows a description of each of the Simpson formations.

JOINS FORMATION

The Joins is considered the basal formation of the Simpson group, in spite of some question concerning priority of the name.

Establishment

The name was proposed before the Geological Society of America in annual meeting in New York in 1928, when Ulrich presented from manuscript a Simpson chart (column 8, Fig. 1), the second of two charts published by Decker (1930, p. 1495), in which the basal formation of the Simpson was termed Joins Ranch with overlying Nebo). The following year Ulrich (1929b, p. 73) published a revised chart (column 9, Fig. 1) in which the original name, Joins Ranch, was shortened to Joins (with overlying Oil Creek in substitution for the pre-empted name, Nebo). Confusion arises, however, in examination of another correlation chart (column 7, Fig. 1), the first of the two charts published by Decker in 1932, credited to Ulrich of the U. S. Geological Survey as of 1928, and prior to the presentation of the term, Joins Ranch, and publication of the term, Joins. In this earliest of the aforementioned charts Ulrich termed the basal Simpson formation Oil Creek (with overlying Bromide). From this confusion of names, however, the two basal formations of the Simpson have since become standardized as Joins and overlying Oil Creek.

Type Section

The type section for the Joins involves exposures along Spring Creek on the Joins Ranch, northwest of Woodford, near the western end of the Arbuckle Mountains.

Lithology

The formation consists of thin limestones and shales, with several intraformational conglomerates near the base, and a thin edge-wise interformational basal conglomerate resting upon a diagnostic Beekmantown eoleperditian Ostracoda and *Hormotoma* zone of topmost Arbuckle. The formation weathers more readily than the subjacent Arbuckle, thus resulting in slightly lower topographic relief and displaying decidedly less "tombstone" topography than Arbuckle dolomitic limestones.

Joins limestones are light to dark gray, though some are surficially oxidized buff color in outcrops. The limestones vary from fine-grained and resistant, to coarsely crystalline and crumbling. They are more dolomitic in the subsurface, particularly in the lower part. An oyster-white, coarsely crystalline dolomitic limestone of this formation was identified by the writer from the subsurface of the Oklahoma City oil field. Minor amounts of chert and glauconite occur in the upper Joins, and oolites occur in some zones near the base.

Joins shales are less abundant and thinner bedded than those of overlying Simpson formations. The shales, however, display the characteristic green color of the younger Simpson shales, though they often appear gray-green to dark gray in subsurface cuttings. The basal Simpson shales of West Texas are often dark gray-green to greenish-black. Very few Ostracoda were washed free of the Joins shales, the majority being imbedded in the limestone.

The Joins contains less sand than any other Simpson formation (excepting the relatively thin topmost Corbin Ranch limestone). Apppreciable quantities of sand, so generally characteristic of Simpson formations, were not being distributed by Oklahoma streams, currents, and wave action during earliest Simpson time. Occasional sandy dolomites are observed near the base of the formation.

Thickness

At the type locality in the southwestern end of the mountains the Joins formation is approximately 300 feet thick. Decker West Spring Creek Zones 66b to 70 involve 234 feet of Joins; Decker U. S. Highway 77 Zones 95 to 102 involve 294 feet. The unit thins to 160 feet in the southeastern end of the mountains. It varies from 200 feet in thickness at the northwestern end, to zero at the northeastern end; and Ham (1945, table 1) portrays it overlapped by the Oil Creek formation beyond the Mill Creek syncline. As with other Simpson formations, the Joins is thicker in southern and western parts than in northern and eastern parts of the mountains. Decker reports the formation approximately 200 feet thick in the Criner Hills.

In subsurface the Joins is the most restricted of the six Simpson formations; hence, it is relatively thin or absent in the state. The tendency of the Joins to become increasingly dolomitic with stratigraphic depth has been mentioned previously. In this respect so closely does basal Joins resemble the underlying Arbuckle dolomite that differentiation is difficult, if not impossible, in lithologic and electrical log comparisons. Consequently, and for practical purposes, part or all of the subsurface section of the Joins formation is often included with the Arbuckle dolomite. Such practice obviously predicates a thin Joins section. It is hoped that the characteristic Joins Ostracoda will be of assistance in the identification of the formation.

Cram (1948, p. 348) reported 210 feet of dense, light brown Joins limestone with tight, white, medium-grained dolomitic sand at its base in the Cumberland oil field. Dannenberg (1955, p. 10) reported only 63 feet of subsurface Joins in Coal County. Hayes (1952, p. 17) reported 300 feet of Joins in the subsurface of Comanche County. Disney (1952, p. 9) reported some 50 feet in Cleveland County, where the Simpson section totals 1,120 feet in thickness. The section appears to have thickened in the Oklahoma City oil field. Kimberlin (1955, p. 9) reported 80 feet in Canadian

County. Cary (1955, p. 9) reported the formation missing in the subsurface of Garfield County (particularly on subsurface "highs"), where the Simpson section is 400 feet thick. Page (1955, p. 10) reported it missing in the subsurface of Noble County, where the Simpson section totals 450 feet.

The subsurface restriction of the Joins section obviously indicates that of all the Simpson seas in Oklahoma, that of the earliest Chazyan Joins was the most restricted. Such is in marked contrast with the preceding widespread and long enduring Beekmantown Arbuckle sea that submerged practically all of the state. The Joins sea entered southern Oklahoma through the Llanorian trough of sub-basinal proportions lying between the Texas Peninsula (west) and Llanoria (east). The sea flooded the Arbuckle basin and deposited therein its thickest section, 300 feet. Gradually invading central Oklahoma beyond the Arbuckle basin, the Joins sea was more-or-less confined to the northwestward-trending trough of Simpson deposition. Younger Simpson sediments in contact with the underlying Arbuckle over much of peripheral Oklahoma testify that this earliest of Simpson seas did not flood laterally very far beyond the trough proper. No Joins is reported in the subsurface of western, northwestern, northern, nor northeastern Oklahoma. There is no Joins in and about the Ozark Uplift of northeastern Oklahoma.

Relationship

The Joins (in outcrop) rests unconformably upon the Arbuckle dolomitic limestone, the aforementioned thin basal conglomerate and abrupt faunal break marking the contact in the Arbuckle Mountains. That the Arbuckle limestone was fairly well base-leveled and low-lying when Joins seas invaded the basin is suggested by the thin basal conglomerate and the general absence of sand in the lower Joins section. The several thin intraformational conglomerates in lower Joins further testify that early Joins seas continued to oscillate upon low-lying coasts. The Arbuckle-Joins hiatus, however, must be considered of first magnitude. Not only did the existing Arbuckle Beekmantown Ostracoda die out following retreat of the Arbuckle sea, but during the interim a totally new and distinctive Chazyan Ostracoda fauna developed and entered the Arbuckle basin with the Joins sea. The occurrence of these Simpson Ostracoda in Texas, New Mexico, and Nevada suggests that the Joins sea entered from the southwest. Further evidence of southwestern origin of the Chazyan sea is offered in other invertebrates indigenous to Chazyan strata of Oklahoma, Texas, and New Mexico; as well as in the fact that the Joins formation of the Arbuckle Mountains becomes thinner, and eventually absent, in the eastern end of the mountains, the Oil Creek overlapping it and resting unconformably upon the Arbuckle limestone.

There is some question concerning evidence of erosional contact of Arbuckle and Joins in subsurface, since the contact in Oklahoma is masked apparently by transitional dolomites. The subsurface contact in West Texas involves dolomitic gray-green Joins shales in contrasting contact with light Ellenburger dolomite, without apparent erosional break; accordingly, a conformable contact is postulated (see photograph . . . . . Powers 1940, p. 122).

The Joins is considered herein disconformable with the overlying Oil Creek. The thick basal sandstone of the Oil Creek, the overlap of the Oil Creek beyond the Joins, and slight change in ostracodal development are criteria suggestive of disconformable relationship of Joins and Oil Creek. The Oil Creek contains many paraschmidtellids and other Ostracoda not observed in the Joins, though close relationship obtains in two species and varieties of two other ostracodal species occurring in both the Joins and overlying Oil Creek. Joins Ostracoda are definitely more closely related to those of the Oil Creek than to those of the Arbuckle . . . the hiatus preceding the Joins was of much greater magnitude than that succeeding it.

Age and Correlation

The Ostracoda of the Joins apparently indicate more indirectly than directly an age of Chazyan for the formation. None of the Ostracoda in the Joins has been recorded from Chazyan strata outside the state of Oklahoma. The similarity of Joins and Oil Creek (Chazyan) Ostracoda, however, is indirect evidence of the Chazyan age of the Joins. As previously mentioned, two species and two varietal species of Oil Creek Ostracoda occur also in the Joins. On the other hand, an abrupt break in ostracodal development is observed at the Arbuckle-Joins contact. Of a dozen or more ostracodal species in the uppermost 1,000 feet of the Arbuckle, not a single species crossed the Arbuckle-Joins hiatus. Lithologically, closer relationship of Joins and Chazyan Oil Creek is indicated in the similarity of thin limestones and green shales, in contrast to the more dolomitic, less clastic section of Beekmantown Arbuckle . . . lying below the basal conglomerate of the Joins.

Other significant lower Ordovician invertebrates in the Joins have presented conflicting evidence concerning the age of the formation. *Desmorthis nevadensis* Ulrich and Cooper, generally regarded as a Chazyan brachiopod, occurs commonly in basal Joins strata. Above this fossil, however, occurs the graptolite zone of *Didymograptus artus* Elles and Wood and *D. bifidus* (Hall) (400 to 200 feet above base of the Joins). These graptolites have been considered of Beekmantown age in Newfoundland; basal Llandeilo of Great Britain; and Auriferous of Australia. Ulrich (1911, p. 663) discovered the former species in Oklahoma, and noted it as pre-Chazyan (late Canadian). When Decker and Dott discovered the second of the two aforementioned graptolites near the base of the Simpson, it was reported as pre-Chazyan (Beekmantown) also (Decker 1936, p. 305). Until 1952 Decker favored an age of upper Beekmantown for the Joins, suggesting a case of mistaken identity or longer range for the associated Chazyan brachiopod, *D. nevadensis* U. and C. Ruedemann (Decker and Merritt 1931, p. 15), however, upon the basis of the aforementioned Chazyan brachiopod and relevant discoveries in New York, contended that the Joins was basal Chazyan, the two aforementioned graptolites occurring in Great Britain Llandeilo strata ("in age very near Arenig"), which would correlate with the base of the Chazyan in America. Decker (1952a, p. 135) also favored an age of Chazyan for the Joins.

Cooper (1956, p. 118) reported that the brachiopod *D. nevadensis* U. and S. occurs commonly in the Pogonip of Nevada. He also suggested a close relationship of the Joins and the Oil Creek because of the occurrence of *Anomalorthis* sp. in the two formations.

Ostracoda

The Joins contains the following Ostracoda, none of which occur in the underlying Arbuckle nor in the overlying Oil Creek:

Eoleperditia mediumbonata Harris, n. sp.
Eoleperditia mediumbonata subsp. *debilis* Harris, n. subsp.
Eoleperditia ? obesiporosa Harris, n. sp.
Leperditella brookingi Harris
Leperditella cooperi Harris
Leperditella valida Harris, n. sp.
Paraschmidtella ? trifoveolata Harris, n. sp.

A single subspecies of an Oil Creek species is limited to the Joins:
Paraschmidtella perforata subsp. *dispersa* Harris, n. subsp.

Two species of Ostracoda were oberved in both the Joins and Oil Creek:
Ballardina concentrica Harris, n. sp.
Ballardina minuta Harris, n. sp.

OIL CREEK FORMATION

The Oil Creek is considered the second oldest Simpson formation, in spite of some confusion involved in establishment of the name.

Establishment

Decker (1930, p. 1495) published a correlation chart (column 7, Fig. 1) credited to Ulrich (and U. S. Geological Survey) as of 1928, in which the Oil Creek was designated as the lowermost of three Simpson formations: Oil Creek, Bromide, and West Spring Creek (with Criner member). On the same page Decker also presented a second chart (column 8, Fig. 1), which Ulrich reportedly presented from manuscript before the Geological Society of America in meeting at New York City in 1928. In this second chart of Ulrich the basal Simpson was termed Joins Ranch (not Oil Creek), overlain by Nebo (not Bromide). In 1929 Ulrich (1929b, p. 73) published a chart (column 9, Fig. 1) in which the basal Simpson formation was designated simply Joins, with overlying Oil Creek in substitution for the pre-empted term, Nebo. Later stratigraphers have adopted the last-mentioned nomenclature, so that currently the two basal members of the Simpson group are Joins and overlying Oil Creek.

Type Locality

The type locality for the Oil Creek formation is along Oil Creek, which traverses the formation in sec. 17, T. 3 S., R. 4 E., approximately 14 miles southeast of Sulphur, Oklahoma. The formation occurs throughout the length of the Arbuckle Mountains, crops out in the Criner Hills, and is widespread in the subsurface of Oklahoma. No Oil Creek equivalent occurs in northeastern Oklahoma.

Lithology

In both surface and subsurface sections the formation is divisible essentially into two members: a basal sandstone, and an upper member of interbedded limestones and shales. A few thin intraformational conglomerates are observed in outcrops. The basal sandstone member predominates in the eastern end of the Arbuckles, while limestones predominate in the central and western parts: both units are encountered in the subsurface.

The massive white basal sandstones consist of fine- to medium-grained, subrounded, frosted quartz grains. A a general rule the sandstones are loosely consolidated and crumble readily under pressure (friable), though locally they may be silicified, in which case they often weather as quartzitic pedestal rocks. Such semi-quartzitic, "salt-and-pepper" Oil Creek sandstones are quite commonly encountered in subsurface "cuttings". The so-called "pepper" of such sandstones may consist of conodont and coprolitic fragments, dermal plate bits, aragonitic shell breccia, or phosphatic pellets. Somewhat similar "salt-and-pepper" sands may be observed also in the overlying McLish and Tulip Creek, particularly in the latter. Those of the Oil Creek are further characterized by specimens and fragments of various species of coarsely porate paraschmidtellid "index" Ostracoda. Occasional dolomitic lentils are associated with Oil Creek sandstones.

Oil Creek limestones are typically thin-bedded, coarse-grained, commonly mottled with abundant aragonitic fossils, blue-gray in color, though oxidizing surficially to buff color in weathering. Minor amounts of chert and glauconite are observed throughout the formation. The coarsely porate paraschmidtellid "index" Ostracoda are readily observed in Oil Creek limestone "cuttings". These porate forms and the associated coarsely corrugated *Cryptophyllus magnum* (Harris) Levinson are so abundant in the Oil Creek that, accordingly, the formation is the most readily identifiable of the Simpson group. Identical species in the Oil Creek of Oklahoma are also abundant in subsurface Oil Creek strata of West Texas, and in Alsate-Fort Peña outcrops of the Marathon Mountains.

Olive-green shales are interstratified with the limestones, occurring more commonly in the upper part of the formation. These shales, as all green shales of the Simpson, appear darker in fresh exposure, oxidizing to buff color upon exposure; they are darkest in fresh "cuttings" and cores. Abundant Ostracoda may be obtained from upper Oil Creek shale exposures; particularly from shale outcrops some 20 feet below the top of the formation may one obtain perfect specimens of the aforementioned *C. magnum* (Harris) Levinson and associated fauna.

Thickness

According to Ham (1945, p. 22) the formation in the vicinity of Roff is 240 feet thick, consisting of 130 feet of basal sandstone; and 110 feet of overlying limestone and shales. Three miles south of Sulphur the formation is 750 feet thick (400 feet of basal sandstone; 350 feet of overlying limestones and shale). Decker (1941, p. 653) reduced his original calculated thickness of the Oil Creek formation on West Spring Creek from 1,075 to 627.3 feet by revising the zones involved, but Ostracoda evidence dictates further revision of the zones to include an additional topmost 50 feet of "grass-covered" section in Zone 48, so that here the formation as revised is 688 feet in thickness (not 627.3), embracing Decker West Spring Creek Zones 48b to 66a inclusive. Likewise, the U. S. Highway 77 Oil Creek section has been revised slightly, so that herein it is 668 feet thick (not 681.5), embracing Decker U. S. Highway 77 Zones 82b to 94 inclusive. Decker (1941, p. 666) reported 559 feet of Oil Creek at the north end of the Criner Hills.

Cram (1948, p. 347) reported from the Cumberland oil field of Oklahoma an exceptional subsurface Oil Creek thickness of 860 feet, subdivisible as follows: the topmost 465 feet consisting of coarsely crystalline, fossiliferous, mottled limestone and some sandy limestone, with green shale beds; next encountered is the First Oil Creek sand, a section 185 feet in thickness and consisting of four parts (approximately 100 feet of hard calcareous sandstones at the top, grading norhwestward into facies of limestones and shales; 30 feet of fairly coarse off-white to tan sandy limestone; 30 feet of tight calcareous sandstone; and 30 feet of brown sandy medium-crystalline limestone); next encountered is the Second Oil Creek sandstone (main producing zone of the field) that averages 210 feet in thickness, and consists of medium-grained, loose, porous, frosted, rounded sand (except for the topmost 15 feet of calcareous sandstone), and local beds of slightly silicifed or semi-quartzitic sandstone.

Frost and Crockett (1951, p. 18) listed Oil Creek sand among producing zones of the Pauls Valley oil field. Dannenberg (1952, p. 10) reported 130 feet of basal Oil Creek sand overlain by 240 feet of Oil Creek limestone, dolomite, and shale in the subsurface of Coal County. Hayes (1952, p. 17) reported 650 feet of subsurface Oil Creek in Comanche County. Of refreshing significance is the fact that he mentioned the occurrence of such Oil Creek "index" Ostracoda as *Crytophyllus magnum* (Harris) Levinson, *Paraschmidtella perforata* (Harris) Kay, and *Leperditella bulbosa* (Harris). Wallace (1954, p. 10) recognized in Grady County wells 450 to 600 feet of Oil Creek dolomite, shale, and sandstone. Kimberlin (1955, p. 9) portrayed 175 feet of Oil Creek sand and superjacent limestone in Canadian Couny. Moore's excellent electrical log cross-section (1953, pp. 12-13) displayed a thick Oil Creek section in the Arbuckle Mountains converging northward to Cleveland County, central Oklahoma . The basal sandstone is well displayed in all wells of the cross-section, including that nearest the mountains, Anderson Prichard No. 1 Chitman, Sec. 11, Twn. 1 S., Rnge. 2 E. Cronenwett (1955, thesis) also portrayed northward convergence of the Oil Creek. Cary (1955, p. 9) reported only 40 feet of Oil Creek "salt-and-pepper" sandstone associated with thin beds of dense tan limestone in the subsurface of Garfield County. Dietrich (1955, pp. 14-15) displayed an excellent electrical log cross-section of Simpson formational convergence from central Oklahoma northward to the Kansas line and westward through the Oklahoma "panhandle". In the former section the Oil Creek is depicted pinching out (overlapped) near the Kansas line; in the latter section the formation is exceptionally thin or possibly overlapped in the "panhandle" near the Colorado line. Cronenwett's isopach map (1955, thesis) of the subsurface Oil Creek of east central Oklahoma, in comparison with that of the Joins, portrays the Oil Creek extensively overlapping the Joins. Though more extensive than the Joins sea (as evidenced by Oil Creek overlap northward and eastward), the Oil Creek sea did not enter northeastern Oklahoma.

Several hundred feet of Oil Creek strata are recognizable in the subsurface section of West Texas, and its identical paraschmidtellid fauna testifies to coexistence in a common sea bounding either flank of the Texas Peninsula during Oil Creek time.

Relationship

The basal sandstone of the Oil Creek, the overlap of the formation beyond the Joins, and the slight "break" in ostracodal development are suggestive of disconformable relationship with the underlying Joins formation both in Arbuckle Mountain outcrops and in the subsurface. In cases of overlap, the Oil Creek rests unconformably upon the Arbuckle limestone or dolomite.

The Oil Creek in the western end of the mountains is overlain disconformably by McLish sandstone, green shales, and thin limestones. In the eastern end of the mountains it is overlain by McLish conglomerate, sand, and the more-or-less locally developed "birdseye" McLish limestone member, and green shales. Greater magnitude of the Oil Creek-McLish hiatus in eastern parts of the mountains is evidenced by more abrupt stratigraphic and faunal "breaks". A coarse limestone conglomerate is reported at this contact at several localities east of the Washita River, above which occurs some sand, which is succeeded by the McLish "birdseye" limestone with characteristic fauna. The large eoleperditian Ostracoda of the "birdseye" limestone facies are unknown in the more clastic facies occurring generally west of the Washita River. This McLish "birdseye" fauna possibly entered the Arbuckle basin from the east, rather than from the southwest. On the other hand, the Oil Creek-McLish contact of the western end of the mountains is marked generally by a thinner sandstone (not a conglomerate); the McLish green shales and thin limestones resemble those of the underlying Oil Creek (not contrasting, as the "birdseye"); and at least one ostracodal species, *Rayella minuta* Harris, n. sp. (though smooth and conservative), as well as the genus *Cryptophyllus* Levinson, are discovered in both the Oil Creek and McLish formations. The writer has not discovered a single representative of *Cryptophyllus* Levinson in the typical "birdseye" McLish member; it is possible that they have been overlooked, and again it is possible that the genus had not yet developed in the basin from whence the McLish "birdseye" fauna invaded the Arbuckle area.

Though there appears a closer relationship between Ostracoda of the Oil Creek and McLish in general, than between those of Oil Creek and the "birdseye" McLish member, by no means is the resemblance to be considered in close agreement. McLish Ostracoda are distinctly different from those of the underlying Oil Creek. The aforementioned single smooth, conservative species common to Oil Creek and basal McLish of the western end of the mountains is the only ostracodal species of at least two dozen in the Oil Creek that survived the Oil Creek-McLish hiatus. The closing Chazyan disturbance terminated Oil Creek time and forced the Oil Creek sea to retreat from the Arbuckle area, as well as from the basin of West Texas. During the interim of retreat not only did the Chazyan characteristic varied and prolific coarsely porate paraschmidtellids and large and rugged *Cryptophyllus magnum* (Harris) Levinson "die out", but the hiatus was of such magnitude that an altogether different Mohawkian schmidtellid and cryptophyllid Ostracoda fauna had developed to enter with the McLish sea from the southwest upon the eroded surface of the Oil Creek landscape. The Mohawkian complex of the new fauna is reflected in the fact that McLish Ostracoda are more closely related to those of the overlying Tulip Creek and Bromide than to those of the underlying Oil Creek.

Age and Correlation

The Oil Creek is exceedingly fossiliferous and its age of Chazyan is unquestioned. The following invertebrates (selected) were listed by Decker and Merritt (1931, p. 21), and testify to the Chazyan age of the formation:

Clitambonites multicostus (Hudson)
Dinorthis pectinella (Emmons)
Orthis pogonipensis Hall and Whitfield
Orthis acutiplicata Raymond
Orthis ignicula Raymond
Maclurites sp. cf. *M. oceanus* (Billings)
Pleurotomaria sp. cf. *P. obesa* Hall
Endoceras magister Ruedemann
Cycloceras rectiannulatum (Hall)
Drepanodus arcuatus Pander
Batostoma suberassum Ulrich

Monticulipora sp. cf. *M. insularis* Seely
Illaenus arcturus Hall
Pliomerops nevadensis (Walcott)

Ulrich has correlated the formation with the Ridley-Lenoir of the Mississippi Valley and with the Chazy of New York.

Cooper (1956, p. 119) stated that several brachiopodal species in the Oil Creek had been incorrectly identified as Chazyan species: *Clitambonites multicosta* (Hudson) is *Anomalorthis oklahomensis* Ulrich and Cooper; *Orthis acutiplicata* Raymond of the Oil Creek is actually *Orthambonites dinorthoides* Cooper; *Orthis ignicula* Raymond of the Oil Creek is now *Orthambonites subconvexus* Cooper. The presence of the aforementioned brachiopods (and the trilobite, *Pseudomera (Pliomerops) nevadensis* (Walcott) Cooper, indicates upper Pogonip age.

Ostracoda

The Oil Creek contains the following Ostracoda, practically all of which are new species:

Eoleperditia abrupta Harris, n. sp.
Eoleperditia spicata Harris, n. sp.
Eoleperditia subcarinata Harris, n. sp.
Leperditella bulbosa (Harris)
Leperditella gibba Harris, n. sp.
Leperditella obesa Harris, n. sp.
Paraschmidtella multicavata Harris, n. sp.
Paraschmidtella oviforma Harris, n. sp.
Paraschmidtella pauciperforata Harris, n. sp.
Paraschmidtella perforata (Harris) Swartz
Paraschmidtella reticulata Harris, n. sp.
Paraschmidtella umbopunctata Harris, n. sp.
Hilseweckella rugulosa Harris, n. sp.
Cryptophyllus magnum (Harris) Levinson
Macronotella elegans Harris, n. sp.
Macronotella mcgeheei Harris, n. sp.
Macronotella upsoni Harris, n. sp.
Eoprimitia arcuata Harris, n. sp.
Eoprimitia moorei Harris, n. sp.
Ballardina concentrica Harris, n. sp.
Ballardina minuta Harris, n. sp.

Ballardina simplex Harris, n. sp.
Haplobolbina arcuata Harris, n. sp.
Eurychilina simplex Harris, n. sp.
Bassleratia corrugata Harris, n. sp.
Rayella minuta Harris, n. sp.

Two of the Oil Creek species occur also in the Joins:

Ballardina concentrica Harris, n. sp.
Ballardina minuta Harris, n. sp.

A single species crossed the Oil Creek hiatus into the overlying McLish:

Rayella minuta Harris, n. sp.

McLISH FORMATION

Establishment

In 1928 Ulrich and Decker studied Simpson outcrops in the mountains of Oklahoma. Ulrich was unable to trace the McLish fauna of the eastern end of the Arbuckle Mountains westward beyond U. S. Highway 77 (Decker 1956, oral communication). Consequently he considered it expedient to establish a new formation for the section west of U. S. Highway 77. This new formation he termed Falls. It included the Simpson section in the western end of the Arbuckles (essentially west of U. S. Highway 77) intervening between formations later established as subjacent Oil Creek and superjacent Tulip Creek. The McLish included the corresponding interval in the eastern part of the Arbuckles and in the Criner Hills. It was recognized that the formations were equivalent in part, but it was further recognized that the fauna of the McLish "birdseye" limestone was distinctive and rather locally developed.

In 1928 Ulrich presented from manuscript to the Geological Society of America in New York City a correlation chart (column 8, Fig. 1) involving the Falls (with overlying McLish formation) resting upon the Nebo. Decker published this chart (1930, p. 1495). Following research with Ordovician strata of Great Britain, Ulrich (1929b, p. 73) published a chart (column 9, Fig. 1) portraying reversed position of Falls and McLish (Falls was portrayed above the McLish). In the accompanying text Ulrich (1929b, p. 77) presented the following information regarding Falls and McLish formations:

The Simpson of Taff's classification comprises seven variously distributed and interfingering formations. Of these only the topmost has been previously named (Bromide, named in 1911). The others are newly named as in the table. Each begins with a sandstone of from a few feet to more than 100 feet in thickness and is distinguished from the others by a complete change in the character and in most cases also in the derivation of its fauna. The first (Joins) and the second (Oil Creek) derive their faunas from the west, whereas the third (McLish) contains species of the Appalachian Lenoir fauna, which therefore are regarded as indicating an invasion from the east at this time. The fourth (Falls) contains species found elsewhere only in Nevada and western Texas, which is interpreted as showing that the source of the invasion was again in the Pacific. The fauna of the fifth formation (Tulip Creek) compares closely only with the Stones River faunas of Tennessee, and is therefore held to be an Oklahoma recurrence of that southern fauna during Blount time that did not reach central Tennessee. The fauna of the sixth (Criner) formation again differs radically from that of the next underlying formation. Genetically comparable fossils occur only to the east in Blount and Chambersburg formations. Finally, the faunules of the succeeding Bromide formation are essentially the same as those found in the Black River and early Trenton formations in Iowa and Minnesota, whose northern origin has long been recognized.

Ulrich (Edson 1935b, p. 1122) later again reversed the stratigraphic order of the Falls and McLish formations, portraying the Falls (with overlying McLish) resting upon the Oil Creek (column 15, Fig. 1). Decker (1930, p. 1498) also portrayed the possibility of both Falls and McLish formations in the Simpson section (column 11, Fig. 1).

Decker and Merritt (1930, table) and (1931, p. 16), however, portrayed only five Simpson formations: Joins, Oil Creek, McLish, Tulip Creek, and Bromide (column 10, Fig. 1). The McLish was assigned a stratigraphic position between the underlying Oil Creek and overlying Tulip Creek; the Falls formation was abandoned as a rather clastic, local facies of the McLish.

Decker (1941, p. 654) summarized Ulrich's viewpoint regarding the Falls formation and advanced additional argument for abandoning the term. He stated, "The term, Falls, was introduced temporarily because Ulrich contended that the rocks in the western part of the mountains in the same general stratigraphic position as the McLish of the eastern part had a fauna entirely different from that of the McLish." Decker then directed attention to a concentrated zone of *Paleocystites tenuiradiatus* (Hall) and associated *Ctenodonta* sp. occurring in both Falls and McLish throughout the mountains. Furthermore, he reports *Maclurites magnus* Lesueur and a sponge of the genus *Girvanella* Nicholson and Etheridge in the Falls of the western Arbuckles and in the

McLish south of Sulphur, east-central Arbuckles. Finally, he stated that Loeblich discovered eight Ostracoda species common to the McLish of the east and the Falls of the west. Such evidence indicates that Falls and McLish are one and the same formation; accordingly, the term, Falls, has been abandoned in favor of the more popular term, McLish. Since both terms, Falls and McLish, were displayed (not published) originally from the same manuscript correlation chart in 1928, however, it might appear both logical and proper that the name of the lower stratigraphic unit (Falls) should obtain priority in usage over that of the superjacent McLish of the same chart. Complicating the issue, however, is the fact that the first publication of the two formations (1929) portrayed McLish as the lower formation. Such priority of McLish in publication, and the fact of popular usage, will undoubtedly effect permanent establishment and employment of the term, other factors being equal or negligible.

Type Locality

The type locality for the McLish formation is on the McLish Ranch, approximately four miles northwest of the town of Bromide, Oklahoma. Loeblich (1933, thesis) has presented in an unpublished thesis the following type section that he and Dr. C. E. Decker measured and described in detail from exposures a mile southwest of the McLish ranch house, in Sec. 35, Twn. 1 S., Rnge. 7 E:

Zone	Thickness	
1	22 feet	Gray "birdseye" limestone
2	8	Yellow and gray massive sandstone
3	10	Yellow to buff compact limestone
4	7	Shaly limestone
5	9	Thin buff limestones, small brachiopods
6	10	Grass covered shale
7	10	Rough yellow limestone
8	1.25	Limestone
9	10	Sandy, rough, buff-colored limestone containing *Maclurites magnus* and a large *Strophomena* sp.
10	12	Dense "birdseye" limestone
11	12	Thin limestones
12	10	Shale, containing *Lichenaria* cf. *carterensis* ..
13	3	Gray limestone
14	8	Shale, grass covered
15	4	"Birdseye"-like limestone
16	5	Buff limestone and shale
17	4	Thin yellow limestones containing *Lichenaria* cf. *carterensis* to flood-plain of Delaware Creek.
Total	145.25	

"Farther south along Delaware Creek, there is exposed 15 feet of iron-stained dolomite, above 30 or 40 feet of white sand. These beds lie below any beds in the above measured section."

(Thus, more than 200 feet of McLish was observed at the type locality.

Loeblich also presented in the aforementioned thesis Ulrich's type section for the Falls formation, as exposed in the roadcut paralleling the north side of Falls Creek, in sec. 32, T. 1 S., R. 2 E., published by Decker (1941, p. 661). This locality displays only 164 feet of sandstones, shales, and limestones; and Ostracoda range in this section may dictate revision to the extent that only the lower part of the section is actually McLish. Thicker (500 feet) and, accordingly, more typical McLish sections are observed on Norris Ranch; U. S. Highway 77; West Spring Creek of the Arbuckles; and in the north end of the Criner Hills.

Lithology

The McLish formation consists essentially of two divisions: a basal sandstone and an overlying section of occasional thin sandstone, interbedded green shales, and variable limestones. In the upper division is the McLish "birdseye" limestone, locally developed in the eastern part of the Arbuckle Mountains and in the Criner Hills. Such a typical sequence of basal sandstone, and an overlying section of interbedded clastics and limestones is observed in both mountain outcrops and throughout the subsurface of Oklahoma.

The McLish basal sandstone is a loosely indurated, fine, white sand body composed of rounded, frosted quartz grains. The sandstone is more thoroughly indurated, locally cross-bedded, and resistant in western parts of the mountains. In outcrops and subsurface some of the sandstone layers are light green because of green shale (illite) coating.

The limestones of the formation are gray-white, gray, light green, or buff. Individual beds may be exceedingly fossiliferous and mottled. In general the limestones vary in crystallinity from fine to coarse; "pink crinoidal" lithology is occasionally observed in subsurface "cuttings". A distinctive lithology involves the lithographic "birdseye" of the upper McLish, distinctive calcite flecking that Ham (1954, pp. 200-203) attributes to algae of the genus *Spongiostroma*. The "birdseye" limestone is generally more massive in contrast to the more normal thin-bedded character of the limestone layers. Decker describes a resistant limestone 60 feet above the base, as well as a thin limestone conglomerate 115 feet above the base, in the U. S. Highway 77 McLish section.

Interstratified olive green shales occur throughout the McLish section, the subsurface "cuttings" being darker than those of exposures. The shales oxidize surficially to buff color. Some of the shales, particularly those in Zones 62 to 68 of Oklahoma Highway 99 Simpson section, contain abundant Ostracoda.

Thickness

In thickness of outcrop the McLish ranges from at least 200 feet at the type locality on McLish Ranch; to 437 feet on the P. A. Norris Ranch south of Franks, Oklahoma; to 370 feet on Robertson Ranch; to 340 feet on Lick Creek. The revised section on U. S. Highway 77 involves Decker Zone 52 through the upper three-fifths (or thereabouts) of Zone 82, or approximately 490 feet. The revised section on West Spring Creek involves Decker Zone 33 through the upper one-sixth (or thereabouts) of Zone 48, or approximately 500 feet. Decker reported some 437 feet of McLish (essentially limestone) through Zones 20 to 26 cropping out at the north end of the Criner Hills.

In the U. S. Highway 77 McLish section (south side of the Arbuckles) the basal sandstone (so-called "Burgen" in Decker Zone 81) is 55 feet in thickness, the base occurring some 1,300 feet below the top of the Simpson section. In the West Spring Creek Simpson section, this basal sandstone probably involves the lower part of Zone 47 and the upper 20 to 30 feet of Zone 48 (Zone 48 being "125 feet largely grass covered"). Examination of Ostracoda Range Chart of the West Spring Creek section reveals Oil Creek Ostracoda having disappeared in Zone 48, thus indicating location of the Oil Creek-McLish contact within Zone 48. Such location of the base of the McLish sandstone in Zone 48 would discover it approximately 1,320 feet below the top of the Simpson section of West Spring Creek. The basal McLish sandstone is 150 feet in thickness on Sycamore Creek, its base 1350 feet below the top of the Simpson section. Decker reports it approximately 150 feet in thickness beneath the "birdseye' McLish limestone member on Norris Ranch, Sec. 2, Twn. 1 N., Rnge. 6 E. The basal "glass" sand is 75 feet thick near Roff.

The McLish formation is reported widely from the subsurface of Oklahoma. In the Cumberland oil field of southern Oklahoma an average thickness of 500 feet of McLish section was reported by Cram (1948, p. 347). As in the Arbuckle Mountain sections, so in the Cumberland subsurface, both divisions (basal sandstone and overlying limestone with interbedded shale and sandstone) are represented. The basal sandstone of Cumberland is 100 feet thick, is green shale-coated, and varies in granularity from fine to medium. The upper 400 feet of the McLish section consists of finely crystalline, buff limestone and coarsely crystalline gray-white limestone interbedded with tight, calcareous, glauconitic lentils. Dannenberg (1952, p. 9) reported in the subsurface of Coal County 535 feet of McLish section, subdivisible into three parts (ascending): 140 feet of basal limestone, dolomite, shale, and sand; 110 feet of sandstone; 290 feet of dense limestone and dolomite. It is possible that some of the dense limestone of the uppermost 290-foot section may represent the "birdseye" McLish member. Hayes (1952, p. 17) reported 425 feet of McLish in the subsurface of Comanche County, subdivisible into three parts (ascending): 185 feet of basal sandy shale, shale, and limestone; 105 feet of sandstone; 135 feet of shale. Wallace (1954, p. 10) reported the two members of the McLish formation, basal sandstone and overlying limestone with interbedded shale, in the subsurface of Grady County. Ford (1954, p. 10) reported 90 feet of "salt-and-pepper" McLish sandstone with interbedded shales in the subsurface of Logan County. Cary (1955, p. 9) reported only 20 to 30 feet of McLish section from the subsurface of Garfield County.

Moore's electrical log cross-section (1953, pp. 12-13) involving Simpson formations between the Arbuckle Mountains and central Oklahoma portrays thick McLish sections in both outcrop and subsurface. Dietrich's electrical log cross-sections (1955, p. 375) involving subsurface Simpson formations from north central Oklahoma westward and northward portray the McLish formation thinning from 190 feet in north-central Oklahoma, to 20 feet in the "panhandle" of Oklahoma; and to 40 to 50 feet at the Kansas line.

The McLish (or Tulip Creek ?) is some 150 to 200 feet thick in the equivalent Burgen and Tyner section of northeastern Oklahoma.

Relationship

The McLish is postulated herein in disconformable relationship with both the underlying Oil Creek and the overlying Tulip Creek formations.

Decker and Merritt (1931, p. 37) have directed attention to a coarse limestone conglomerate at the top of the Oil Creek and underlying the McLish at the eastern end of the Arbuckle Mountains . . . . "indicating hiatus of much of lower Chazy time." Since the writer considers the Oil Creek as Chazyan in age, and the McLish as Black River in age, then this aforementioned conglomerate lying between the Oil Creek and McLish formations marks the Chazyan-Black River hiatus, rather than "the hiatus of much of lower Chazy time." This basal conglomerate of the McLish is apparently localized in the Arbuckle Mountains, for the formation in both surface and subsurface is generally characterized by thick basal sandstones.

So pronounced was the hiatus separating Chazyan Oil Creek and Blackriverian McLish that the characteristic rugose *Cryptophyllus magnum* (Harris) Levinson and the innumerable coarsely porate paraschmidtellids of the Oil Creek became extinct ere the McLish sea entered the Arbuckle basin with but a single, conservative, smooth species (*Rayella minuta* Harris, n. sp.) of the preceding epoch.

The disconformity at the top of the McLish-base of the Tulip Creek is marked by a thick basal sandstone of the Tulip Creek; this sandstone has been termed the "Wilcox" in the U. S. Highway 77 Simpson section.

A McLish-Tulip Creek hiatus is suggested in the western end of the mountains by a prolific Tulip Creek fauna making an abrupt first appearance immediately above the basal Tulip Creek sandstone. This McLish-Tulip Creek hiatus was much less significant than the preceding Oil Creek-McLish hiatus, as evidenced by the fact that several McLish species of *Schmidtella* Ulrich and *Cryptophyllus* Levinson survived the McLish-Tulip Creek hiatus with little or no variation.

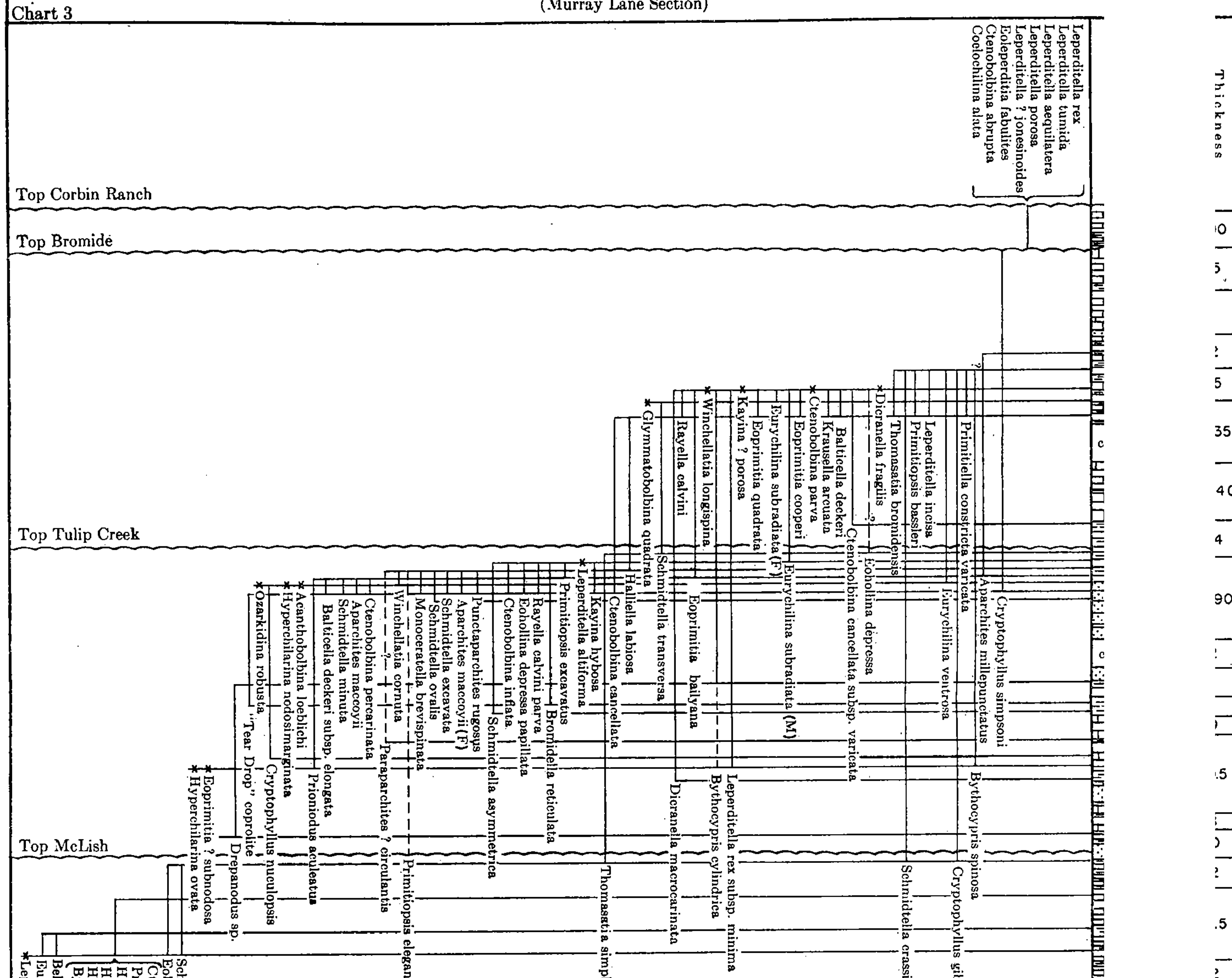
Green shale McLish outcrops on Oklahoma Highway 99 (in contact with the Tulip Creek) contain eight distinctive Ostracoda species not occurring in the overlying Tulip Creek. The writer

OKLAHOMA HIGHWAY 99 SECTION IN ARBUCKLE MOUNTAINS

Sec. 11, Township 1 S., Range 3 E.
(3 miles S. Fittstown, Oklahoma)
(For description of zones see
AAPG Bull. vol. 25, p. 662)

Highway 99 Section
(Murray Lane Section)

Chart 3



postulates a post-McLish hiatus as responsible for the extinction of the McLish Ostracoda. The hiatus was apparently not too pronounced, for one of the McLish green shale species (*Schmidtella affinis* Ulrich) and all of the genera of the McLish green shale ostracodal suite succeeded in surviving the hiatus to range into the overlying Blackriverian Tulip Creek and Bromide.

Age and Correlation

Decker and Merritt (1931, p. 36) reported the following invertebrate fossils from the McLish:

Girvanella ocellata (Seeley) Bassler
Tetradium carterensis Bassler
Maclurites magnus Lesueur
Raphistoma stamineum Hall
Paleocystites tenuiradiatus (Hall) Billings
Ctenodonta sp. cf. *C. socialis* Ulrich
Ctenodonta sp. cf. *C. gibberula* Salter
Pachydictya sp. cf. *P. elegans* Ulrich
Pachydictya robusta Ulrich
Rhinidictya basalis (Ulrich)
Orthis acutiplicata Raymond
Orthis ignicula Raymond
Plectambonites pisum Ruedemann
Rafinesquina champlainensis Raymond
Strophomena incurvata (Shepard) Owen
Valcourea strophomenoides (Raymond)
Zygospira recurvirostris (Hall) Chamberlin
Modiolopsis sp. cf. *M. gregalis* Sardeson

Raymond (1905, p. 357) reported several of the aforelisted fossils from his "Second Zone" (Chazyan) of the Lake Champlain region. The two gastropods, *Raphistoma stamineum* Hall and *Maclurites magnus* Lesueur, are considered "index" fossils of the Chazyan of eastern and central North America. These two fossils, together with *Paleocystites tenuiradiatus* (Hall) Billings, and others, induced Decker and Merritt to stipulate an age of Chazy for the McLish, correlating it with the Lenoir limestone of Alabama and the Crown Point formation of New York.

Loeblich (1938, p. 5) studied the McLish Bryozoa and concluded that the Chazyan age of the McLish could not be verified by these fossils. He stated, furthermore, that neither did the Bryozoa indicate an age of Black River.

Edson (1935a, fig. 4) stated that the McLish is closely related to Black River.

Cooper (1956, p. 119) reported additional brachiopodal species from the formation, with the notation that some of the species of previous lists had been misidentified:

Ancistrorhyncha ? perplexa Cooper
Dorytreta bella Cooper=*Zygospira recurvirostris* (Hall)
Glyptorthis sp. 4
Orthambonites minutus Cooper
Ptychopleurella oklahomensis Cooper
Sphenotreta sulcata Cooper
Orthis acutiplicata Raymond (Identification doubtful)
Plectambonites pisum Ruedemann " "
Rafinesquina champlainensis Raymond " "
Strophomena incurvata (Shepard) " "
Valcourea strophomenoides Raymond " "

Cooper considered the McLish correlative with the Lenoir of the Southern Appalachians, sharing brachiopods and other invertebrate fossils.

Ostracodal evidence induces the writer to stipulate an age of Black River (possibly Lowville) for the McLish. Of the 26 Ostracoda species recorded from the Chazyan Oil Creek, only *Rayella minuta* Harris, n. sp., a smooth conservative form, was successful in surviving the hiatus and ranging into the lower McLish. On the other hand, coarsely rugose *Cryptophyllus magnum* (Harris) Levinson and innumerable coarsely porate paraschmidtellids, and others, "died out" at the end of Oil Creek or Chazyan time. Entering the Arbuckle basin(for the first time) with the McLish sea were several species of *Schmidtella* Ulrich and *Crytophyllus* Levinson that continued into the overlying Tulip Creek and Bromide with little, if any, subspecific change. The extinction of the Oil Creek forms, the abrupt appearance of younger genera, and several species long ranging from McLish into Tulip Creek and Bromide induces the writer to favor an age of Black River for the McLish.

The 200-foot Burgen sand-Tyner shale section of northeastern Oklahoma is correlated with the McLish (or Tulip Creek ?); more evidence being sought during 1957.

Ostracoda

The following Ostracoda were recovered from the McLish "birdseye" limestone:

Eoleperditia fabulites (Conrad) Swartz
Eoleperditia magna Harris, n. sp.
Eoleperditia ? perplexa Harris, n. sp.
Eoleperditia simplex Harris, n. sp.
Leperditella ? subcygnoides Harris, n. sp.

The following species were obtained from upper McLish shales cropping out on Oklahoma Highway 99:

Hyperchilarina symmetrica Harris, n. sp.
Haploprimitia angusta Harris, n. sp.
Haploprimitia angusta var. *deltata* Harris, n. var.
Primitiopsis minutiperforatus Harris, n. sp.
Bellornatia mclishi Harris, n. sp.
Ctenobolbina projecta Harris, n. sp.
Eurychilina cultrata Harris, n. sp.
Bromidella spiveyi Harris, n. sp.
Bythocypris sp. cf. *B. granti* Ulrich
Schmidtella affinis Ulrich

Three species from outcrops of McLish shales in the western part of the Arbuckle Mountains range into the Tulip Creek and Bromide formations:

Schmidtella affinis Ulrich
Schmidtella crassimarginata Ulrich
Cryptophyllus gibbosum Harris, n. sp.

TULIP CREEK FORMATION

Establishment

In a chart (column 8, Fig. 1) presented from manuscript before the Geological Society of America in annual meeting in New York City in 1928 Ulrich introduced the Tulip Creek as a Simpson formation in the stratigraphic interval between the underlying McLish and overlying Criner formation. Decker published this chart (1930, tab. 5). Ulrich (1929b, p. 73) published a Simpson correlation chart (column 9, Fig. 1) again depicting the Tulip Creek in stratigraphic position below the Criner, but in this instance, overlying the Falls (not McLish). He later (Edson 1935b, p. 1122) proposed the Cool Creek formation in stratigraphic position between Tulip Creek and Criner formations (column 15, Fig. 1).

Decker and Merritt (1931, p. 16) portrayed the Tulip Creek in stratigraphic position between the subjacent McLish and superjacent Bromide (column 10, Fig. 1), and subsequently stratigraphers have thus adopted it. At one time Decker (1941, p. 665) considered including the Tulip Creek within the lower Bromide, but decided that it represented a sedimentary cycle and a justifiable formation of the Simpson group. Cram (1948, p. 346) stated that the Tulip Creek in the subsurface of the Cumberland oil field was simply "an expanded basal Bromide sandstone section." Edson (1930, pp. 947, 1227), however, reported a distinct angular unconformity separating Tulip Creek and Bromide in the subsurface of Oklahoma; and Cronenwett (1956, thesis) presented an electrical log cross-section depicting erosional contact between the two formations. Ostracoda of the Tulip Creek, though displaying close affinity to those of the Bromide, are distinctive and readily differentiated, thus indicating justification for retention of the Tulip Creek as a separate formation. The writer is convinced, upon the basis of ostracodal study, that freshly exposed contacts of the Tulip Creek and Bromide will reveal evidences of erosion.

Type Section

The type section for the formation is located along Tulip Creek, on the southern side of the Arbuckle Mountains, adjacent the west side of U. S. Highway 77, though exposures in the second creek west of the aforementioned highway must be exploited also in order to obtain the complete section (see Springer Section, Decker and Merritt 1931, p. 63).

Lithology

The formation is subdivisible into two parts: a basal sandstone ("Wilcox" of the type Tulip Creek locality), and an overlying section of shales with thin-bedded limestones and few thin sandstones.

The sandstones range from massive to thin-bedded; they are essentially soft and unindurated, rarely cross-bedded. In outcrop the sandstones may be ferruginous, though more commonly they are brown to dirty-white in color; they are composed of rounded, frosted quartz grains ("golfball") averaging 0.50 mm in diameter. In surface and subsurface the Tulip Creek sandstones characteristically display "salt-and-pepper" (stippled) appearance, the "pepper" being conodont fragmenta, phosphatic pellets, darkened aragonitic shell bits, or discolored quartz grain.

The Tulip Creek contains an abundance of olive-green and some light maroon shale. The shale is essentially light green in exposures, though weathering to buff color; subsurface "cuttings" are more brittle, harder, and darker green. Fossils may be washed free of Tulip Creek shale outcrop samples, particularly following a period of "slacking" and boiling, but the hard shales of subsurface "cuttings" do not "break down" readily. Such subsurface shales, however, frequently reveal conodonts, Ostracoda, and Bryozoa on parting planes. Decker Zone 36 (1941, p. 663) of Oklahoma Highway 99 Simpson section is an excellent locality for collecting Ostracoda and Bryozoa from Tulip Creek shales; the Rock Crossing section (1941, p. 665) in the Criner Hills is recommended likewise.

Exposed Tulip Creek limestones range in color from off-white, to blue-gray, to buff, to pink. The beds are generally thin. Many of the thin-bedded Tulip Creek limestones will display bedding planes characteristically plastered with schmidtellid ostracodal valves, such limestones being blue-gray or red to pink on freshly broken surface. In crystallinity the limestones vary from fine to coarse, many being coarsely crystalline and mottled with fossil fragmenta. The limestones are not as hard as the more dolomitic Chazyan limestones of the Joins and Oil Creek. The "birdseye" lithology, so typical of the underlying McLish, is not observed in the Tulip Creek.

Thickness

The Tulip Creek formation of the U. S. Highway 77 section involves Decker Zones 26 through 51 (1931, pp. 62-64), a total of 395 feet (subdivisible into 175-foot basal sand and 235 feet of overlying green (some maroon) shales with thin limestones and occasional thin sandstone). The West Spring Creek section (Decker and Merritt 1931, pp. 55-56) includes the lower three-eighths of Decker Zone 20 through 32, or 396 feet. As in the type section on U. S. Highway 77, so in the West Spring Creek section, the basal 175 feet consists essentially of sandstone, with occasional green shale bed. The revised Rock Crossing section in the Criner Hills (Decker

1941, p. 666) involves the lower three-fourths of Decker Zone 6 through Zone 17, or approximately 200 feet. Apparently the exact Tulip Creek-Bromide contact is immediately below the 14-inch limestone layer 8 feet below the top of Decker Zone 6, where a thin, oxidized, detrital layer occurs.* The lower part of the Tulip Creek (and the remainder of the subjacent Simpson section) is not exposed at the Rock Crossing locality. The revised Tulip Creek section of Oklahoma Highway 99 (Decker 1941, p. 663) involves the lower third of Decker Zone 34 (or ten feet higher) through Zone 61, or 130 to 140 feet in thickness.

In the subsurface, Cram (1930, p. 623) reported a total of 1,500 feet of Simpson section in the Wichita Mountain area of Oklahoma. The writer postulates some 300 feet of Tulip Creek section (interval 360 to 665) in this 1,500-foot Simpson section. Cram (1948, p. 346) reported 630 feet of Bromide-Tulip Creek from the Cumberland field, approximately 270 feet of basal section being Tulip Creek, "expanded basal Bromide sandstone section." Disney and Cronenwett (1955, p. 110) reported 120 feet of Tulip Creek section (50 to 80 feet of basal sand; 70 feet of overlying shale) in the subsurface of central Oklahoma. Hayes (1952, p. 17) reported 275 feet of Tulip Creek section in the subsurface of Comanche County (90 feet of basal sand; 185 feet of overlying shale). Ford (1954, p. 10) reported 120 feet of Tulip Creek shale, limestone, and dolomite in the subsurface of Logan County. Page (1955, p. 10) reported 100 feet in the subsurface of Noble County.

The Tulip Creek formation thins northward and northwestward, Kimberlin (1955, p. 9) having reported only 70 feet in the subsurface of Canadian County. Dietrich (1955, p. 9) reported the formation ranging in subsurface thickness from 210 feet in central Oklahoma (Twn. 8 N., Rnge. 3 W.), to 65 feet in Grant County (Twn. 29 N., Rnge. 4 W.) and Beaver County (Twn. 4 N., Rnge. 26 E. C. M.). Some 150 to 200 feet of Burgen-Tyner section of northeastern Oklahoma is correlative with either the McLish or the Tulip Creek, evidence now being sought for more exact correlation.

Cole, Dickey, and Kraus (1941, p. 1057) reported some 392

* Perhaps a more exact description of this contact is to be noted in Decker and Merritt (1931, p. 83). In their Zone 6 of this reference the Tulip Creek-Bromide contact is to be discovered at its base.

feet (minimum) of Tulip Creek section in a 1,000-foot Simpson section of Pecos County, Texas.

Relationship

Herein the Tulip Creek formation is postulated in disconformable relationship with both the underlying McLish and overlying Bromide formations.

The so-called "Wilcox" sand of the type section along U. S. Highway 77 is considered the basal sandstone of the formation, though no true basal conglomerate nor exceptionally coarse sand was observed at the contact. In the West Spring Creek Simpson section the basal Tulip Creek sand contains a greater percentage of green shale, but again no conglomerate was observed. The aforementioned detrital zone near the top of Zone 6 at the Rock Crossing Tulip Creek-Bromide contact is the only evidence of erosion observed by the writer at any Tulip Creek contact, possibly because of slumpage or soil cover. The cross-bedded sandstones of Zones 28 to 30 of the Oklahoma Highway 99 Simpson section is a basal (or near-basal) Bromide sand, in which case the Tulip Creek-Bromide unconformity would occur below it. Ostracodal evidence suggests that a brief hiatus separated the Tulip Creek from the underlying McLish. No abrupt faunal break was observed across the McLish-Tulip Creek contact in the western part of the mountains, essentially because of the general rarity of fossils in topmost McLish and basal Tulip Creek sandstones. A few species of *Schmidtella* Ulrich and *Cryptophyllus* Levinson apparently crossed the McLish-Tulip Creek contact with little, if any, variation in the western part of the mountains, though a prolific Tulip Creek fauna makes an abrupt appearance immediately above the basal sandstone. The prolific fauna at this Tulip Creek horizon contains innumerable species making their appearance for the first time in the Simpson section. Accordingly, the aforementioned brief hiatus is suggested.

On Oklahoma Highway 99 in east central part of the mountains, where the Tulip Creek is in faulted ? contact with the underlying McLish, one may observe green shales and "birdseye" limestone beds of the McLish immediately below the contact. Though the McLish shales resemble those of the Tulip Creek (possibly a brighter green than those of Tulip Creek at this road-cut), the McLish ostracodal fauna in these shales is definitely distinctive and differing from that of the overlying Tulip Creek. Though all of the genera of this McLish green shale section are represented in both Tulip Creek and Bromide, only a single species (*Schmidtella affinis* Ulrich) among a dozen McLish species at this locality ranged into the prolific fauna of the overlying Tulip Creek. The aforementioned possible McLish-Tulip Creek faulted contact at this locality may explain partially the faunal break between the two formations; nevertheless, a disconformable relationship is postulated.

No coarse clastics mark the disconformable contact with the overlying Bromide, though a 50-foot basal Bromide sandstone occurs above the contact of the type U. S. Highway 77 Tulip Creek section; and a basal Bromide sandstone of similar thickness may be observed in the West Spring Creek section; and a cross-bedded near-basal sandstone on Oklahoma Highway 99. Further evidence of erosional break between the two formations is discovered in the fact of distinctive ostracodal faunas in each. Though several species of Ostracoda are common to both Tulip Creek and Bromide formations, the majority of the species in each formation are "index" forms, either as distinct species or subspecies, and a definite line of demarcation separates the two groups in faunal range charts. Responsibility for the faunal break is attributed to a brief hiatus, possibly the least pronounced of all erosional breaks among the Simpson formations.

Age and Correlation

The Tulip Creek ostracodal fauna indicates an age of Black River for the formation. Following is a list of invertebrate fossils reported by Decker and Merritt (1931, p. 38) as indicative of Black-riverian age:

Anolotichia impolita Ulrich
Batostoma fertile Ulrich
Pachydictya acuta (Hall) Ulrich
Rhinidictya grandis Ulrich
Dinorthis deflecta (Conrad) Grabau and Shimer
Modiolopsis sp. cf. *M. occidens* Walcott
Raphistoma sp. cf. *R. peracutum* Ulrich and Scofield
Endoceras sp. cf. *E. annulatum* Hall
Bumastus erastusi (Raymond)

Schmidtella affinis Ulrich
Cryptophyllus simpsoni (Harris) Levinson
Prioniodus aculeatus Stauffer

Cooper (1956, p. 120) reported the following brachiopods from the Tulip Creek:

Atelelasma sulcatum Cooper
Hesperorthis matutina Cooper
Orthambonites minutus Cooper
Plectorthis punctata Cooper
Valcourea deckeri Cooper
Valcourea tenuis Cooper
Mimella sp. 2
Murinella sp. 2

He stated that the *Dinorthis deflecta* (Conrad) Grabau and Shimer, reported by Decker and Merritt from the Tulip Creek, was a case of misidentification . . . "because that species is restricted to the Platteville formation which is considerably younger than the Tulip Creek." Cooper correlated the Tulip Creek with the Elway of Virginia and Tennessee.

Branson and Mehl (1943, p. 376) reported six Tulip Creek conodonts in common with the Joachim of Missouri . . . . . . three, in common with the Plattin.

The following previously described Ostracoda occur in the Tulip Creek and indicate an age of Black River for the formation.

Aparchites maccoyii (Salter) Jones
Aparchites millepunctatus (Ulrich)
Schmidtella affinis Ulrich
Schmidtella brevis Ulrich
Schmidtella crassimarginata Ulrich
Cryptophyllus simpsoni (Harris) Levinson
Dicranella macrocarinata Harris
Eurychilina ventrosa Ulrich
Bythocypris cylindrica (Hall) Ulrich

Finally, the close affinity of Tulip Creek and Bromide Ostracoda in both genera and species is suggestive of Blackriverian age for both formations.

The Tulip Creek is correlated with the Decorah of the upper Mississippi Valley. Tentatively the Tulip Creek (or McLish) is correlated with the Burgen-Tyner section of northeastern Oklahoma . . . . Tyner conodonts suggest an age of either McLish or Tulip Creek.

Ostracoda

The Tulip Creek contains the following "index" species of Ostracoda:

Hyperchilarina angularis Harris, n. sp.
Hyperchilarina ovata Harris, n. sp.
Leperditella altiforma Harris, n. sp.
Kayina hybosa Harris, n. sp.
Schmidtella asymmetrica Harris, n. sp.
Schmidtella brevis Ulrich
Schmidtella excavata Harris, n. sp.
Schmidtella ovalis Harris, n. sp.
Cryptophyllus nuculopsis Harris, n. sp.
Eoprimitia ? subnodosa Harris, n. sp.
Primitiopsis elegans Harris, n. sp.
Primitiopsis excavatus Harris, n. sp.
Eohollina depressa (Kay) subsp. *papillata* Harris, n. subsp.
Ctenobolbina cancellata Harris, n. sp.
Ctenobolbina inflata Harris, n. sp.
Ctenobolbina percarinata Harris, n. sp.
Winchellatia cornuta Harris, n. sp.
Bromidella reticulata Harris (Occurs in lower Bromide also)
Eobromidella eurychilinoides Harris, n. sp.
Coelochilina alatispinata Harris, n. sp.
Balticella deckeri subsp. *elongata* Harris, n. subsp.
Monoceratella brevispinata Harris, n. sp.
Thomasatia simplex Harris, n. sp.
Rayella calvini Kay subsp. *parva* Harris, n. subsp.

The following three species were recovered from the McLish, Tulip Creek, and Bromide formation:

Schmidtella affinis Ulrich
Schmidtella crassimarginata Ulrich
Cryptophyllus gibbosum Harris, n. sp.

The following species range from the Tulip Creek into the Bromide:

Aparchites maccoyii (Salter) Jones
Aparchites millepunctatus (Ulrich)
Hyperchilarina nodosimarginata Harris, n. sp.
Schmidtella minuta Harris, n. sp.
Schmidtella transversa Harris, n. sp.
Cryptophyllus simpsoni (Harris) Levinson
Primitiopsis minutus Harris, n. sp.
Dicranella macrocarinata Harris (Rare in Bromide)
Eurychilina ventrosa Ulrich
Bythocypris cylindrica (Hall) Ulrich

BROMIDE FORMATION

Establishment

Ulrich (1911, pl. 27) established the Bromide formation as . . . "the formation occurring between the Simpson and Viola limestone" (column 4, Fig. 1). Bassler (1915, pl. 2) likewise considered the Bromide (of Blount and Black River age) in stratigraphic position between the Simpson and the Viola (column 5, Fig. 1); as did Ulrich (1927, Fig. 2) again in 1927 (column 6, Fig. 1). Edson (1927, p. 969) depicted the Bromide as Lowville in age and correlative with the Tyner of northeastern Oklahoma, and the Joachim of Missouri. In 1928 Ulrich (Decker 1930, p. 1495) divided the Simpson into Oil Creek, Bromide, and West Spring Creek (with Criner member); curiously enough considering the West Spring Creek (with Criner member) in unconformable relationship between the underlying Bromide and overlying Viola (column 7, Fig. 1). Later Ulrich (Decker 1930, p. 1495) revised the Simpson section to include seven formations, Joins Ranch, Nebo, Falls, McLish, Tulip Creek, Criner, and Bromide (column 8, Fig. 1). In this revision the West Spring Creek formation (of the previous chart) was removed and reserved for later assignment as the uppermost formation of the Arbuckle group. The Criner formation was retained, however, but was assigned to stratigraphic position unconformably below (not above) the Bromide. In 1929 Ulrich (1929b, p. 73) presented essentially the same chart, i. e., Joins, Oil Creek, McLish, Falls, Tulip Creek, Criner, and Bromide (column 9, Fig. 1). In this chart Joins Ranch was shortened to Joins; the pre-empted term, Nebo, was abandoned in favor of Oil

Creek; and the position of Falls and McLish was reversed. Decker and Merritt (1930, table) and (1931, p. 16) shortened the Simpson section to include the five formations as currently adopted: Joins, Oil Creek, McLish, Tulip Creek, and Bromide (column 10, Fig. 1), though Decker (1930, p. 1498) in the interim temporarily postulated the validity of the term, Falls (column 11, Fig. 1).

In all of the aforementioned charts (excepting that of Ulrich 1928) (column 7, Fig. 7) published during the interim 1911 to 1931, the Bromide formation was portrayed as topmost Simpson. In 1932 Ulrich (Edson 1935 b, p. 1122) added the Webster above the Bromide, "for beds of late Black River and early Trenton age . . . beds correlating with the Decorah of Minnesota and with Taff's lower Viola" (column 12, Fig. 1). The Cool Creek formation was also established at this time in stratigraphic position between the Tulip Creek and overlying Criner.

Cooper (1956, pp. 120-121) divided the Bromide into two members, Mountain Lake and overlying Pooleville (column 20, Fig. 1). The Mountain Lake included (in general) Ulrich's Cool Creek (Edson 1935b, p. 1122) formation; while the Pooleville apparently included Ulrich's Criner and Webster (name preempted).

The Corbin Ranch of this publication (column 21, Fig. 1) includes only the topmost 20 to 30 feet of the Bromide section, i. e., uppermost Webster of Ulrich . . . . . uppermost Pooleville of Cooper.

Loeblich (1942, pp. 413-415) has presented an excellent resume of Bromide research.

Type Section

The Bromide was named for exposures near the town of Bromide in Coal County, Sec. 32, T. 1 S., R. 8 E., at the eastern end of the Arbuckle Mountains. The type section is exposed as a faulted inlier of upper Simpson immediately northwest of the site of the Galbraith Hotel in Bromide, Oklahoma. Loeblich (1942, p. 416) measured and described in 15 beds of this section some 128 feet of limestone and shales. The topmost 10 to 18 feet of dense thin-bedded limestones of Loeblich Beds 2 and 3 are quite probably the Corbin Ranch formation. Furthermore, it is quite possible that the lower part of the section (plus additional section covered at the base) involves some normal or faulted Tulip Creek strata, since both Decker and the writer in independent research have recognized in the east central part of the Arbuckles (Oklahoma Highway 99 Simpson section) Tulip Creek strata originally recorded as Bromide (Decker 1941, p. 663).

Bromide sections, more typical than the abbreviated section of the type locality, are recorded along U. S. Highway 77 and West Spring Creek (Decker and Merritt 1931, pp. 54-55), where the formation displays the cyclic deposition so characteristic of Simpson formations, and, accordingly, is divisible into two parts; a basal sand, and an upper section of limestones and shales.

Lithology

The Bromide sandstone is thin-bedded to massive, off-white to buff in color, and is composed of angular to rounded quartz grains generally smaller than 0.50 mm in diameter, though occasional rounded frosted grains may attain a diameter of 0.75 to 1 mm.

Bromide shales are light green in outcrop and darker and harder in subsurface "cuttings". An occasional maroon shale layer is interbedded with the green. The shales weather to buff in outcrop. Ostracoda are abundant in the shales and are readily freed of the matrix in the washing process.

The limestones vary from thin to massive, though the former occur more commonly; they are nodular in the upper part of the section. In crystallinity the limestones vary from fine to coarse, and either type in fresh exposure may be mottled with fossil fragments.

The topmost dense section is assigned herein to the Corbin Ranch; accordingly, no lithographic nor "birdseye" lithology is observed in the Bromide proper. The limestones vary in color from light, to gray, to buff or brown; they are not as blue or pink on fresh surface as many of the Tulip Creek limestones. Bedding planes may be plastered with fossils, including Ostracoda and Bryozoa.

Thickness

The U. S. Highway 77 revised Bromide section, involving Decker Zones 1 through 25, is 427 feet in thickness; subdivisible into a 55- to 60-foot basal sandstone, and a 370-foot section of overlying shales and limestones. The West Spring Creek revised section, involving Decker Zone 1 through the upper five-eighths of Zone 20, is 420 feet in thickness, subdivisible into the same basal sandstone (60 to 75 feet), and overlying shale and limestone section (355 feet). Hence, the two sections (only 11 miles apart) are practically identical in lithology and thickness. The Bromide section on Sycamore Creek (Decker and Merritt 1931, pp. 70-71), 17 miles east of U. S. Highway 77 section, includes Decker Zone 1 through the upper half of Zone 22. The same 400-foot Bromide section occurs here as in the two aforementioned western sections, though the basal sand here is 20 to 30 feet thicker. The revised Bromide section of Oklahoma Highway 99 (abbreviated by faulting) involves Decker Zone 15 through the upper two-thirds of Zone 34, and is approximately 105 feet in thickness (Zones 23 and 25 apparently representing faulted repetition of section). It is altogether possible that the lower contact here should be some ten feet higher than indicated in Zone 34, i. e., nearer the base of the cross-bedded sands and sandy limestones of Zones 28 to 32. The revised Bromide section at Rock Crossing in the Criner Hills (Decker Zone 1 through the upper one-fourth of Zone 6) is 200 feet in thickness. The lower contact here occurs immediately below a 14-inch limestone bed at the top of Zone 6, a thin, oxidized, detrital shale seam marking the contact . . . . . no basal Bromide sandstone is observed here. The Bromide (and possibly the Corbin Ranch) are the only two Simpson formations exposed in the Wichita Mountains, though some 1,500 feet of subsurface Simpson section was portrayed by Cram (1930, p. 623) in a near-by well, the upper 350 feet probably being Bromide.

Cram (1948, p. 346) reported 360 feet of Bromide in the subsurface of Cumberland oil field. Disney and Cronenwett (1955, p. 110) reported 256 feet Bromide sand ("First Wilcox", 13 feet; "Second Wilcox", 243 feet) overlain by 65 feet of Bromide or Simpson Dolomite in the subsurface of Cleveland County. Kimberlin (1955, p. 9) reported a minimum thickness of 240 feet in Canadian County. Akmal (1953, p. 8) reported 165 feet in Lincoln and Payne Counties; Ford (1954, p. 10) reported 270 feet from Logan County; Page (1955, p. 10) reported 270 feet from Noble County; Cary (1955, p. 9) reported 175 to 275 feet in the subsurface of Garfield

County. Allen (1954, p. 15) reported from 90 to 250 feet of Bromide in a Simpson section totaling 340 feet in Woods and Alfalfa Counties.

Cole, Dickey, and Kraus (1941, p. 1057) reported 185 feet of Bromide in the subsurface of Pecos County, Texas.

In descending order the subsurface Bromide section of Oklahoma is subdivisible into Simpson Dolomite, "First Wilcox" Sand, Marshall Zone, and "Second Wilcox" Sand. The "First Wilcox" Sand and "Second Wilcox" Sand in the subsurface of Grady and Garvin Counties, et al, are observed to fuse into a single sand ("Second Wilcox") in central Oklahoma . . . . . . the "First Wilcox" Sand then being simply the topmost element of the more massive "Second Wilcox".

Relationship

The Bromide is postulated herein in disconformable contact with both the underlying Tulip Creek and the overlying Corbin Ranch.

Many Bromide sections, particularly those of the southern side of the Arbuckle Mountains and in the subsurface of Oklahoma, display a thick basal sandstone, though no true basal conglomerates have been reported at the contact with the underlying Tulip Creek. Edson (1930, pp. 947, 1227) reported that Oklahoma stratigraphers recognize a pronounced subsurface Tulip Creek-Bromide unconformity; and Cronenwett (1956, thesis) displayed it in an electrical log cross-sectional study of east central Oklahoma. Cram (1948, p. 346), however, stated that the Tulip Creek of the Cumberland oil field of southern Oklahoma is simply an expanded part of the basal Bromide, a conception advanced by many oil company geologists of the state. Such conception may be justified to some extent from a lithologic standpoint, but ostracodal research indicates otherwise. An examination of the Ostracoda Range Charts (in pocket) reveals an abrupt faunal break at the Tulip Creek-Bromide contact. The majority of some three dozen ostracodal species in the Tulip Creek are observed to have disappeared at the Bromide contact, and shortly above the contact a prolific Bromide fauna is observed to have appeared. A brief hiatus is deemed responsible for this normal faunal break between the two formations. With the exception of the thin detrital zone at the Tulip

Creek-Bromide contact of the Rock Crossing section, the writer has not observed freshly exposed Tulip Creek-Bromide contacts. The aforementioned ostracodal faunal breaks across the contact is convincing evidence that such freshly exposed, clean-cut contacts should display some indication of erosion.

The Bromide is overlain disconformably by the Corbin Ranch formation. A thin, ferruginous, oxidized zone or discolored surface, with some carbonaceous material marks the contact at the base of Zone 14 on Oklahoma Highway 99. Furthermore, the lithology of the uppermost Bromide section involves nodular limestones and shale, in contrast to that of the lithographic limestone and calcareous shales of the overlying Corbin Ranch. Again, distinctive Ostracoda suites in both the Bromide and the Corbin Ranch offer convincing evidence of an erosional hiatus having separated the two formations. With the exception of long-ranging, conservative *Eoleperditia fabulites* (Conrad) Swartz, none of the three dozen ostracodal species of the Bromide occurs in the overlying Corbin Ranch, the post-Bromide hiatus having been responsible for the extinction of the Bromide fauna. The eight to twelve ostracodal species that entered the Arbuckle basin with the Corbin Ranch sea were distinctly different from those living in Bromide waters.

Age and Correlation

Decker and Merritt (1931, p. 48) listed many fossils from the Bromide that indicate an age essentially Blackriverian. A few are listed as follows:

Rafinesquina minnesotensis (Winchell)
Ischadites iowensis (Owen)
Zygospira nicolleti Winchell and Schuchert
Dinorthis subquadrata (Hall)
Cliftonia gouldi Decker
Orthis tricenaria Conrad
Rhyncotrema minnesotensis (Sardeson)
Plectambonites sericeus (Sowerby)
Diplograptus maxwelli Decker
Tetranota obsoleta Ulrich and Scofield
Prasapora simulatrix Ulrich
Monotrypa magna Ulrich

Ampyx mcgeheei Decker
Isoteles gigas DeKay
Illaenus americanus (Billings)

Cooper (1956, p. 121) listed 40 new species of brachiopods from the lower Bromide (Mountain Lake member); and some 50 species from the upper Bromide (Pooleville member). Apparently not a single species crossed the Mountain Lake-Pooleville contact, for distinctive species are listed from the two separate formations.

Cooper revised the list of Decker and Merritt (1931, p. 48) as follows (part):

Rafinesquina minnesotensis=Öpikina minnesotensis (Winchell)
Zygospira nicolleti=Protozyga loeblichi Cooper
Dinorthis subquadrata=Chaulistomella magna Schuchert and Cooper
Cliftonia gouldi=Oxoplecia gouldi (Decker)
Orthis tricenaria=Hesperorthis sulcata Cooper
Rhynchotrema minnesotensis=Rostricellula transversa Cooper
Plectambonites sericeus (Sowerby)
Other species identified questionably

Cooper correlated the Mountain Lake with the Lincolnshire, and the Pooleville with the Wardell of the Appalachian district.

Loeblich (1948, p. 417) concluded from a study of 30 Bromide bryozoan species that the fauna is Decorah in age (Black River of authors; Trenton of Kay . . . 1937, p. 294).

His faunal list included the following previously described species:

Anolotichia impolita (Ulrich)
Dekayella praenuntia var. *echinata* Ulrich
Nicholsonella laminata Ulrich
Batostoma winchelli Ulrich
Hemiphragma irrasum Ulrich

The Ostracoda of the Bromide also indicate an age of Blackriverian, several of the species having been recorded from the Decorah of Minnesota. Follows a list of Bromide species previously described from Black River strata:

Eoleperditia fabulites (Conrad) Swartz . . . also in McLish and Corbin Ranch
Halliella labiosa Ulrich

Eohollina depressa (Kay) Harris
Winchellatia longispina Kay
Eurychilina subradiata Ulrich
Krausella arcuata Ulrich
Rayella calvini Kay
Punctaparchites rugosus (Jones) Kay
Aparchites millepunctatus (Ulrich) . . . . also in Tulip Creek
Eurychilina ventrosa Ulrich . . . . also in Tulip Creek
Bythocypris cylindrica (Hall) Ulrich . . . also in Tulip Creek

Additional and rather conclusive evidence of Blackriverian age of Bromide Ostracoda is discovered in the close relationship of the Bromide ostracodal fauna to that of the underlying Tulip Creek (and the McLish also, for that matter). Though a definite faunal break occurs at the Tulip Creek-Bromide contact, by reason of a brief erosional hiatus, several of the Tulip Creek species are observed to have crossed the hiatus into the overlying Bromide . . . . and several other Tulip Creek species are observed to have survived the erosional hiatus to re-enter the Arbuckle basin as varietal forms in the Bromide sea. Thus, the Bromide is closely related to the Tulip Creek. On the other hand, no Bromide species except *E. fabulites* occurs in Corbin Ranch of Trenton age; neither are any Bromide species observed in the Viola limestone, containing such Trenton fossils as *Cryptolithus tesselatus* Greene, and *Ceratopsis chambersi* (Miller). The Bromide, accordingly, in ostracodal affinity is evidently not as closely related to the overlying Corbin Ranch and Viola (both Trenton age, and neither containing Bromide Ostracoda) as to the underlying Tulip Creek and McLish (Black River age, and containing several Bromide species).

Ostracoda

The following 34 species and subspecies of Ostracoda were discovered as "index fossils of the Bromide:

Eoleperditia inflativentralis Harris, n. sp.
Paraparchites ? circulantis Harris, n. sp.
Leperditella incisa Harris, n. sp.
Leperditella rex (Coryell and Schenck) subsp. *minima* Harris, n. subsp.
Kayina ? porosa Harris, n. sp.

Schmidtella excavata subsp. *incisa* Harris, n. subsp.
Primitiella constricta Ulrich subsp. *varicata* Harris, n. subsp.
Echinoprimitia imputata Harris, n. sp.
Eoprimitia bailyana (Jones and Holl) Harris
Eoprimitia cooperi Harris, n. sp.
Eoprimitia quadrata Harris, n. sp.
Euprimitia elegans Harris, n. sp.
Halliella labiosa Ulrich
Primitiopsis bassleri Harris
Eohollina depressa (Kay) Harris
Ctenobolbina bispinata Harris, n. sp.
Ctenobolbina cancellata subsp. *varicata* Harris, n. subsp.
Ctenobolbina parva Harris, n. sp.
Winchellatia longispina Kay
Trubinella teisi Harris, n. sp.
Acanthobolbina loeblichi Harris, n. sp.
Dicranella fragilis Harris, n. sp.
Eurychilina papillata Harris, n. sp.
Eurychilina subradiata Ulrich
Balticella deckeri (Harris)
Glymmatobolbina quadrata Harris, n. sp.
Thomasatia auricula Harris, n. sp.
Thomasatia bromidensis Harris, n. sp.
Tetradellina henningsmoeni Harris, n. sp.
Krausella arcuata Ulrich
Rayella calvini Kay
Platyrhomboides quadratus Harris, n. sp.
Bythocypris ? spinosa Harris, n. sp.
Punctaparchites rugosus (Jones) Kay

The following ten species occur in the Bromide and the Tulip Creek:

Aparchites maccoyii (Salter) Jones
Aparchites millepunctatus (Ulrich)
Hyperchilarina nodosimarginata Harris, n. sp.
Schmidtella minuta Harris, n. sp.
Schmidtella transversa Harris, n. sp.
Cryptophyllus simpsoni (Harris) Levinson
Primitiopsis minutus Harris, n. sp.
Dicranella macrocarinata Harris (Extremely rare in Bromide)

Eurychilina ventrosa Ulrich
Bythocypris cylindrica (Hall) Ulrich
Four species range from the McLish into the Bromide:
Eoleperditia fabulites (Conrad) Swartz
Schmidtella affinis Ulrich
Schmidtella crassimarginata Ulrich
Cryptophyllus gibbosum Harris, n. sp.

CORBIN RANCH FORMATION

Establishment

In 1932 Ulrich presented from manuscript a Simpson chart before the Geological Society of America in New York City, which was not published until 1935 (Edson 1935b, p. 1122). In this chart (column 12, Fig. 1) the Webster was portrayed as a new formation lying between the Bromide and the overlying Viola. Ulrich intended the Webster, "for beds of late Black River and early Trenton age . . . beds that correlate with the Decorah of Minnesota and with Taff's lower Viola". Edson (1935b, Fig. 8) indicated confusion in text and chart (column 15, Fig. 1) concerning the exact stratigraphic position that Ulrich had visualized for the Webster. In assigning the Webster to the stratigraphic position beneath the Viola limestone, then it follows that Ulrich intended exclusively or as a part thereof the lithographic limestone and calcareous shale section at the top of the Simpson section herein termed the Corbin Ranch formation. The following statement by Ulrich (1927, pp. 28-29) (when the Simpson section consisted of only a lower part, Simpson, and an upper part, Bromide) must be interpreted also as referring, in part at least, to the section he termed Webster in 1932 (the writer has emphasized the element of the statement particularly apropos):

> The Simpson faunas of Taff comprise at least three faunas of exceedingly diverse origin and geographic distribution. The lowest has a Pacific fauna strictly comparable only with the upper Pogonip of Nevada; the succeeding lower Bromide contains an Atlantic fauna not found in northern Arkansas and whose path of migration must now be covered by overthrusted sheet of Ouachita formations; **and the closing stage, provisionally added to Bromide, that contain a good representation of Decorah and Prosser faunas of Minnesota,** which are regarded as having invaded from far north. None of these faunas nor any bed that might contain them occur in southern Missouri or Arkansas.

Cooper's Bromide brachiopodal research (1956, pp. 120-121) resulted in his subdividing the Bromide into two members, Mountain Lake and overlying Pooleville. The Mountain Lake (in general) is Ulrich's Cool Creek formation, while the Pooleville apparently includes Ulrich's Criner and his Webster (name preempted). The Corbin Ranch of this publication is the topmost lithographic limestone and calcareous shale section of Cooper's Pooleville.

Edson (1935a, Fig. 4) portrayed in the Arbuckle Mountain section an un-named formation of lower Prosser age resting conformably upon the underlying Webster and unconformably beneath the overlying Viola. This un-named unit is the Corbin Ranch formation of this publication.

Decker and Merritt (1931, p. 42) inadvertently mentioned the Corbin Ranch on the norhwestern side of the Arbuckle Mountains, "At one locality on the south side of Colbert Creek, four miles southwest of Davis, about 30 feet of thin limestones occur between the heavy beds (Bromide) and the typical Viola." Washed samples from this locality have produced the typical Corbin Ranch ostracodal fauna.

In subsurface sections of Oklahoma the top of the Simpson section is often termed "Simpson Dense". This is the Corbin Ranch formation.

Type Section

The type section involves Decker Zones 2 through 14 of the Oklahoma Highway 99 Simpson section (Decker 1941, p. 663) on the Carleton W. Corbin Ranch, on the west side of Oklahoma Highway 99, three miles south of Fittstown, Oklahoma. The formation is described in detail as follows:

(See also p. 97 for zones, lithology, and description)

Decker Zone		Inches
	.... Viola limestone	
1	Gray-green, slightly oxidized, glauconitic, fossiliferous (re-worked ? Bryozoa and brachiopods) detrital shale, separating irregular disconformable surfaces of Corbin Ranch and overlying Viola limestone	2
	.... Top Corbin Ranch	
2	Dense, gray-white, fossiliferous limestone, somewhat argillaceous and crumbling near base; oxidized, slightly pyritized, coarser, and buff-colored in topmost third	6
3	Hard, dense, gray-white, fossiliferous limestone	13
4	Nodular, dense, gray-white, fossiliferous limestone layers interbedded with gray-green shale	9
5	Dense, hard, oyster-white, fossiliferous, "birdseye" limestone (as in Zone 3)	4
6	Dense, off-white, fossiliferous, nodular, "birdseye" limestone layers interbedded with fossiliferous gray-white calcareous shale lentils (as in Zone 4)	13
7a	Lithographic, oyster-white, "birdseye" limestone layers with innumerable subcircular algal ? ringlets on exposed surface	6
7b	Chalky-white, dense, fossiliferous, nodular limestone with gray-white, calcareous, fossiliferous shale breaks (as in Zones 4 and 6)	9
8	Dense, fossiliferous, "birdseye" limestone with bedding plane separating upper third from lower two-thirds	16
9a	Gray-white, calcareous shale break	1
9b	Dense, off-white, fossiliferous limestone with several bedding planes	5
9c	Thin-bedded, green-gray, fossiliferous, calcareous shale with a few thin, fossiliferous limestone lentils in upper half	12
10a	Hard, dense, gray-white, fossiliferous, "birdseye" limestone with algal ? ringlets	7
10b	Gray, calcareous shale break	2
10c	Lithographic, gray-white, "birdseye" limestone with algal ? ringlets, tinted pink in lower half and grading into Zone 11	10
11	Some two dozen gray-white, hard, dense, fossiliferous limestone layers with algal ? growth, the series separated by thin, gray, calcareous shale breaks. (This section pink-tinted)	56
12	Hard, dense, fossiliferous, off-white to buff, slightly dolomitic limestone. The upper face of this layer is somewhat irregular, somewhat case-hardened, with pink oxidized surface, slightly pitted	13
13	Thin-bedded, fossiliferous, gray-white and pink limestone with interbedded shale films, including an inch of shale at base	18
14a	Hard, dense, off-white, fossiliferous limestone with an inch of gray, calcareous shale at base	9
14b	Hard, dense, slightly fossiliferous, light buff limestone becoming "gritty" toward base	13
14c	Green-gray, calcareous, "gritty" shale resting upon slightly oxidized, irregular surface	5
	.... Top Bromide .... Total	19 Feet

Lithology

In the outcrop the Corbin Ranch formation consists of hard, dense to lithographic, off-white, fossiliferous limestone, with thin,

TYPE SECTION
CORBIN RANCH FORMATION
WEST SIDE OKLA. HWY 99, 3 MILES S. FITTSTOWN, OKLA.

ZONE	LITHOLOGY		DESCRIPTION
	Viola		
1		2"	2" Detrital green glauconitic shale
			— Top of Corbin Ranch —
2		6"	2" Buff, hard, oxidized, fossiliferous dense limestone 4" Dense, off-white, fossiliferous limestone, crumbly near base
3		13"	Hard, dense off-white fossiliferous limestone
4		9"	Interbedded off-white, nodular limestone and gray-green shale
5		4"	Hard, dense "birdseye" limestone (as in Zone 3)
6		13"	Off-white, nodular "birdseye" limestone layers interbedded with calcareous shale (as in Zone 4)
7a		16"	7" Hard, dense, off-white "birdseye" limestone layers (as in Zone 3 & 5) with algal ? ringlets
7b			9" Interbedded, nodular, gray-white, fossiliferous limestone and shale (as in Zones 4 & 6)
8		16"	Hard, dense, off-white, fossiliferous "birdseye" limestone (upper 1/3 separated by bedding plane)
9a		18"	1" Gray shale
9b			5" Gray-white fossiliferous limestone
9c			12" Thin-bedded, fossiliferous, calcareous, green-gray shale with thin limestone lentils in upper part
10a		19"	7" Hard, dense, fossiliferous, gray-white limestone with algal ? ringlets
10b			2" Thin, calcareous, gray fossiliferous shale
10c			10" Hard, dense, gray-white, fossiliferous "birdseye" limestone with algal ? ringlets grading into Zone 11
11		56"	Some two dozen, hard, dense, fossiliferous limestone layers with algal ? ringlets separated by thin, gray, calcareous shale breaks (this section tinted pink)
12		13"	Hard, dense, fossiliferous limestone... upper face pitted, oxidized, case-hardened.... probably not erosional, however *Leperditella porata* — *Leperditella tumida*
13		18"	Thin-bedded gray-white and pinkish limestone with interbedded shale films (this section includes an inch of shale at base) *Eoleperditia fabulites*
14a		27"	9" Dense, off-white, fossiliferous hard "birdseye" limestone (this section includes an inch of gray shale at base
14b			13" Hard, dense, slightly fossiliferous, buff-white limestone, gritty" at base
14c			5" Green, calcareous, "gritty" shale resting upon oxidized surface of Bromide
	Bromide		

calcareous, gray-white, fossiliferous shales. In the type section the lower part is tinted pink. Another characteristic involves subcircular algal ? ringlets from one to several inches in diameter . . . . . these ringlets particularly noticeable four feet below the top and near the middle of the section. Washed samples of the "gritty" section in Zone 14 reveal innumerable brecciated echinodermal and bryozoan fragmenta, with no sand. Ostracoda occur throughout the section.

Outcrops of Corbin Ranch limestone are generally more massive, contain no graptolites, and ordinarily contain no chert, in contrast to the overlying thin-bedded, graptolitic, cherty Viola limestone. Since the Corbin Ranch is in disconformable contact with both bounding formations, however, one should expect some chert marking the contact upon occasions. Ford (1954, p. 10) reported 10 feet of white chert underlying 50 feet of Simpson dense limestone in the subsurface of Logan County. Since the subsurface Viola contains a dense limestone similar to the Corbin Ranch dense limestone, the white color of this chert is significant, for it indicates to the writer that it is not the brownish to resinous smoky chert with included brown flecks and short dark spicular ? rods or tubules, so characteristic of the Viola chert; hence, the overlying 50 feet of "dense" limestone is Simpson "dense" (Corbin Ranch), and not the Viola "dense".

In subsurface the formation is known as the Simpson "Dense", Bromide "Dense", or Bromide "Lithographic"; and here again it is characteristically hard, dense, conchoidally-fracturing, off-white to buff limestone becoming noticeably dolomitic toward the base. Since the subsurface Viola section also contains a "dense" limestone, careful examination of "cuttings" is mandatory for correct identification. In this respect, the Viola "dense" is generally associated with the aforementioned brownish-to-resinous smoky chert containing short dark spicular ? rods or tubules . . . . the limestone "cuttings" also contain the characteristic flecks and dark rods. Furthermore, the Viola "dense" and associated limestone "cuttings" often display reticulated fragments of the "lace-collar" cryptolithid trilobite, whereas the Simpson "dense" may be associated with a lighter chert or contain one or more specimens of its several characteristic Ostracoda.

The Corbin Ranch limestone displays conchoidal fracture, even on outcrop, so that Ostracoda are recovered only by carefully teasing fragments with a needle, or by selecting outcrop fragments whose parting planes display Ostracoda in lateral profile. The calcareous shales of the outcrop, however, "break down" following repeated boiling, and the residue contains many excellent Ostracoda.

The formation has been identified in the Arbuckle Mountains only at the type locality on Oklahoma Highway 99 and at the aforementioned locality on Colbert Creek, four miles southwest of Davis, Oklahoma, both localities being on the northern side of the Arbuckles. The writer has identified it from fossiliferous (*Leperditella tumida* Ulrich) subsurface cuttings from a well drilled near Davis. The formation is missing in the type Simpson sections at Falls Creek, U. S. Highway 77, West Spring Creek, and Rock Crossing. Normally the formation occurs between the massive, resistant uppermost Bromide (Pooleville) beds and the Viola.

Thickness

The formation is only 19 feet in thickness at the type locality on Oklahoma Highway 99, involving Decker Zones 2 through 14. The formation is approximately 24 feet thick on Colbert Creek, southwest of Davis, Oklahoma.

In subsurface the formation varies in thickness from zero to more than 100 feet. Wallace (1954), p. 10) reported from 90 to 110 feet in Grady County; Hayes (1952, p. 17), 90 feet in Comanche County; Dannenberg (1952, p. 9), 60 feet in Coal County; McKenney (1953, p. 7), 13 feet in Logan; Akmal (1953, p. 8), 10 feet in Lincoln and Payne Counties.

Ford's report of 50 feet of Simpson "Dense" (1954, p. 10) underlain by 10 feet of white chert has been mentioned previously. The white color of the chert is significant, since it indicates to the writer that it is not the Viola brownish-to-resinous smoky chert with included brownish flecks and short dark spicular ? rods or tubes; hence, the overlying 50 feet of dense limestone is actually Simpson "Dense" (Corbin Ranch) and not the Viola "Dense".

Relationship

The Corbin Ranch displays disconformable relationship with the underlying Bromide Pooleville and the overlying Viola limestone.

The base of the Corbin Ranch is characterized by a slightly irregular, iron stained surface with occasional thin red shale detrital. Ford's report of chert at the Bromide-Corbin Ranch contact in the subsurface of Logan County has been previously mentioned; and chert probably marks the contact in unreported outcrop localities.

Attention is again directed to the distinctive Ostracoda suites in both the Bromide Pooleville and the Corbin Ranch, the Pooleville containing some 36 distinctive forms, none of which occurs in the overlying Corbin Ranch, the post-Pooleville erosional hiatus being responsible for the extinction of Pooleville forms. On the other hand, the Corbin Ranch contains eight to twelve characteristic species, none of which occurs in the Pooleville nor in the overlying Viola.

At the type locality on Oklahoma Highway 99 the contact is marked by an irregular, two- to three-inch, soft, ferruginous, red shale layer with associated pyrite, glauconite, and carbonaceous material (particularly noticeable in washed residue). Furthermore, the hard, lithographic Corbin Ranch limestone is observed in lithologic contrast to the overlying thin-bedded, cherty, graptolitic Viola limestone. At Rock Crossing locality on Hickory Creek in the Criner Hills, where the Corbin Ranch is missing as a result of erosion (or faulting ?), a thin bog-iron red shale seam marks the Bromide Pooleville-Viola contact.

Attention has been directed to the fact that all of the Corbin Ranch Ostracoda became extinct during the post-Corbin Ranch hiatus; the succeeding Viola sea introducing for the first time such Trenton ostracodal species as *Ceratopsis chambersi* (Miller) Ulrich and *Primitiella* sp. cf. *P. unicornis* (Ulrich).

Age and Correlation

The following three previously described *Ostracoda* occurring in the Corbin Ranch indicate an age of Black River-Trenton for the formation:

Eoleperditia fabulites (Conrad) Swartz
Leperditella aequilatera (Ulrich)
Leperditella tumida (Ulrich)

The fact that the three to four dozen Tulip Creek-Bromide Ostracoda (unquestionably Blackriverian in age) perished at the end of Bromide Pooleville time, indicates indirectly an age of Trenton for the eight to twelve distinctly different Ostracoda appearing in the succeeding Corbin Ranch formation.

The Corbin Ranch is correlated with the Simpson "Dense" or Bromide "Dense" in the subsurface section of Oklahoma. It is correlative with the Prosser formation of the upper Mississippi Valley. It is correlated tentatively with the Fite limestone of northeastern Oklahoma.

Ostracoda

The Corbin Ranch contains the following Ostracoda, none of which occurs in the overlying Viola, and only one of which, *Eoleperditia fabulites* (Conrad) Swartz, in the underlying Bromide:
Eoleperditia fâbulites (Conrad) Swartz
Leperditella aequilatera (Ulrich)
Leperditella ? jonesinoides Harris, n. sp.
Leperditella porosa Harris, n. sp.
Leperditella rex (Coryell and Schenck)
Leperditella tumida (Ulrich)
Ctenobolbina abrupta Harris, n. sp.
Coelochilina alata Harris, n. sp.

SUMMARY

Ostracodal research reveals disconformable relationships not only among the three Ordovician groups of the Arbuckle area (Arbuckle, Simpson, and Patterson Ranch), but also among the various formations of the Simpson (Fig. 19; and column 21, Fig. 1).

In Arbuckle Mountain outcrops the basal conglomerate of the Simpson Joins is not particularly pronounced in coarseness, thickness, nor in areal extent. In fact, in the subsurface of Oklahoma and Texas, the Arbuckle/Ellenburger-Joins contact generally appears transitional through a dolomitic sequence, rather than disconformable; clastics are generally missing. Ostracodal research reveals, however, that the hiatus separating West Spring Creek (Arbuckle Beekmantown) and Joins (Chazy) was of such duration and significance that all of the Arbuckle Ostracoda became extinct ere the Joins sea entered the Arbuckle basin.

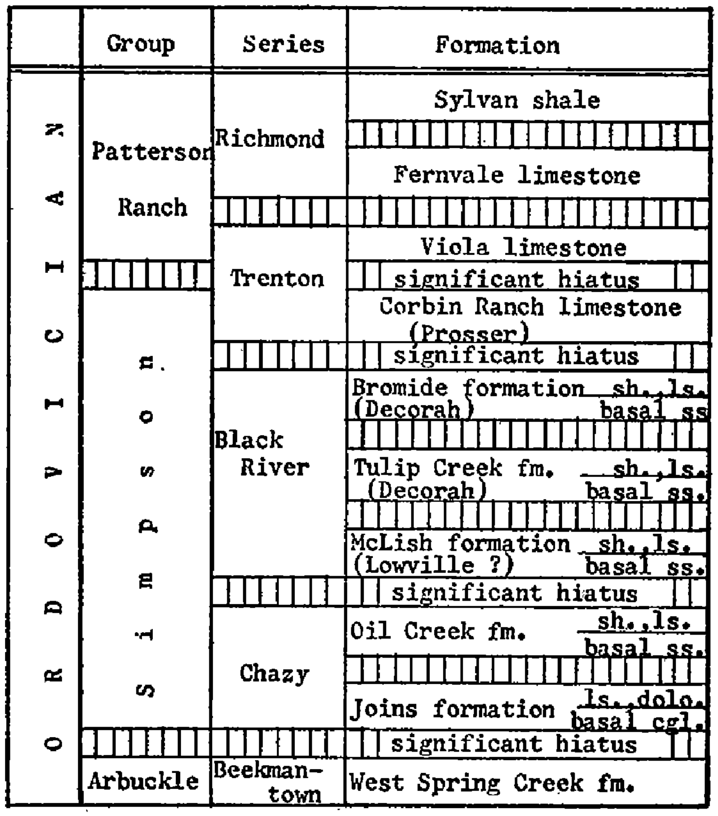


Figure 19. Simpson Formations of the Arbuckle Mountains, Harris 1956

A brief Joins-Oil Creek hiatus was deemed responsible for the slight faunal "break" in Chazyan ostracodal development in the Arbuckle area. The hiatus separating the Chazyan Oil Creek from the Blackriverian McLish, however, was so pronounced that the Chazyan Ostracoda "died out" ere the McLish (Black River) sea entered the Arbuckle basin.

The McLish, Tulip Creek, and Bromide contain in common many ostracodal genera and several species that indicate an age of Black River for the three formations. Interformational disconformities, however, were responsible for distinctive "index" faunal suites and species within the formations. The McLish is possibly Lowville in age, while the Tulip Creek and Bromide fauna is of Decorah complex.

The absence of Bromide ostracodal species in the overlying Corbin Ranch formation indicates that a significant erosional hiatus separated the two formations. The Corbin Ranch is considered Trenton in age because of the distinct "break" or absence of distinctive Black River Ostracoda of the preceding Tulip Creek and Bromide.

A significant hiatus was responsible also for the fact that no Corbin Ranch ostracodal species occur in the overlying Viola limestone.

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PART 2

THE SIMPSON OSTRACODA

A detailed discussion of the morphology and systematic classification of Ostracoda is beyond the scope of this publication. The topic as presented herein consists of:

Habitat, Anatomy, Carapace, and Classification of Ostracoda
Description of Simpson Ostracoda
Summary

HABITAT, ANATOMY, CARAPACE, AND CLASSIFICATION OF OSTRACODA

The Subclass Ostracoda consists of a group of small aquatic, or more commonly marine, members of the class Crustacea belonging to the Phylum Arthropoda.

Parker and Haswell (1936, p. 550) described the Subclass as follows:

"Crustacea with unsegmented or indistinctly segmented body bearing not more than four pairs of appendages on the trunk, the limbless posterior part provided with a pair of caudal styles. There is a well-developed bivalved carapace. Paired eyes may be present or absent. Both antennules and antennae are used in swimming; the latter are generally biramous. The mandibles have a palp. The young escapes from the egg as a nauplius."

Habitat

Ostracoda are gregarious, occurring in vast hordes swimming near the surface as plankton, or creeping about the bottom as benthonic scavengers among a host of bottom dwelling invertebrates of the same habit. The majority of recent species live on or near the bottom, creeping among algae and weeds or burrowing in the ooze. Except for one or two families (including Cypridae Zenker) Ostracoda are restricted to marine or brackish water. Ulrich and Bassler (1923, p. 279) reported some forms living in foul sewer waters, while others live in sulphuric waters, and even in hot springs. They further comment that practically no forms live in cold well water or spring water. The writer, however, has raised fresh-water species in the laboratory, in waters diluted and replenished from the hydrant. Such facts concerning environment indicate that Ostracoda thrive well under conditions that would prove unfavorable for most other invertebrates.

Ostracoda lived in great profusion and variety in most of the epicontinental seaways of the past, for on all continents their fossil shells are now recovered from marine clastics and nonclastics, in age ranging from Cambrian to Recent. In lesser number, more fragile, and otherwise distinctly different from their marine contemporaries, fresh-water Ostracoda, nevertheless, were abundant in the lakes and sluggish streams of the aged continents, as evidenced by their remains in sediments of these continental waters.

Ostracoda occur in all types of Simpson lithology, though free specimens are more commonly recovered from calcareous shales separating thin-bedded limestones. Some of the intraformational conglomerates near the top of the Arbuckle limestone contain many perfect eoleperditian specimens. Bedding planes of well-indurated Oil Creek and Tulip Creek calcareous sandstones may be literally plastered with specimens of only one or two species of *Paraschmidtella* Swartz and *Schmidtella* Ulrich, respectively. In many of the sandy facies, however, conodont dermal plates, teeth, and coprolites profusely scattered among ostracodal shell breccia testify to the destructive nature of this extinct scavenging marine form. Accordingly, and in the absence of the fossil ostracodes, conodont teeth and coprolites often constitute excellent index fossils of certain Simpson strata. Particularly and strikingly is this fact demonstrated in some of the sandy facies of the Tyner formation of northeastern Oklahoma, where representatives of the genus *Prioniodus* Pander, and others of his vermicular ? tribe, constitute the predominant fauna that indicates for the horizon an age of Black River.

The green and brownish calcareous shales among Tulip Creek, Bromide, and Corbin Ranch limestones contain abundant and diagnostic Ostracoda. The upper Simpson shale outcrops in Criner Hills (Rock Crossing) and along Oklahoma Highway 99 south of Fittstown are exceedingly fossiliferous. From such out-cropping shales Ostracoda are readily freed of the matrix by boiling and washing; accordingly, the major portion of the fauna herein described was thus obtained. In contrast, however, the ostracodes cannot be washed nor boiled free of the equivalent Simpson shale sections when recovered as cuttings and cores of indurated subsurface strata. Generally speaking, more ostracodal evidence is obtained from cuttings of Ordovician limestones than from the equivalent shale facies. The Simpson limestone outcrops contain abundant Ostracoda, from which they are freed with cutting and picking tools. The majority of Joins and Oil Creek fossils herein described were obtained thusly.

Anatomy

Anatomical details of the ostracodal body are determined from a study of the living animal, for with the exception of a single imperfectly preserved Carboniferous specimen, the body proper has not been discovered in fossil state.

The ostracode body is unsegmented or indistinctly segmented and bears seven or nine pairs of appendages (two of antennae, one of mandibles, two of maxillae, and two or four pairs of slender legs). Antennae and antennules are large, the latter often biramous. Both mandible and first maxillae bear a large flabellate plate, and the former bears a leg-like palp as well. The second maxillae, the last appendage of the cephalon, is jaw-like in some forms (*Cypris* Muller); leg-like in others (*Cythere* Muller). The only thoracic appendages are two or four pairs of slender legs. All appendages are adapted for swimming or creeping. The short and rudimentary posterior limbless abdominal segment is terminated by a furca, which assumes the shape of a single spinose or bifurcating plate or a pair of small caudal styles.

The body and limbs are completely encased in a bivalved chitinous or calcareous carapace, which is attached laterally to the body by means of muscles. The appendages, together with the abdominal extremity, protrude along the ventral margin of the carapace when the valves are open, the organism in lateral profile then presenting the appearance of a shell-enclosed water flea.

A distinct heart is not developed, though one of the two Recent orders (marine Mydocopa) possesses a rudimentary heart; the other Recent order (marine and fresh water Podocopa) possesses no heart.

Ostracodal reproduction is oviparous. The sexes are distinct, and generative organs of both male and female are well-developed and complex in structure. Zoologists consider variations in form of sexual organs invaluable in specific distinctions, Skogsberg (1928, p. 16) having commented relevantly, "A subdivision of the genus *Cythereis* on the basis of the shape and structure of the shell is, generally speaking, impossible . . . . . The subdivisions, on the contrary, must be based on the structure of the appendages and of the penis. Especially the structure of the penis appears to be significant. Indeed, just as in several other groups of Arthropods this organ appears to have been the seat of the initial morphological changes leading to speciation. Unfortunately, the morphological interpretation of the structural complexities of this organ is still uncertain. To carry out the homologies of its different parts will probably prove the most fascinating and fruitful morphological problem that the Ostracoda group has to offer." The sexes of Recent species generally display shells somewhat similar in size and shape. In some, *Candona* Baird, for example, the male carapace is larger and differs in outline from the female; in *Cypris* Müller the female is the larger. In fossil shells the male is generally the more slender-elongate, while the female is shorter, relatively higher, and more inflated. Living ostracodes generally carry their eggs and young brood (nauplii) in the rear portion of the carapace. Many species of Paleozoic Ostracoda display so-called sexual dimorphism of carapace, i. e., a non-velate slender male carapace and a relatively higher, marginally velate or pouched female dimorph. Many such dimorphic representatives of several genera occur in the Black River section of the Simpson. Some paleontologists consider the marginal pouch to be the "brood-pouch", and, consequently, an unmistakable feature of the posterior end. Others, including the writer, do not consider this marginal pouch invariably diagnostic of the posterior end; on the other hand, the pouch is generally located more anteriorly than posteriorly (see remarks regarding orientation).

Breeding habits of Ostracoda present several interesting facts. In the first place, propagation is effected in one of three fashions: exclusively sexual by the fertilized egg; exclusively asexual (parthenogentic) by the egg fertilized within and by the same animal; and temporarily parthenogenetic, in which a number of asexual generations alternate with a sexual generation. Systematists have incorporated the various methods of propagation among bases of generic differentiation. Parthenogenesis is common among fresh-water ostracodal species, in many of which the male is rarely observed; in others, not yet discovered. A colony of a species of *Cypris* Müller was retained in an aquarium for more than thirty years, and during the period no male appeared, reproduction occurring exclusively by parthenogenesis.

Another matter of interest and no little wonder, is the egg of the ostracoda. The fertilized eggs of the Ostracoda may well be considered the original "Easter Eggs", for their limy shells vary in color from white, to red, to green. They are laid singly or in packets upon water plants that have been scraped by the animal and made suitable for egg attachment. The eggs possess astounding vitality, the classic example involving the hatching of eggs after having remained in dried mud for more than thirty years. The young escape from the egg as nauplii, which in some cases differ strikingly from the adult form. Growth is effected by successive series of molts or instars. Some recent forms require three or four months for the completion of molting . . . . . others, longer. This crustacean characteristic of molting has served to some extent to confuse ostracodal literature, inasmuch as immature molts have been described as adults.

Carapace

The ostracodal carapace is described herein according to its structure, shape, surface and overlap, orientation, and classification.

Structure of Carapace

The bivalved shell or carapace that encases the ostracode is a calcareous exoskeleton consisting of right and left valves articulating along the dorsal (hinge) margin. The valves are opened by an elastic ligament, passing from one hinge to another, and are closed by a large near-median adductor muscle, which extends transversely from valve to valve. The area of muscular contact is indicated on the interior of the valve by a pit, tubercle, or a series of closely spaced markings, and is often reflected inversely on the surface by markings, pit, or boss. The shells of many Ostracoda are less than one millimeter in length, but a Recent *Gigantocypris* Müller attains a length of twenty-five millimeters, and some of the Ordovician isochiline and eoleperditian forms were twice as long. *Eoleperditia magna* Harris, n. sp. in McLish strata, the largest of Oklahoma Ostracoda, attained a length of 15 to 20 millimeters.

With the aid of transmitted light, certain wall structures are discernible which cannot be seen by reflected light alone, and especially is this true of post-Paleozoic ostracodal shells. Many current publications involving descriptions of Mesozoic and Cenozoic Ostracoda include "transmitted light features" as an essential element of the descriptions. Lienenklaus (1900, p. 500), in a study of Tertiary Ostracoda from Germany, was the first paleontologist to apply criteria of wall structure in the general allocation of fossil species, and was also the first to suggest that the arrangement of the muscle-scar pattern was of taxonomic significance (1894, p. 166). Transmitted light reveals that the shell wall of living Ostracoda consists of two layers, known as *outer* and *inner lamellae.* The outer layer, thicker than the inner, is entirely calcified and it alone comprises the fossil carapace. The inner layer, consisting of a marginal calcified portion and a thin, membraneous, central portion, is never preserved in the fossil state. The boundary between the two wall layers, or the inside edge of the calcified portion of the inner layer, is known as the *inner margin;* the outer edge of the shell is known as the *outer margin.* The calcified peripheral portion of the inner layer is fused with the calcified peripheral portion of the outer layer for a part, or the whole, of its width. The line along which the two aforementioned calcified layers unite is known as the *line of concrescence,* and this line of concrescence usually closely parallels the outer margin of the carapace. Its distance from the outer margin, and its course, are considered by the paleontologist as features of taxonomic value. The narrow strip between the line of concrescence and the outer margin is known as the *marginal zone,* and the course of the inner edge of this marginal zone is likewise a feature of taxonomic importance. In some genera it coincides with the line of concrescence throughout; in others, it is at a greater or lesser distance within this line, along a part, or the whole, of its length. In most of the post-Paleozoic genera the inner margin approaches or coincides with the line of concrescence between the middle and the anterior third of the ventral margin. In such genera, the course of the inner margin may be regular, following the curvature of the outer margin of the shell, or it may be irregular and complicated.

Transmitted light also reveals closely-shaped *normal pores* perforating the general body of the carapace. These normal pores have little recognized taxonomic value. *Radial pores* pierce the marginal zone of the carapace, opening internally along the line of concrescence, and externally on or near the outer margin of the shell. Both sets of pore canals bear hair-like bristles during the life of the animal. The radial canals strongly influence the appearance of the shell, especially in those genera in which the marginal zone is broad and transparent. The number, arrangement, and structure of the radial canals are regarded as features of taxonomic importance. In some shells, the radial canals are few in number, in others, numerous; in some, they are narrow, in others, wide; in some simple, in others branched. In many genera the canals exhibit a bulbous enlargement near the midpoint. Some open internally by a wide pore, others by a small pore.

No transmitted light study of the Simpson Ostracoda was undertaken, the shell walls either being too thick or too encased with rock matrix. Levinson (1951, figs. 1-9) sectioned and studied species of at least a score of different ostracodal genera. The thin-sectional study enabled him to differentiate among the genera *Milleratia* Swartz, *Eridoconcha* Ulrich and Bassler, and *Cryptophyllus* Levinson.

Shape of Carapace

Upon the basis of shell outline, the writer recognizes two major groups of fossil Ostracoda, *straight-hinged* and *arched-hinged*. Representatives of the straight-hinged group predominate in Paleozoic strata; the arched-hinged group are abundant in Paleozoic strata, though possibly more diagnostic of post-Paleozoic. Several of the Paleozoic genera with apparent arched-hingement, actually possess a straight hinge, depressed below a slight dorsal umbonation of the carapace (such as *Schmidtella* Ulrich and *Cryptophyllus* Levinson). All of the straight-hinged Paleozoic genera "died out" at (or before) the close of the era.* With the exception of one or two conservative possibilities (*Cytherella* Jones and *Bythocypris* Brady) the Paleozoic arched-hinged genera also became extinct with their straight-hinged contemporaries at the end of the Paleozoic.

* The writer does not consider the straight-hinged form described as *Monoceratina* Alexander, from Cretaceous strata, a true *Monoceratina* Roth, from the Pennsylvanian . . . . . . different hingement.

Mesozoic and Cenozoic genera, accordingly, constitute a new order of Ostracoda. There are less than a half-dozen Mesozoic-Cenozoic genera truly possessing a straight hinge paralleling the axis of the body, such as *Loxoconcha* Sars, *Orthonotocythere* Alexander, and *Monoceratina* Alexander (not Roth). Such post-Paleozoic genera as *Cythereis* Jones, *Cythere* Müller, and *Cytherura* Sars also possess straight hinge-lines, but this hingement is further characterized by being inclined from the horizontal. Innumerable genera of the arched-hinge type occur in the Mesozoic-Cenozoic section.

The curvature of the free margins of Paleozoic genera is rather evenly rounded and, in a general fashion, unbroken except for slight offset in the marginal pouch or peripheral keel of some forms. Paleozoic genera displaying acutely produced posterior extremity or angularity of free margins are extremely rare, *Krausella* Ulrich and *Bairdia* McCoy, with produced posterior nose, and *Platyrhomboides* Harris n. gen., with flattened venter, being numbered among this group. Free margins of many post-Paleozoic genera, however, are irregular in curvature (*Cythereis* Jones, *Cythere* Müller, *Cytheridea* Bosquet, *Cytherura* Sars, *Cytherideis* Jones, *Eucythere* Brady, *Cytheropteron* Sars, *Paracypris* Sars, *Krithe* Brady, *Argilloecia* Sars, *Bairdoppilata* Jennings, *Cytheretta* Howe, and *Orthonotocythere* Alexander). A deep notch characterizes the anterior end of the Cypridinidae Sars.

Surface and Overlap of Carapace

The ostracodal carapace displays wide variation in sculpture (lobation) and ornamentation of the lateral surface. Broadly speaking, variation in sculpture and major ornamentation are considered of generic import, while variation in minor ornamentation is of specific import.

A carapace of primitive sculpture (*Eoleperditia* Swartz and *Bythocypris* Brady) is *simply convex* and without peripheral flange. Further advance discovers the development of the *primary anteromedian sulcus* (S^1); obscure to shallow in *Leperditella* Ulrich and *Paraschmidtella* Swartz; deep and distinct in *Euprimitia* Ulrich and Bassler, *Eurychilina* Ulrich, *Ctenobolbina* Ulrich, etc. Dimorphism, with attendant marginal flange and "brood-pouch", appears a contemporary development of the sulcus in such genera. With further development, the *second* and *third sulcus* (S^2 and S^3) is added and the dimorphic carapace becomes bi- or tri-lobate, as in the Beyrichiidae Ulrich. A specialized development appearing in Ordovician and later genera is the single or double dorsal horn projecting above the hingement (*Aechmina* Jones and Holl and *Dicranella* Ulrich); or projecting laterally (*Monoceratella* Teichert and *Acanthobolbina* Harris, n. gen.). Silurian, Devonian, and Carboniferous ostracodes may display one or more ridges or shoulders more-or-less paralleling the periphery (*Phanassymetria* Roth, *Amphissites* Girty, *Octonaria* Jones, *Seminolites* Coryell, etc.) An unusual type of concentric development is observed in the genera *Eridoconcha* Ulrich and Bassler and *Cryptophyllus* Levinson.

In ornamentation the primitive shell is smooth and finely perforate. Further development of pores results in a coarsely perforate, to reticulate, to rugose surface. Pustules develop into nodes and spines, the latter bristling laterally or projecting peripherally. The writer has observed in a series of Cretaceous molts surficial ribs having developed from a row of thin spines, and peripheral wing having developed from a row of marginal beads. A smooth surface has been observed to become reticulate following several moltings. On the other hand, the early molts or instars of *Leperditella porosa* Harris n. sp., from the Corbin Ranch member of the Simpson, are more pronouncedly perforate than the larger adult.

The basal members of the Simpson section, Chazyan Joins and Oil Creek, contain many eoleperditian and paraschmidtellid species, two straight-hinged subelliptical genera without sulcus and otherwise considered simple in shape and ornamentation. By Lowville and Black River epochs, however, Simpson Ostracoda had developed advanced shapes and extremes of ornamentation. The Tulip Creek and Bromide Black River formations, particularly, contain several genera irregular in outline, lobate in sculpture, and ornate with reticulations, nodes, and spines; among these are many dimorphic representatives. The topmost Corbin Ranch limestone member contains both the conservative eoleperditian and leperditellid, as well as the more advanced ctenobolbine and coelochiline genera.

Opposed valves of Ostracoda may be equal or unequal, and either the right or the left may be larger, and overlapping the smaller. Overlap may be limited to dorsum or venter, or to both, or it may involve the entire smaller valve (*Cytherella* Jones). As a rule, overlap of a given valve in a given genus is consistent, hence, of generic value; but some species have been illustrated with either the right or the left the larger. Generally, ornamentation of opposite valves is symmetrical, but in some genera the ornamentation is asymmetrical, knobs and spines being developed on either the smaller or the larger valve. The topmost Arbuckle and basal Simpson sections are characterized by eoleperditian forms displaying post-dorsal inflation on the larger right valve only.

A surficial peculiarity is observed in the Simpson species, *Primitiopsis bassleri* Harris. Both valves of the species are reticulate, but the writer has observed scores of adults with right valve perfectly smooth, possibly worn. The agency of wear could not have been uncontrolled, for why then would the right valve alone display the smooth surface? In the laboratory the writer has witnessed fresh-water Ostracoda whirling or spinning on their sides on the surface of the water, and on the bottom of a water-filled watch glass. A habit of this nature in *Primitiopsis bassleri* Harris would explain its smooth right valve.

Orientation of Carapace

The matter of correct orientation of Paleozoic Ostracoda is a matter of much dispute among paleontologists. The carapace of this animal, long extinct, presents us with some definite relevant information, such as, position of the antero-dorsal "eye-spot", near-median "muscle scar", and true posterior "brood-pouch" (*Primitiopsis* Jones). Living Ostracoda present additional information, much of which is of problematical value in correctly orienting Paleozoic Ostracoda, for features characteristic of the living animal and shell will not necessarily have obtained in the fossil predecessor. Ulrich and Bassler (1923, pp. 283-285), Bonnema (1932, pp. 288-295), and others, (Swartz 1933, pp. 235-237), (Kummerow 1931, pp. 155-159), (Warthin 1933, p. 442), (Hessland 1949, pp. 118-128), and (Kesling 1951, pp. 90-104), have presented various details regarding orientation of the Ostracoda. Many American paleontologists assume that the presence of certain standard criteria, such as, "eye-spot", "brood-pouch", and retral swing, will properly orient a fossil form. Others, including the writer, consider the "eye-spot", primary sulcus, and near-median "muscle scar" of highest order in orientation, and relegate to a position of secondary importance the so-called "brood-pouch" and retral swing.

1. The hinge line, or articulating contact, is dorsal; the opposing free margin is ventral.

Internally the hinge line of the majority of post-Paleozoic genera will display some type of tooth-and-socket articulating process. Very few Paleozoic forms possess tooth-and-socket hinge apparatus, the hingement generally being a simple contact, or poorly developed bar-and-groove apparatus. In the absence of actual hingement apparatus in the Paleozoic straight-hinged valve, the dorsal or hinge margin may be recognized by the fact that it is the straighter of the two longer margins; the more arcuate (convex to concave) margin is the ventral. In considering shells with arched hingment, however, the more highly convex margin contains the hingement apparatus; the more lowly arcuate (convex to concave) margin is ventral. In the Paleozoic cytherelline, cavelline, bythocyproid, bairdian, and octonarian genera the higher arch is dorsal. Likewise, in post-Paleozoic *Cythereis* Jones and *Cythere* Müller (types with "grass-hopper head" and inclined straight hingement) the higher arch is dorsal.

2. The straight channeled hingement is generally widened posteriorly.

The straight hinged genus *Leperditella* Ulrich is very often tightly appressed along the anterior quarter (to half) of its hingement, while posteriorly it is less appressed, often channeled, and even slightly flaring. Many other genera display such posterior widening of hingement channel, particularly those with carapace inflated and slightly umbonate posteriorly.

3. Another rule, not invariable, discovers the venter more inflated. Such is particularly true of Mesozoic-Cenozoic forms, as *Brachycythere* Alexander, *Cytheropteron* Sars, and *Cytherura* Sars. An exception to this rule is observed in the Ordovician genera, *Schmidtella* Ulrich, *Paraschmidtella* Swartz, and *Cryptophyllus* Levinson, wherein the area of maximum thickness is slightly above the middle.

4. The anterior end of living forms contains the cephalic part of the animal, which is indicated in life by the projecting antennae and antennules and occasionally on the shell by an antero-dorsal "eyespot;" the opposite end, the posterior, contains the abdomen

with terminal furca. The antero-dorsal "eye-spot" of Paleozoic fossils, when present, is considered one of the most reliable criteria of orientation. The majority of the earlier and larger Paleozoic genera, as well as the ornate post-Paleozoic cytherid group, exhibit an "eye-spot".

5. The deep primary sulcus is located anteriorly.

Various writers have labeled the several vertical sulci of Paleozoic Ostracoda S^1, S^2, S^3. Many Paleozoic ostracodes display only the single prominent, slightly diagonally inclined, vertical sulcus. In such cases, it is located ahead of the center; and is further characterized generally by a deeper excavated lower end and recurvature about a distinct antero-jacent tubercle or boss. In the genus *Leperditella* Ulrich the anterior sulcus is but a slight depression, in some cases visible only when the shell is moistened. In *Dicranella* Ulrich, *Ctenobolbina* Ulrich, *Bromidella* Harris, and others, the primary sulcus is deep and distinct. Beyrichian forms display S^2 and S^3 to varying extent, in addition to the deeper and more pronounced antero-median S^1.

6. The posterior end of the ostracodal carapace (particularly that of post-Paleozoic genera) is observed in most cases to be the more pointed or angular; the anterior end, accordingly, is the more gracefully rounded.

7. The posterior, or abdominal end, is ordinarily thicker than the anterior, thus effecting a wedge-shaped dorsal profile.

8. The true vertical "brood-pouch", when present, establishes the posterior end of the carapace . . . the essentially horizontal marginal pouch is located ventrally, more anteriorly than posteriorly.

The genus *Primitiopsis* Jones possesses a true "brood-pouch" located vertically on the posterior end of the female carapace. Other Paleozoic genera displaying sexual dimorphism, such as, *Bromidella* Harris, *Eurychilina* Ulrich, *Coelochilina* Ulrich and Bassler, *Dicranella* Ulrich, etc., possess a marginal pouch. This pouch is located more forward than posteriorly on the ventral margin. Whether or not the marginal cavity served as a "brood-pouch" on such genera is conjectural. Some postulate that the eggs and nauplii were transferred from the posterior end to the more forward marginal pouch; others, that the pouch is actually posterior in location, rather than forward. This pouch generally occurs on genera possessing, in addition, the deep antero-median sulcus, a feature considered by the writer most basic in proper orientation of the carapace. In such cases of associated marginal pouch and antero-median sulcus, the marginal pouch is also located more anteriorly than posteriorly.

9. Near-median adductor muscle scar is off-set anteriorly in many forms.

The near median adductor muscle scar, though not always evident, even when the surface is moistened, is located typically immediately ahead of the center of the carapace. Surficially the scar assumes the proportions of a distinct pit (elongate to subcircular), darkened subcircular smooth spot, or slightly raised boss, and is more evident on moistened than on dry surface. On many fossil shells without matrix the scar may be more evident internally than externally. In sulcate shells the scar is located well behind the lower end of the depression. On some forms (*Amphissites* Girty and *Macronotella* Ulrich) the muscle scar or pit is located so near the mid-point that determination of proper orientation upon this criterion alone is difficult to impossible.

10. Prominent dorsal, lateral, and peripheral spines of most forms project backward.

In the genera *Paraechmina* Ulrich and Bassler, *Ceratopsis* Ulrich, *Aechminella* Harlton, and others, the prominent dorsal spine is slightly recurved toward the rear of the carapace. In *Ctenobolbina* Ulrich, *Janischewskya* Batalina, *Winchellatia* Kay, and others, the lateral spine or node below and behind the primary sulcus projects backward. *Hollinella* Coryell may possess a peripheral keel that terminates posteriorly in a backward-projecting spine. Such genera as *Bromidella* Harris, *Krausella* Ulrich, *Rayella* Teichert, *Hollinella* Coryell, and others, possess one or more conspicuous peripheral spines, the majority and more prominent of which are pointed posteriorly.

11. So-called retral swing of the carapace is an unreliable criterion in orientation.

Retral swing or backward swing of the carapace may be observed on such large Ordovician forms as *Eoleperditia* (Conrad) Swartz and *Leperditia* Conrad. Representatives of such genera display the prominent antero-dorsal "eye-spot" and distinct downward and backward projection of carapace outline. Other genera (*Ctenobolbina* Ulrich, *Eurychilina* Ulrich, *Bromidella* Harris, *Dicranella* Ulrich, *Ceratopsis* Ulrich, *Hollinella* Coryell, and others) present in lateral outline the similar so-called retral swing. In such forms the downward extension is actually an anterior prow, while the more sharply rounded posterior end projects upward and backward. Such a conclusion is apparent in view of the forward location of the primary sulcus with antero-jacent bulbous inflation. Practically all of the aforementioned genera possess dimorphic representatives with marginal pouch associated with the anterior prow.

Classification

Recent Ostracoda are grouped into two Orders: exclusively marine Myodocopa with paired compound eyes, a heart, and an anteriorly notched carapace; and Podocopa, marine and fresh-water forms without paired eyes and heart, and without notched carapace. Subdivision of these two orders of Recent Ostracoda are established upon the basis of appendages and sexual organs. Little consideration is allotted the carapace itself in the classification of living Ostracoda.

Features generally employed by paleontologists in classifying fossil ostracodes include those of size and shape, nature of hingement and overlap, wall structure as revealed by transmitted light, sulcation and lobation of carapace, and surficial ornamentation. Of these criteria, wall structure (the transmitted light feature) and hingement are generally considered most reliable guides for differentiating the post-Paleozoic cythereid group. In classifying the Paleozoic group, however, the value of wall structure is minimized, fossilization having completely destroyed the fragile inner wall and calcification having so solidified the remaining outer wall that light is not readily transmitted. Thin sections, which have proven of inestimable value in the classification of fusulinid Foraminifera, are made difficult because of the convexity of the carapace. Differentiation of hinge structure constitutes no consistently reliable criterion of classification of the Paleozoic Ostracoda, for the reason that it is generally simplified to the extent of simple, or shallow bar-and-groove contact. Accordingly, then, the problem is resolved to such practical features as shape, lobation of carapace, and surficial ornamentation. Since these features vary according to definite lines of phylogenetic development, they constitute for the paleontologist natural elements of taxonomic value. The features of shape and lobation of carapace are, broadly speaking, of family and generic significance, while that of surface ornamentation is more strictly a specific characteristic.

Smooth Ostracoda, as with other smooth organisms, are considered the more primitive and conservative, while those extremely ornate and exaggerated in parts are considered near-end members and approaching a "blind alley" of extinction.

The paleontologist is constantly faced with the demand to furnish practical classifications of skeletal parts. In many cases (including that of Paleozoic Ostracoda) the skeleton or part thereof constitutes the only remains of the animal, and, accordingly, constitutes the most practical basis for their classification. It must be admitted, however, that in a paleontological classification based upon skeletal parts only, the somewhat arbitrarily established result becomes more practical than zoologically correct. If a classification of such nature be recognized upon its face value as a classification of parts only, intercorrelated as closely as possible with living descendants, then it becomes scientifically correct. Jones and Hinde (1890, p. 4) defend the paleontologist's stand as follows, "The character of the shell is closely correlated with other structural features of the organisms, that it may very reasonably be considered as affording a safe clue to their systematic relationships." Ulrich and Bassler (1923, p. 274) note regarding this point, "It is evident that the varied lobing and sulcation of the valves and the presence of large protuberances or nodes on their exterior, can be nothing else but external manifestations of and conforming to internal anatomical features of the animals themselves. Though it may be, as a rule, impossible to interpret the meaning of these shell characters we may, nevertheless, appreciate and establish their respective values as taxonomic criteria by noting the relative persistence of each particular feature both severally and in combination with other characters. If the same peculiarity is recognized in a number of otherwise similar, yet clearly distinguishable, species, then we may reasonably infer that it represents some anatomical character of sufficient importance to the animal to require its maintenance and continued development through one or more diverging or parallel lines of genetically related species. Obviously, too, the relative importance of any single character or any combination of characters is in proportion to its persistence in nature."

The classification of Ulrich and Bassler (1923, pp. 294-322), emended by Bassler and Kellett (1934, pp. 13-47), and later by Swartz (1936, pp. 541-586), has been followed in the description of the Simpson Ostracoda.

DESCRIPTION OF SIMPSON OSTRACODA

Order OSTRACODA Latreille, 1802

Family LEPERDITIIDAE Jones, 1856 (emend. Ulrich and Bassler, 1923)

Genus EOLEPERDITIA Swartz, 1949

Genotype: *Cytherina fabulites* Conrad, 1843

Leperditia of authors (partim)

Eoleperditia Swartz, 1949, Jour. Paleontology, vol. 23, pp. 317, 318; Scott 1951, Jour. Paleontology, vol. 25, pp. 323, 325, 326; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, p. 274; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 70.

Large, thick-shelled, essentially smooth leperditians without appreciable swelling on post-dorsal shoulder of left valve, and with simple non denticulate hingement contact; right valve overlapping left about free margins, with maximum overlap ventral; inner lower edge of right valve with stubby prongs to serve as "stops" for overlapped edge of smaller left valve; "eye tubercle" present in most species, but surface otherwise smooth except for normal pores; subovate non-chevron-like adductor muscle scar pattern behind and below "eye tubercle", secondary scars often preserved above that of the adductor.

Range: Ordovician and Silurian.

Remarks: Swartz has directed attention to the fact that the species *Eoleperditia fabulites* (Conrad) Swartz has long constituted a classical, though erroneous, example of the genus *Leperditia* Rouault. Critical analysis of the genotype of *Leperditia* Rouault, *L. britannica* Rouault, reveals several characters strikingly different from corresponding characters of *Eoleperditia fabulites* (Conrad) Swartz. As now revised, the genus *Eoleperditia* Swartz differs from *Leperditia* Rouault in: first, absence of prominent elongate inflation along post-dorsal shoulder of left valve; secondly, adductor muscle scar pattern is ovate, not chevron-like, or V-shaped; and thirdly, hingement contact is non-denticulate.

Nine species and two varieties of eoleperditian Ostracoda were discovered in the Simpson section. Three of the forms, all with some inflated swelling along mid- or post-dorsum, characterize the basal Simpson Joins formation and differ from those in the subjacent Arbuckle limestone in shorter and lower post-dorsal inflation, or in absence of pronounced sub-central alate process, similar to that of *Leperditia* (*Isochilina*) *armata* Walcott from the Lowville of New York and Kentucky and *Eoleperditia tuberculata* (Kolmodin) from the Silurian of Gotland. Three smooth leperditians are observed in the Chazyan Oil Creek section; while three others, including the largest of Oklahoma Ostracoda, *Eoleperditia* magna Harris, n. sp., occur in the McLish "birdseye" limestone. Two smooth species, including *Eoleperditia fabulites* (Conrad) Swartz, are fairly abundant in the Corbin Ranch, topmost formation of the Simpson, which rests disconformably upon the Bromide proper and is likewise separated from the overlying graptolitic Viola limestone. No eoleperditians whatever were recovered from Tulip Creek Arbuckle Mountain outcrops, though such has been reported elsewhere from equivalent Black River strata (the writer has recovered recently *E. fabulites* (Conrad) Swartz from the Tyner shale of northeastern Oklahoma, strata equivalent in age to the McLish or Tulip Creek.

These large eoleperditian forms, though distinctive of the various formations of the Simpson, are rarely recovered from shale sections, where faunal content may be washed free and clean of the matrix; rather, individual valves are freed of limestone matrix only after tedious work with cutting and picking tools, in fashion similar to recovery of fossil evidence from well cores.

Eoleperditia abrupta Harris, n. sp.

Plate 1, figures 5a, 5b

This short, relatively high species is distinguished by abrupt posterior and post-ventral truncation and low, inflated swelling on mid-dorsum of right valve (possibly on left also). Carapace is rather evenly convex, though depressed behind and below anterior cardinal angle; cardinal angles not produced into wings; no ventral well nor inflated bulb was observed.

Holotype right valve MCZ No. 4487; length: 3.87 mm; height: 2.62 mm; paratype male right valve MCZ No. 4488; length: 4.08 mm; height: 2.65 mm, from Oil Creek horizon in Zone 84 of U. S. Highway 77 Simpson section.

Range: Observed only in the single zone, though undoubtedly it has a longer range in the Oil Creek.

Remarks: This species, with dorsal swelling along hingement of short high body, is similar to *Eoleperditia appressa* (Ulrich), from the Trenton of Kentucky. The Oil Creek species, however, is more produced anteriorly and less so posteriorly, and the dorsal swelling is weaker and more centrally located.

The trivial name is the feminine form of the Latin adjective, abrupta, meaning "precipitous, steep"; referring to the steep posterior end of the abbreviated form.

EOLEPERDITIA FABULITES (Conrad) Swartz, 1945

Plate 1, figures 1a, 1b

Cytherina fabulites Conrad 1843, Acad. Nat. Sci. Phila., Proc., vol. 1, p. 332.

Cytherina sp. Hall 1847, Paleontology N. Y., vol. 1, p. 44, pl. 10, fig. 12.

Leperditia fabulites (Conrad) Jones 1856, Ann. Mag. Nat. Hist., ser. 2, vol. 17, p. 89; Walcott 1882, N. Y. State Mus. Nat. Hist., p. 214; Ellis 1903, N. Y. State Mus., Bull. 66, Misc. 2, p. 583; Taff 1903, U. S. G. S. Folio 98, p. 3; 1905, U. S. Folio 122, p. 2; Raymond 1911, Carnegie Museum, Annals, vol. 7, no. 2, p. 253; Coryell 1919, Ind. Acad. Sci., Proc., pp. 274, 275; 1927, Ostracoda Plates and Text Figures, Columbia Univ., vol. 1, p. 81, pl. 43, figs. 10-14; Harris (partim) 1931, Okla. Geol. Survey, Bull. 55, p. 87, pl. 10, figs. 1, 2; Twenhofel and Shrock 1935, Invert. Paleontology, 1st. ed., p. 438, fig. 161A; Teichert 1937, Meddel. Gronland, Bd. 119, no. 1, pp. 43, 44; Huffman 1945, Jour. Geology, vol. 53, pp. 154, 156, 160, 166; Prouty 1946, A. A. P. G., Bull., vol. 30, pp. 1145, 1148, 1163, 1178; Shimer and Shrock 1948, Index Foss. N. America, p. 664, pl. 280, figs. 1-4; Hussey 1950, Mich. Geol. Soc., Ann. Field Trip Guidebk., pp. 2, 3, pl. 1, figs. 18, 19; Montgomery 1951, Tulsa Geol. Soc., Digest, vol. 19, pp. 151, 152; Moore, Lalicker, and Fischer 1952, Invert. Foss., pp. 524-525, fig. 14-2, 3a-b; Piveteau 1953, Traité de Paléontologie, p. 267; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, p. 252.

Leperditia canadensis josephiana Jones 1858, Geol. Survey Canada, dec. 3, p. 94, pl. 11, fig. 16; Nicholson 1899, Ancient Life History of the Earth, p. 107, fig. 47i; Coryell 1927, Ostracoda Plates and Text Figures, Columbia Univ., vol. 1, p. 161, pl.

11, figs. 16a-c.

Leperditia josephiana (Jones) Billings 1863, Geol. Survey Canada, Rept. Prog., Comm., p. 954.

Leperditia fabulites (Conrad) *josephiana* Jones 1881, Ann. Mag. Nat. Hist., ser. 5, vol. 8, pp. 343-345, pl. 19, fig. 7, pl. 20, figs. 7, 8.

Leperditia sp. Harris, Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., fig. 10.

Eoleperditia fabulites (Conrad) Swartz 1945, Geol. Soc. America, Bull., vol. 56, pt. 2, p. 1205; 1949, Jour. Paleontology, vol. 23, pp. 318, 319, pl. 66, figs. 1-10; Scott 1951, Jour. Paleontology, vol. 25, pp. 321-326, pl. 51, figs. 1-5, text-figs. 1-3; Hussey 1952, Mich. Dept. Conserv., Geol. Survey Div., Publ. 46, Geol. Ser. 39, pp. 18-20, pl. 8, figs. 9-10.

For other synonomy, see Bassler and Kellett (1934, pp. 384, 385).

This oft-described leperditian with distinct "eye tubercle", subevenly convex smooth surface and definite retral swing was reported originally from the middle Ordovician (Lowville limestone) of St. Joseph's Island, Canada. It was reported also from the Stones River of the Appalachian Valley and Canada; and Bassler reported it in the Chambersburg limestone of Maryland (*Tetradium cellulosum* (Hall) horizon), where it is associated with *Leperditella tumida* (Ulrich).

Hypotype left valve MCZ No. 4489; length: 8.20 mm; height: 5.36 mm; hypotype left valve MCZ No. 4489A; length: 6.20 mm; height: 3.90 mm, from topmost Corbin Ranch formation of the Simpson group, in Zone 4 of Oklahoma Highway 99 Simpson section.

Range: This species occurs commonly in the Corbin Ranch formation, where it is associated with *Eoleperditia inflativentralis* Harris, n. sp. and *Leperditella tumida* (Ulrich). It occurs rarely in the Bromide; probably also in McLish "birdseye" limestone.

EOLEPERDITIA INFLATIVENTRALIS Harris, n. sp.

Plate 1, figures 2a, 2b

Carapace subsymmetrically subquadrate in lateral outline, with slight retral swing, smooth rounded body extremely inflated, with maximum thickness before and below central area, thus effecting longer and gentler posterior slope; long straight hingeline terminated by cardinal angles noticeably alate or notched; "eye tubercle" distinct.

Holotype left valve MCZ No. 4490; length: 7.00 mm; height: 4.00 mm; imbedded paratype left valve MCZ No. 4491; length: approximately 7.00 mm; height; approximately 4.00 mm; from Bromide limestone in Zone 1 of U. S. Highway 77 Simpson section.

Range: Topmost massive beds of the Bromide formation of the Simpson, where it is associated with *Eoleperditia fabulites* (Conrad) Swartz.

Remarks: This species differs from its contemporary, *E. fabulites* (Conrad) Swartz, in its more symmetrical lateral outline, extremely inflated subcentral area, and distinctly notched cardinal angles.

The trivial name represents a combination of the Latin words, inflatus, "inflated", and ventralis, "of or belonging to the belly"; the name referring to noticeable inflation of the belly of the carapace.

EOLEPERDITIA MAGNA Harris, n. sp.

Plate 1, figures 3a, 3b

Carapace large, some approximating 20 mm in length, subquadrate and subsymmetrical in lateral profile; long straight hingement with distinct notched cardinal angles; ends not prominently produced, anterior nose the higher, posterior end broadly and gracefully rounded, without noticeable retral swing, carapace strongly inflated in the lower region, with maximum thickness well below equatorial line; a rather wide, compressed peripheral flange bounds either end and extends through the cardinal angles, though failing to extend beneath the highly inflated medio-ventral area of carapace, lower end of anterior flange is overhung slightly by antero-ventral inflation of carapace; surface smooth, with distinct "eye tubercle"; some shells exhibit a broad, shallow sulcate depression immediately below the mid-region of the hingement.

Holotype left valve MCZ No. 4492; length: 13.25 mm; height: 7.25 mm, from zone near middle of McLish formation at north end of Criner Hills, Oklahoma, in sec. 16, T. 5 S., R. 1 E.

Range: McLish "birdseye" (possibly limited to middle zones).

Remarks: This largest of Simpson Ostracoda resembles a small productid brachiopod in its unusual size and subsymmetrical lateral ouline. In possession of terminal marginal rims that do not continue beneath the venter this species resembles *Eoleperditia amygdalina* (Jones) from the Chazy limestone of Canada. The Canadian form, however, lacks the subsymmetrical lateral profile, notched cardinal angles, and extraordinary size of the McLish species. In large size, near-median dorsal depression, and terminal, compressed marginal rims this species resembles *E. grandis* (Schrenk) from a Silurian glacial erratic in Poland, but the Simpson form possesses more pronounced cardinal angles, is more highly inflated, and lacks the compressed ventral flange and post-dorsal hump on shoulder of left valve. Similar large forms with compressed flange have been described as species of *Isochilina* Jones, although in this genus the marginal flange is continuous beneath the venter.

Eoleperditia mediumbonata Harris, n. sp.

Plate 1, figures 4a, 4b

Carapace typically leperditian in size, ventral overlap, retral swing, "eye-tubercle", and distinct pores; cardinal wings fairly well developed; a low, elongate, median to post-median swelling lies immediately below the straight hingement of each valve, a low, elongate swelling is centrally located immediately within the ventral border of the larger right valve (exaggerated in female?) and is bounded on either side by definite wells, no corresponding ventral inflation occurs on the smaller left valve, venter of left valve is flattened and beveled to fit within that of right; slightly convex smooth surface.

Holotype (female?) right valve MCZ No. 4493; length: 4.50 mm; height: 2.87 mm, paratype (male?) left valve MCZ No. 4494; length: 5.45 mm; height: 3.15 mm, from Joins horizon, 42 feet above base of U. S. Highway 77 Simpson section.

Range: Common in lower part of Joins (possibly in upper part of Joins also).

Remarks: In outline and cardinal angles this species somewhat resembles *Eoleperditia linneyi* (Ulrich), from Middle Ordovician of Kentucky, but Ulrich's species possesses dorsal hump only on the left valve, there being neither dorsal nor ventral hump on the right valve.

The trivial name for this species represents an adjectival combination of the Latin words, medius, meaning "middle", and umbon, meaning "boss on a shield"; referring to the near-median inflation below the hingeline.

EOLEPERDITIA MEDIUMBONATA subsp. DEBILIS Harris, n. subsp.

Plate 1, figures 6a, 6b

In the more elongate subspecies the dorsal swelling is but weakly developed, some forms displaying merely the suggestion of an inflation; no ventral knob is observed on the right valve, as in *E. mediumbonata* Harris, n. sp. The anterior nose is noticeably produced.

Holotype male right valve MCZ No. 4495; length: 6.11 mm; height: 3.75 mm; paratype male right valve MCZ No. 4496; length: 5.15 mm; height: 3.12 mm, from Joins horizon, at top of Zone 93 of U. S. Highway 77 Simpson section.

Range: Joins.

Remarks: In lateral profile, notched cardinal angles, and dorsal inflation on left valve this subspecies resembles *E. gibbera* (Jones), from the upper Silurian of Canada, but the Oklahoma form displays a more produced anterior nose, more distinctly notched cardinal angles, and a dorsal inflation on the right, as well as on the left valve.

The subspecific name is the Latin adjective, debilis, meaning "weak or feeble"; referring to the weakly developed near-median subhingement inflation.

EOLEPERDITIA ? OBESIPOROSA Harris, n. sp.

Plate 1, figures 7a, 7b

This relatively small leperditian form is characterized by subquadrate outline and subsymmetrical lateral profile; ends not noticeably produced, the anterior nose the more sharply rounded, ends slightly pinched or flattened, post-cardinal angle the more obtusely truncated; strongly tumid subcentral portion of carapace is beset with coarse irregular pores, a low, elongate, bulbous inflation is situated near mid-point of the dorsal margin, apparently a low, short, sharp keel lies directly within the antero-cardinal angle and parallels the hinge line; "eye tubercle" well developed.

Holotype left valve MCZ No. 4497; length: 3.05 mm; height: 1.87 mm; thickness: 0.83 mm, from outcrop 42 feet above base of Joins formation of U. S. Highway 77 Simpson section.

Range: Joins.

Remarks: This small, sculptured leperditian is represented in the writer's collection by a single left valve. A length of 3 mm is quite small for an adult representative of the genus *Eoleperditia* Swartz, hence the questionable assignment. Further research may reveal the form to be a member of the genus *Leperditella* Ulrich, or of a new genus.

The species is much larger than *Paraschmidtella perforata* (Harris) from the overlying Oil Creek. Further differences are observed in the more elongate outline, greater inflation of lower body, and presence of median dorsal hump and distinct "eye tubercle".

The trivial name is a contrived adjective adapted from the Latin words, obesa (feminine), meaning "plump", and porus, meaning "a passage or pore"; referring to the coarsely perforated inflated body of the carapace.

EOLEPERDITIA? PERPLEXA Harris, n. sp.

Plate 1, figures 8a, 8b

A fairly large leperditian, subquadrate and subsymmetrical in lateral profile; ends subequal in height, the posterior slightly lower and more broadly rounded; cardinal angles approximately equal and distinctly notched; surface but slightly convex, with maximum thickness, through prominent, submedian, outward-projecting broad spine, a broad depression characterizes the central area above the spine and is bounded laterally by a slight inflation, a low, inflated rounded tubercle lies in the upper central part of the depression immediately below the hinge line, an "eye tubercle" is present with very low, broad post-ventral adjacent swelling; surface appears smooth, but careful scrutiny reveals scattered, low papilli, a characteristic feature more evident in areas below the spine and possibly within the somewhat flattened terminal peripheral flanges.

Holotype right valve MCZ No. 4498; length: 7.00 mm; height:

3.80 mm; paratype left valve MCZ No. 4499; length: 9.12 mm; height: 5.37 mm, from McLish "birdseye" limestone in Section 1 of Zone 31, northeast of Connerville, Oklahoma, on road to Bromide.

Range: McLish "birdseye" limestone.

Remarks: In dorsal depression and irregular nodes this questionable species resembles *Isochilina subnodosa* Ulrich, a Trenton form of Kentucky. In its prominent submedian spine the species resembles *I. armata* (Walcott), from the Black River of New York and Kentucky. From the former the Simpson species differs in the presence of basal spine and surficial papilli, and from the latter, in its more symmetrical lateral outline and presence of dorsal nodes and depression. The generic status of this form is questioned, since nodes and sulcus are not characteristic of the genus *Eoleperditia* Swartz.

The trivial name is the Latin adjective, perplexa, meaning "confused"; referring to the generic identity made questionable by surficial irregularities of the species.

EOLEPERDITIA SIMPLEX Harris, n. sp.

Plate 1, figures 9a, 9b

Leperditia fabulites Harris (partim) 1931, Okla. Geol. Survey, Bull. 55, p. 87, pl. 10, figs. 1, 2.

Carapace large, elongate, moderately convex, with distinct retral swing, thickest immediately before center, resulting in a longer and flatter posterior slope; ends bluntly rounded, anterior nose the higher and less produced than the broadly rounded posterior end; long straight hingement with acute, though not alate or notched, anterior cardinal angle and with post-cardinal angle somewhat rounding into post-cardinal slope; "eye tubercle" present; surface smooth.

Holotype left valve MCZ No. 4500; length: 10.25 mm; height: 6.00 mm; paratype right valve MCZ No. 4501, length: 10.53 mm; height: 6.60 mm; paratype nepionic left valve MCZ No. 4502; length: 7.12 mm; height: 4.42 mm, from McLish "birdseye" limestone in Section 1 of Zone 31 northeast of Connerville, Oklahoma, on road to Bromide.

Range: Abundant in "birdseye" member of McLish.

Remarks: This species resembles *Eoleperditia fabulites* (Conrad) Swartz in elongate outline with definite retral swing, moderately convex body, and smooth surface without surficial nodes or depressions. The McLish species is larger than *E. fabulites* (Conrad) Swartz, however, the cardinal angles are not so prominent, the surface is but moderately convex, and the anterior nose is less produced.

The trivial name is the Latin adjective, simplex, meaning "simple"; referring to the smooth unornamented surface of the species.

EOLEPERDITIA SPICATA Harris, n. sp.

Plate 1, figures 10a, 10b

Rather large, subquadrate, and bilaterally symmetrical leperditian with maximum dimensions through center; hingement elongate, with cardinal angles noticeably produced and notched to form ear-like spikes; ventral outline gently and evenly convex, ends rather evenly rounded, the anterior possibly less produced; the smooth, convex inner area of carapace is bordered by a flattened margin that is ventrally produced into a low erect keel, venter of carapace depressed or channeled between inflated central area and the low, ventral marginal keel.

Holotype right valve MCZ No. 4503; length: 8.00 mm; height: 5.00 mm, from Oil Creek horizon. In Zone 3 of sec. 22, T. 1 N., R. 4 E., southwest of Hickory, Oklahoma.

Range: Rare in Oil Creek.

Remarks: The symmetrical lateral profile, distinct cardinal "ears", and ventral peripheral keel separated from convex body of carapace by a narrow depression constitute identifying characteristics of this species. In outline and smooth surface this species resembles *Isochilina ottawa* Jones, from the lower Ordovician of Canada, though the latter species lacks the distinct cardinal processes and the ventral peripheral keel with superjacent fossa. Though possessing similar outline and cardinal "ears" identical to *Eoleperditia argenta* (Walcott), from Middle Cambrian of Utah, the Simpson form is only one-seventh the size, is more bilaterally symmetrical, and possesses characteristic lower keel.

The trivial name is adapted from the Latin adjective, spicatus, meaning "ear-like or spike-like"; referring to the ear-like spikes of the cardinal angles.

EOLEPERDITIA SUBCARINATA Harris, n. sp.

Plate 1, figures 11a, 11b

Large carapace bilaterally subsymmetrical in lateral profile, with posterior nose slightly lower and more broadly rounded, ends with flattened flange extending through cardinal angles, but not across the base (except in young); cardinal angles distinct, though not winged; carapace "pitched up" into a subcarinate ridge that attains maximum height near the ventral margin, thus effecting a wedge-shaped transverse section with rounded ventral profile; surface with scattered fine pores, two wells on ventral surface, "eye tubercle" distinct.

Holotype right valve MCZ No. 4504; length: 7.25 mm; height: 4.25 mm, from Oil Creek horizon, in Zone 3 of sec. 22, T. 1 N., R. 4 E., southwest of Hickory, Oklahoma.

Range: Oil Creek.

Remarks: This species resembles *Eoleperditia limatula* (Raymond), from the Chazy of New York, in lateral outline and ventral inflation, but it is slightly smaller and lacks the radiating anastomosing lines of the New York form. Raymond directed attention to a subhingement hump on the smaller left valve of the Chazyan form.

The trivial name is a combination of the Latin prefex, sub, meaning "somewhat", and the adjectival form of the noun, carina, meaning "a keel"; referring to the keel-like ridge within the ventral border of the carapace.

Family *LEPERDITELLIDAE* Ulrich and Bassler, 1906

Genus APARCHITES Jones, 1889

Genotype: *A. whiteavesi* Jones, 1889

Aparchites Jones 1889, Ann. Mag. Nat. Hist., ser. 6, vol. 3, p. 384; Jones 1890, Geol. Soc. London, Quart. Jour., vol. 46, pp. 2, 7, 8; Vogdes 1890, U. S. G. S., Bull. 63, p. 153; Krause 1891, Wissenschaft. Beil. zum Prog. der Luisenstadt. Oberreal. zu Berlin, Prog., Nr. 101, p. 8; Weller 1903, N. J. Geol. Survey, Paleontology, vol. 3, p. 210; Ulrich and Bassler 1906, U. S. Nat. Museum, Proc., vol. 30, p. 150; Boucek 1936, Neues Jahrb. Mineralogie, Geologie, Paläontologie, Abt. B, Bd. 76, p. 37; Kay 1936, Jour. Paleontology, vol. 10, p. 332, Öpik 1937, Univ.

Tartu, Geol. Inst., Publ. no. 50, p. 23; Teichert 1937, Meddel. om Gronland, Bd. 119, no. 1, pp. 45, 46, 47; Kay 1940, Jour. Paleontology, vol. 14, pp. 240-242, 244; Schmidt 1941, Senckenberg. Naturforsch. Ges., Abh., vol. 454, pp. 18, 19; Cooper 1942, Jour. Paleontology, vol. 16, pp. 770, 774; Shimer and Shrock 1948, Index Foss. North Amer., p. 664; Hessland 1949, Upsala Univ., Geol. Inst., Bull., vol. 33, pp. 134, 183, 184; Moore, Lalicker, and Fischer 1952, Invert. Foss., p. 528, text fig. 14-4, 5; Piveteau 1953, Traité de Paléontologie, pp. 276, 290; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, pp. 231, 249, 268; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 8.

For additional synonomy see Bassler and Kellett (1934, p. 156).

Shell exceeding average size, attaining a length of 3 mm, highly convex, subovate or suboblong in lateral profile; hingement straight, ventral margin thickened, often beveled or channeled; equivalved; surface smooth or punctate.

Range: Ordovician to Devonian.

Aparchites maccoyii (Salter) Jones, 1893

Plate 2, figures 2a-2c, 3a-3b, 4

Cythere phaseolatus McCoy (not Hisinger) 1846, Syn. Silurian Foss. Ireland, p. 58.

Cythere maccoyii Salter 1854, Morris's Cat. Brit. Foss, 2nd ed., p. 105.

Primitia maccoyii (Salter) Jones and Holl 1868, Ann. Mag. Nat. Hist., ser. 4, vol. 2, p. 55, pl. 7, figs. 1-3; Jones 1893, Geol. Soc. London, Quart. Jour., vol. 49, p. 289; Kummerow 1924, Jahrb. Preuss. Geol. Landesanst, vol. 44, p. 428; Coryell 1927, Ostracoda Plates and Text Figures, Columbia Univ., vol. 1, p. 205, pl. 7, figs. 1a-c; ibid, vol. 2, p. 23, pl. 30, figs. 3a-c; Ellis and Messina 1953, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 3.

Aparchites maccoyii (Salter) Jones 1893, Geol. Soc. London, Quart. Jour., vol. 49, pp. 289, 290, 297; Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Mar. 5-6, 1937, 4th, 5th pp., figs. 22a-b, 52a-b, 58a-b.

Aparchites ellipticus Ulrich (partim) 1894, Geol. Minn., vol. 3, pt. 2, p. 644; Harris (not Ulrich), Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., figs. 2, 2a.

Leperditella maccoyii (Salter) Bassler and Kellett 1934, Geol. Soc. Amer., Spec. Pap. no. 1, p. 374.

Leperditia excavata Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 26 (2 views).

Aparchites carinatus Kay 1940, Jour. Paleontology, vol. 14, pp. 236, 244, pl. 29, figs. 29-32.

For additional synonymy, see Bassler and Kellett (1934, p. 374).

Carapace ovate-elongate with slight retral swing, approximating 1.5 mm in length, the female slightly larger and relatively higher than the slender male, carapace thickest at mid-region; dorsal margin slightly arched, hingement deeply channeled, "brood-pouch" of female is fairly straight along its ventral profile, but slopes slightly downward and backward; venter deeply excavated between flaring peripheral keels of the two valves, three distinct keels displayed in adult male; two low keels on right valve and a sharper and slightly more flaring keel on left; right valve projects ever so slightly beyond left at ends and cardinal angles, along ventral contact of valves the beveled edge of the left is received into a shallow recession of the right; smooth surface evenly convex, curvature of female surface uniformly convex from hinge-line through "brood pouch", eight to twelve bead-like spinelets project from either end of perfect male specimen.

Hypotype male specimen MCZ No. 4506; length: 1.15 mm; height: 0.75 mm; hypotype female specimen MCZ No. 4506A; length: 1.45 mm; height: 1.00 mm; hypotype female specimen MCZ No. 4506B; length: 1.17 mm; height: 0.77 mm, from Bromide horizon, 10 feet below top of Zone 3 of Rock Crossing Simpson section.

Range: Commonly occurring in Bromide and Tulip Creek. The species has been described from Caradoc beds of Ireland, Keisley limestone of England, Ordovician of North Wales, the Drift of Mark Brandenburg of North Germany, Ordovician of Ayshire, Scotland, Decorah of Minnesota, and the Ion of Iowa. In the study of Minnesota Ostracoda Ulrich observed the striking similarity, if not actual identity, of some Decorah specimens of *Aparchites ellipticus* Ulrich with *A. maccoyii* (Salter); the writer considers them conspecific. A contemporary of the species, *Eoprimitia bailyana* (Jones and Holl) Harris, occurs in both the Caradoc of Ireland and the Bromide of Oklahoma.

Remarks: Jones and Höll state concerning the dorsal channeling of the species, "... at the middle third of the hingeline the edge of each valve is suddenly depressed, and the boundary of inflation is rounded in the young and slightly ridged in the old specimens." Female specimens with "brood pouch" occur commonly in Simpson samples, though such dimorph has not been reported in association with the more slender male from other localities. One such form, *Öpikella frequens* (Steusloff), was reported from Ordovician boulders in the glacial drift near New Brandenburg by Kummerow, and by Henningsmoen from the upper Ordovician of Norway, but the Oklahoma form is slightly smaller, possesses more rounded cardinal angles, and lacks the prominent adductor muscle scar of the European form.

This form differs from true *Aparchites* Jones in the faint terminal overlap of its right valve. In some forms, however, the overlap is practically nil; accordingly, the writer assigns the form to Jones' genus. It differs from *A. ellipticus* Ulrich in its longer outline and lack of slight umbonation of the left valve.

APARCHITES MILLEPUNCTATUS (Ulrich), 1894

Plate 2, figures 1a-1d

Leperditia millepunctata Ulrich 1892, Amer. Geologist, vol. 10, p. 268, pl. 9, figs. 37-39; Coryell 1957, Ostracoda Plates and Text Figures, Columbia Univ., vol. 1, p. 121, pl. 9, figs. 37-39; Ellis and Messina 1952, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 1.

Aparchites millepunctatus Ulrich 1894, Geology Minn., vol. 3, pt. 2, p. 645, pl. 45, figs. 16-18; Coryell 1927, Ostracoda Plates and Text Figures, vol. 1, p. 95, pl. 45, figs. 16-18; Kay 1940, Jour. Paleontology, vol. 14, pp. 235, 244.

Aparchites minutissima var. *trentonensis* Harris (not Ulrich), Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 12.

Leperditella aequilatera Harris (not Ulrich), Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., fig. 12.

Additional synonomy in Bassler and Kellett (1934, p. 159).

Posterior nose of this elongate, equilaterally subsymmetrical form is slightly lower and broader than the anterior. The carapace is thickest immediately below the median line, the upper half evenly tapering to the sharp elongate hingement. Dorsal contact of valves is even, occasionally ever so slightly channeled; the left valve faintly overlaps the right ventrally (eroded forms display a channeling instead of left valve overlap). Surface of perfect specimen is evenly and finely perforate, eroded surface smooth; tiny, bead-like spinelets border the periphery of perfectly preserved specimens.

Hypotype specimen MCZ No. 4507; length: 1.34 mm; height: 0.75 mm, from Bromide horizon, in Zone 2 of Rock Crossing Simpson section.

Range: This species occurs rather commonly throughout the Bromide and Tulip Creek. Ulrich described the form from the Decorah of Minnesota and the Platteville of Illinois.

Remarks: This species differs from *A. granilabiatus* Ulrich in its more slender outline and in the absence of "a small raised spot near the center." This species differs essentially from *A. maccoyii* (Salter) Jones in the lack of channeled hingement.

Genus *PARAPARCHITES* Ulrich and Bassler, 1906

Genotype: *P. humerosus* Ulrich and Bassler, 1906

Paraparchites Ulrich and Bassler 1906, U. S. Nat. Mus., Proc., vol. 30, pp. 149-150; Bassler 1913, 1927, 1937, Zittel-Eastman Textbk. Paleontology, 2d ed., p. 373; Zittel 1915, Gründzuge der Paläontologie, vol. 2, p. 231; Knight 1928, Jour. Paleontology, vol. 2, p. 231; Bradfield 1935, Bull. Amer. Paleontology, vol. 22, no. 73, p. 29; Kellett 1936, Jour. Paleontology, vol. 10, p. 770; 1937, ibid, vol. 11, p. 80; Kummerow 1939, Preuss. Geol. Landesanst., Abh., N. F., Heft 194, pp. 9, 10; Schmidt 1941, Senckenberg. Naturforsch. Ges., Abh., vol. 454, p. 18; Cooper 1942, Jour. Paleontology, vol. 16, pp. 767, 772, 775; Shimer and Shrock 1948, Index Foss. N. Amer., p. 664; Ellis and Messina 1952, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 1; Moore, Lalicker, and Fischer 1952, Invert. Foss., pp. 538-539, text fig. 14-10, 2; Piveteau 1953, Traité der Paléontologie, p. 276; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, pp. 243, 271; Ellis and Messina 1954, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 5; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p., 141.

Antiparaparchites Coryell and Rogatz 1932, Amer. Mid. Nat., vol. 13, p. 387, pl. 34, figs. 3, 4 (see expl. pl. 35); Bassler and Kellett 1934, Geol. Soc. Amer., Spec. Pap. no. 1, pp. 16, 156: Agnew 1942, Jour. Paleontology, vol. 16, p. 757; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, pp. 231, 271; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 8.

Additional synonymy in Bassler and Kellett (1934, p. 423).

Shell not exceeding 3 mm in length, subovate to oblong in lateral profile; hingement straight: dorsal edge of left valve extends slightly beyond that of right, but ventral edge of right valve projects slightly beyond that of left; surface smoothly convex, with short spine preserved near antero-dorsal angle of many specimens.

Range: Ordovician to Permian.

Remarks: Practically all of the established species of this genus range in age from Mississippian to Permian; many of them possessing a small antero-dorsal spine. Such a spine is not observed on the single Simpson species tentatively assigned to the genus, and it is altogether likely that it is not a member of the genus *Paraparchites* Ulrich and Bassler.

PARAPARCHITES? CIRCULANTIS Harris, n. sp.

Plate 6, figures 1a-1c

Aparchites subcircularis Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 7.

Carapace small (0.5 mm in diameter), subcircular in lateral profile, slightly longer than high and not strongly inflated, maximum dimensions through or before center: left valve extending above short, straight, faintly depressed hingement of right in a low, even curve; right valve faintly and evenly overlapping barely thickened free marginal periphery of left.

Holotype specimen MCZ No. 4508; length: 0.53 mm; height: 0.45 mm; thickness: 0.27 mm, from Bromide horizon, at top of Zone 15 of U. S. Highway 77 Simpson section.

Range: Not commonly occurring in the Bromide.

Remarks: In lateral outline this tiny Simpson form resembles *Paraparchites subcircularis* Geis, from the Salem of Indiana; but the Mississippian form is eight to ten times larger than the new species, displays ventral overlap of larger right valve, and nepionic molts particularly, possess definite "eye tubercles". The generic identity of this recognizable, small, circular Bromide form is questioned because of its small size and lack of antero-dorsal spine.

The trivial name is adapted from the Latin word, circulantis, "making round"; referring to the subcircular lateral profile of the species.

Note: Article 25 of International Code of Zoological Nomenclature decrees as invalid the status of "new species" for a form illustrated, but undescribed, in any publication appearing since December 31, 1930. Accordingly, as suggested by the Rules for such a case, the original synonymic reference to this previously illustrated, though undescribed, species appears here "without date following the trivial name", thus permitting herein official establishment of the new species.

Genus HYPERCHILARINA Harris, n. gen.

Genotype: *H. ovata* Harris, n. sp.

Leperditella Weller (partim) 1903, N. J. Geol. Surv., Rept. on Paleontology, p. 309.

Smooth, punctate, or reticulate, biconvex, nonsulcate forms of intermediate size (1 to 3 mm), with left valve projecting above straight hinge line of smaller right valve and overlapping it about free margins; ventral surface of right valve often flattened and thickened or beaded, thus preventing abnormal overlap of larger left valve.

Range: Ordovician.

Remarks: This genus resembles the genera *Paraparchites* Ulrich and Bassler and *Antiparaparchites* Coryell and Rogatz in projection of one valve above dorsal edge of opposite valve. Unlike these genera, however, the valve (left) of the new genus that extends above the hingement also overlaps the ventral edge of the smaller opposite (right) valve. Left valve overlap along venter of some specimens assumes the proportions of slight projection, rather than a true embracing overlap, such being the case in the species *H. nodosimarginata* Harris, n. sp.

The generic name is adapted from the Greek words, hyper, "above, beyond, over", and chilarion, "a small lip"; referring to the projection of the dorsal and ventral edges or "lips" of larger left valve beyond or above respective margins of smaller right valve.

HYPERCHILARINA NODOSIMARGINATA Harris, n. sp.

Plate 5, figures 16a-16c

Leperditia nodomarginata Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 19.

Adult approximating 2 mm in length, subquadrate in lateral profile, with straight hinge and slight retral swing (readily observable in nepionic molt), highest post-centrally, thickest centrally; long straight hingement contact faintly and narrowly depressed, cardinal angles approximately equal, rounded, ventral margin gently and evenly convex; anterior nose but slightly sharper and more produced than broadly rounded posterior end; left valve larger than right and overlapping it about free margins and extending faintly above its dorsal margin, basal edge of smaller right valve flattened and inwardly beveled beneath overlapping edge of left, lateral edge of beveling thickened, and studded with 12 to 18 bead-like spinelets about the ventral angles to prevent abnormal overlap of the larger valve; surface smooth and rather gently convex, with slight flattening or semi-channeling bordering peripheral thickening.

Holotype specimen MCZ No. 4509; length: 1.63 mm; height: 1.12 mm; thickness: 0.86 mm, from Bromide horizon, in Zone 12 of U. S. Highway 77 Simpson section.

Range: Commonly occurring in upper Tulip Creek and Bromide (not in overlying Corbin Ranch).

Remarks: This species differs from *Aparchites granilabiatus* (Ulrich), from the Decorah of Minnesota, in its smooth, rather than granular, surface and in absence of "a faint smooth spot just in front and above the center". In outline it somewhat resembles *A. fimbriatus* (Ulrich), of Richmond age, but the Simpson species possesses fewer and shorter peripheral beads and displays extension of left valve above hinge line of right. The "neatly curved obscurely crenulated ventral edge" of *Isochilina amii* Jones, from the *Cryptolithus tesselatus* Green horizon in the Trenton northeast of Quebec, Canada is not so definitely beaded as the new species. The species is very similar in outline, size, and peripheral beading to *Leperditella ornata* Weller, from the Black River of New Jersey (herein assigned to the new genus), but the eastern form is much more inflated, with maximum thickness below, rather than near center; it also possesses more peripheral beads. Weller (1903, p. 309) observed that dorsal and ventral projections of left valve beyond right excluded the New Jersey form from the genus *Aparchites* Jones.

The trivial name is adapted from the Latin words, nodosus, "full of knots", and marginis, "edge, border"; referring to the nodose ventral margin of the right valve.

Note: Article 25 of International Code of Zoological Nomenclature decrees as invalid the status of "new species" for a form illustrated, but undescribed, in any publication appearing since December 31, 1930. Accordingly, as suggested by the Rules for such a case, the original synonymic reference to this previously illustrated, though undescribed, species appears here "without date following the trivial name," thus permitting herein official establishment of the new species.

Hyperchilarina angularis Harris, n., sp.

This species, ancestral to the species *H. nodosimarginata* Harris, n. sp., is relatively shorter and higher, subtriangular in lateral outline; dorsal rim is slightly thickened and arched, anterior nose the more acutely pointed and produced, and with rolled keel developed at mid-ventral margin, thus resulting in well-excavated venter.

Holotype specimen MCZ No. 5410; length: 1.62 mm; height: 1.12 mm; thickness: 0.87 mm; paratype specimen MCZ No. 4510A; length: 1.62 mm; height: 1.12 mm; thickness: 0.80 mm; paratype intermediate molt specimen MCZ No. 4510B; length: 1.27 mm; height: 0.90 mm; thickness: 0.65 mm, from Tulip Creek horizon, in Zone 31 of U. S. Highway 77 Simpson section.

Range: Tulip Creek.

Remarks: The trivial name is obtained from the Latin adjective, angularis, "having angles"; referring to the subtriangular lateral outline of the carapace.

Hyperchilarina ovata Harris, n. sp.

Plate 5, figures 17a-17b

Carapace elongate-ovate in lateral profile, maximum length and height through center, maximum thickness slightly below center; ends evenly rounded, posterior slightly lower and produced, thus effecting faint retral swing; left valve larger than right and overlapping it about it about free margins, with maximum overlap a strong graceful ventral curve, left valve also projects dorsally above fairly long, slightly and narrowly depressed, straight contact, with maximum height at center, faint terminal projection of left valve, valves slightly separated or channeled; surface smooth and rather uniformly convex, outer periphery of smaller right valve thickened and dotted with short beads at ventral angles (thickening and beading apparently prevented abnormal overlap of larger left valve).

Holotype specimen MCZ No. 4511; length: 1.30 mm; height: 0.90 mm; thickness: 0.62 mm; paratype largest specimen measured MCZ No. 4512; length: 1.60 mm, from Tulip Creek horizon, in Zone 31 of U. S. Highway 77 Simpson section.

Range: This is a commonly occurring index fossil of the Tulip Creek, though not as abundant as representatives of the genera *Schmidtella* Ulrich and *Cryptophyllus* Levinson.

Remarks: The species superficially resembles many smooth, straight-hinged, elongate-ovate Ostracoda. Critical examination of the Simpson form reveals, however, the peculiar characteristic of left valve projection beyond both dorsal and ventral margins of the smaller right valve; with further identifying feature in the peripheral beading of smaller right valve at ventral angles. The species, though resembling *Aparchites ellipticus* Ulrich in lateral outline, convexity, and projection of larger left valve beyond dorsal edge of right, differs from the Minnesota Trenton form in several respects; i. e., longer hingement, higher dorsal projection of left valve, pronounced ventral overlap of left valve, peripheral beading of right valve, and absence of channel bordering contact of valves. The species differs from *Hyperchilarina symmetrica* Harris, n. sp., McLish shale ostracode, in smaller size, proportionately thinner carapace, and presence of peripheral beads on right valve.

The trivial name is obtained from the Latin adjective, ovatus, "egg-shaped"; having reference to the elongate-ovate lateral outline of the species.

HYPERCHILARINA SYMMETRICA Harris, n. sp.

Plate 5, figures 18a-18b

Carapace subquadrate to ovate in lateral profile, highly inflated, with maximum length and height through center, and maximum thickness below median line; ends evenly and broadly rounded, no retral swing observed, anterior nose slightly more acutely rounded and produced than posterior; left valve overlaps right about free margins and projects above narrowly and faintly depressed straight hingement in a low, even arch, ventral and terminal overlap fairly even, though not as pronounced as in other species of the genus; surface smooth, with low thickened ridge encircling periphery of smaller right valve, base of right valve inwardly beveled, peripheral beads at ventral angles of right valve are scarcely developed.

Holotype specimen MCZ No. 4513; length: 2.00 mm; height: 1.42 mm; thickness: 1.16 mm, from McLish shales, near the base of Zone 66 of Oklahoma Highway 99 Simpson section.

Range: Recovered in quantity from McLish shales in Zones 66 to 68 of Oklahoma Highway 99 Simpson section.

Remarks: This species is larger and much more inflated than *H. nodosimarginata* Harris, n. sp., and exhibits more dorsal overlap and less ventral beading. It is thicker in proportion to its length, is larger, has much less beading than *H. ovata* Harris, n. sp., and neither are the valves slightly separated or flaring at terminal noses, as in the smaller and later species.

The trivial name is an adjectival form of the Greek word, symmetros, "symmetry"; having reference to the symmetrical lateral profile of the species.

Genus LEPERDITELLA Ulrich, 1894

Genotype: *Leperditia inflata* Ulrich, 1892

Leperditia Ulrich (partim) 1892, Amer. Geologist, vol. 10, pp. 263, 268.

Leperditella Ulrich 1894, Geology Minn., vol. 3, pt. 2, p. 636, Ruedemann 1901, N. Y. State Mus., Bull. 49, p. 73; Ulrich and Bassler 1906, U. S. Nat. Mus., Proc., vol. 30, p. 150; Zittel 1915, Gründzuge der Paläontologie, Abth. 1 (Invert.), p. 594; Wilson and Mather 1916, Ontario Bur. Min., 25th Ann. Rept., pt. 3, pp. 53, 61; Öpik 1934, Univ. Tartu, Geol. Inst., Publ. no. 44, pp. 5, 7; 1937, ibid, no. 50, p. 23; Teichert 1937, Meddel. om Gronland, Bd. 119, no. 1, p. 46; Kay 1940, Jour. Paleontology, vol. 14, p. 241; Coryell and Schenck 1941, ibid, vol. 15, p. 176; Schmidt 1941, Senckenberg. Naturforsch. Ges., Abh., vol. 454, pp. 17, 18; Cooper 1942, Jour. Paleontology, vol. 16, p. 775; Shimer and Shrock 1948, Index Foss. N. America., p. 664; Ellis and Messina 1952, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 1; Moore, Lalicker, and Fischer 1952, Invert. Foss., pp. 526, 527, text fig. 14-3, 10; Piveteau 1953, Traite de Paleontologie, p. 276; Henningsmoen 1953, Norsk. Geol. Tiddskr., Bd. 31, pp. 231, 250, 251, 275; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 108.

Additional synonomy in Bassler and Kellett (1934, p. 372).

Shell not exceeding 3 mm in length, elongate subovate in lateral profile; left valve slightly larger than right, often projecting along ventral border; a broad, shallow, generally obscure sulcus characterizes the anterior quarter of carapace; hingement effected by shallow groove of right valve receiving beveled edge of larger left valve, thus resulting (in many specimens) in slight projection in dorsal periphery of right valve beyond that of the left.

Range: Ordovician.

Leperditella aequilatera (Ulrich), 1894

Plate 2, figures 5a-5b, 6

Leperditia aequilatera Ulrich 1892, Amer. Geologist, vol. 19, p. 265, pl. 9, figs. 9-11; Coryell 1927, Ostracoda Plates and Text Figures, Columbia Univ., vol. 1, p. 121, pl. 9, figs. 9-11; Ellis and Messina 1952, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 1.

Leperditella aequilatera Ulrich 1894, Geology Minn., vol. 3, pt. 2, p. 636, text fig. 46i; Bassler 1915, U. S. Nat. Mus., Bull. 92, p. 696; Bassler and Kellett 1934, Geol. Soc. Amer., Spec. Pap. no. 1, p. 372.

Leperditia aequilateralis Ulrich, Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 6.

Leperditella A. Harris, Okla. City Geol. Soc., Field Conf., Guidebk., March 5-6, 1937, 4th, 5th pp., fig. 6.

Carapace small, elongate-elliptical in lateral profile, with slight forward swing, maximum length and thickness through center; dorsal line straight, with subequal cardinal angles, anterior nose more produced and lower than posterior, posterior end roundly truncated ventrally; left valve but faintly overlaps right about free margins; hingement straight, rather tightly appressed along anterior quarter and slightly channeled otherwise; surface appearing smooth, though actually very finely perforate, antero-median sulcus obscurely developed.

Hypotype specimen MCZ No. 4514; length: 0.70 mm; height: 0.42 mm; hypotype specimen MCZ No. 4514A; length: 0.47 mm; height: 0.30 mm, from Zone 4 in Corbin Ranch formation of Oklahoma Highway 99 Simpson section.

Range. A commonly occurring form in Corbin Ranch beds at the top of the Simpson, where it is associated with *Leperditella rex* (Coryell and Schenck) and *L. tumida* (Ulrich).

Remarks: This small, smooth, simple, elongate ostracode is one of a number of conservative forms appearing in the Simpson section. It is the only tiny smooth form occurring in the Corbin Ranch, and may be recognized otherwise by its equilateral outline and rather evenly convex, smooth surface.

LEPERDITELLA ALTIFORMA Harris, n. sp.

Plate 2, figures 7a-7b

Outline of carapace below straight hingeline an asymmetrical three-quarter circle with antero-ventral truncation, anterior nose is exceptionally high and well forward, so that antero-cardinal angle is practically a right angle, posterior end broadly rounded and produced in gracefully rounded retral swing; height in young and adult is nine-elevenths the length, carapace thickest at or immediately below center; left valve overlaps right about free margins, with maximum overlap ventral; surface smooth and rather lowly convex.

Holotype left valve MCZ No. 4515; length: 1.00 mm; height: 0.83 mm, from Tulip Creek horizon, at base of Zone 34 of Oklahoma Highway 99 Simpson section.

Range: Apparently this form occurs sparsely in the Tulip Creek member of the Simpson, being recovered from Zones 34 of Oklahoma Highway 99, and 32 of U. S. Highway 77 Simpson sections, respectively.

Remarks: Research of the literature reveals very few leperditellids with carapace subquadrate to semicircular in outline and with anterior nose near cardinal angle. *Leperditella subquadrata* (Jones), from topmost Silurian or basal Devonian of Pennsylvania, agrees in size, but lacks the retral swing and extremely high anterior nose of the Oklahoma form. *Eoleperditia frontalis* (Jones), from the middle Silurian of Canada, possesses the identical outline of the Simpson form, but is five to six times larger and displays other leperditian characteristics, including distinct "eye tubercle".

The trivial name of this species is a combination of the Latin adjective, altus, "high", and the noun, forma, "shape"; referring to the relatively high carapace of the species.

LEPERDITELLA BROOKINGI Harris, 1931

Plate 2, figures 8a-8c

Leperditella brookingi Harris 1931, Okla. Geol. Survey, Bull. 55, p. 88, pl. 3, figs. 2a-2c; Bassler and Kellett 1934, Geol. Soc. Amer., Spec. Pap. no. 1, p. 373.

This species, averaging 1 mm in length, has been recovered from Joins strata of Simpson sections on U. S. Highway 77 and West Spring Creek. It is associated with *L. cooperi* Harris and with *Eoleperditia mediumbonata* Harris, n. sp. and its subspecies, *debilis* Harris, n. subsp.

Holotype specimen MCZ No. 4516; length: 1.15 mm; height: 0.75 mm; thickness: 0.57 mm, from Joins horizon, at top of Zone 98 of U. S. Highway 77 Simpson section.

The species was named in honor of Colonel L. E. Brooking, physicist and technical adviser with Civil Aeronautics Authority in Washington, D. C.

LEPERDITELLA BULBOSA (Harris), 1931

Plate 2, figures 9a-9c

Isochilina bulbosa Harris 1931, Okla. Geol. Survey, Bull. 55, p. 87, pl. 5, figs. 2a, b; 1931, Okla. Acad. Sci., Proc., vol. 12, pp. 57, 59, pl. 13, fig. 10; Bassler and Kellett 1934, Geol. Soc. Amer., Spec. Pap. no. 1, p. 338; Hayes 1952, Shale Shaker, vol. 3, no. 2, p. 17; 1955, Shale Shaker, Digest, p. 110.

This excellent and commonly occurring index fossil has been identified in various exposures of the lower Oil Creek and from subsurface Oil Creek strata of West Texas. It is recognized by a short, low bulb on the post-ventral margin of the larger left valve, the smaller right valve possessing no such ventral inflation. Internal casts exhibit the leperditellid antero-dorsal sulcus. Closely resembling this species is *L. valida* Harris, n. sp., a Joins index form with more pronounced and more centrally located peripheral knob.

Holotype specimen MCZ No. 4517; length: 1.98 mm; height: 1.33 mm, from Oil Creek horizon, on railroad cut in sec. 11, T. 1 N., R. 4 E., 0.8 mile north of Hickory, Oklahoma.

LEPERDITELLA VALIDA Harris, n. sp.

Plate 2, figures 10a-10b

The larger left valve of this species displays a short, inflated knob immediately within the periphery of the mid-ventral margin. The knob projects slightly outwardly and downwardly beyond ventral outline of the carapace. A distinct, broadly concave area between the ventral knob and the centrally inflated area of the carapace accents both bounding features. As in *L. bulbosa* (Harris) in Oil Creek strata, no ventral knob occurs on the smaller right valve of the species.

Holotype left valve MCZ No. 4518; length: 1.83 mm; height: 1.25 mm, from Joins horizon, in Zone 93 of U. S. Highway 77 Simpson section.

Range: Recovered from Joins Zones 93 to 96 of U. S. Highway 77 Simpson section.

Remarks: This species differs from *L. bulbosa* (Harris) in the more strongly inflated and more centrally located ventral knob of its left valve.

The trivial name is the feminine form of the Latin adjective, valida, meaning "strong"; referring to the strongly inflated knob along the lower border of the left valve.

LEPERDITELLA COOPERI Harris, 1931
Plate 3, figures 1a-1c

Leperditella cooperi Harris 1931, Okla. Geol. Survey, Bull. 55, p. 88, pl. 3, figs. 1a-c; Bassler and Kellett 1934, Geol. Soc. Amer., Spec. Pap. no. 1, p. 373.

This elongate-ovate simple form with high posterior end has been recovered from Joins strata in Simpson sections of U. S. Highway 77 and West Spring Creek. In the Joins it is associated with large eoleperditians possessing subhingement inflated ridge on post-dorsal shoulder.

Holotype specimen MCZ No. 4519; length: 1.63 mm; height: 1.09 mm; thickness: 0.77 mm; paratype specimen MCZ No. 4519A; length: 1.20 mm; height: 0.87 mm; thickness: 0.41 mm, from Joins horizon, at top of Zone 98 of U. S. Highway 77 Simpson section.

Range: Joins.

Remarks: This species was named in honor of Dr. C. L. Cooper, of the U. S. Geological Survey, Washington, D. C.

LEPERDITELLA GIBBA Harris, n. sp.
Plate 2, figures 11a-11c

Carapace sub-ovate, inflated, with slight retral swing; approximating 1 mm in length, height approximating three-fourths the length, thickest centrally; exceptionally short hingement, with shallow channel, cardinal angles approximately equal; posterior end slightly lower and more broadly rounded than anterior; valves seemingly equal, but left valve actually receives rabbeted edge of the right; surface smooth.

Holotype specimen MCZ No. 4520; length: 0.80 mm; height: 0.63 mm, from Oil Creek horizon, above middle of Zone 91 of U. S. Highway 77 Simpson section.

Range: Oil Creek.

Remarks: This short, rotund, subequivalved, smooth form resembles *Leperditella canalis* Ulrich in general shape, short hingement, full-bodied tumidity, and smooth surface. It differs from the aforementioned Ordovician form from Minnesota in smaller size, in channeled hingement, and in absence of "groove along the ventral border of the left valve".

The trivial name (used in apposition) is adapted from the Latin noun, gibba, meaning "hump"; referring to the hump-like or gibbous carapace.

LEPERDITELLA INCISA Harris, n. sp.

Plate 3, figures 4a-4b

Carapace tiny, semicircular; height three-fifths the length, maximum thickness near the center; high anterior nose emphasizes definite retral swing; long, straight, channeled hingeline; cardinal angles approximately equal; dorsal edge of smaller right valve tends to project slightly beyond that of the left, though left valve distinctly overlaps the right ventrally.

Holotype specimen MCZ No. 4521; length: 0.47 mm; height: 0.30 mm; thickness: 0.17 mm, from Bromide horizon, at top of Zone 22 of Oklahoma Highway 99 Simpson section.

Range: Apparently limited to the Bromide formation; recovered from the type locality, from Zone 4 and 5 of West Spring Creek Simpson section, and from Bromide subsurface strata of Crane County, Texas.

Remarks: Slight umbonation of the right valve above the left may be sufficient criterion for assigning this form to a new genus comparable to the genus *Hyperchilarina* Harris, n. gen., with umbonate left valve.

The trivial name is adapted from the Latin word, incisus, "cut into"; referring to the widely channeled open "cut" of the hingement.

LEPERDITELLA? JONESINOIDES Harris, n. sp.

Plate 3, figures 6a-6b

Leperditella jonesinoides Harris, Oklahoma City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., fig. 7.

Carapace ovate-elongate, with forward swing; i. e., with low, broadly rounded, produced anterior end, and higher, more acutely rounded, ventrally truncated posterior end; dorsal margin slightly umbonate post-ventrally by reason of strong inflation of posterior half of carapace; a narrow, slightly oblique sulcus lies before the inflated area, it flattens and disappears on the hingeline and deepens behind a low antero-jacent knob located midway between the hinge and median line; straight hingement slightly channeled; surface exceedingly finely punctate.

Holotype left valve MCZ No. 4522; length: 1.30 mm; height: 0.83 mm, from Corbin Ranch calcareous shales, in Zone 6, near top of Simpson section on Oklahoma Highway 99.

Range: This smooth, slightly sulcate form is limited to the Corbin Ranch formation.

Remarks: The species superficially resembles members of the genus *Jonesina* Ulrich and Bassler; i. e., *J. howardensis* Kellett and *J. gallowayi* Bradfield; hence the trivial name for the species. The Simpson form differs in its larger size, less pronounced sulcus and posterior inflation, shallow hingement channel, and more arcuate ventral profile. The species differs from *Primitia prunella* Barrande, from the Upper Ordovician of Bohemia, in its smaller size, in less inflated carapace, and in smooth, rather than punctate, surface.

Note: Article 25 of International Code of Zoological Nomenclature decrees as invalid the status of "new species" for a form illustrated, but undescribed, in any publication appearing since December 31, 1930. Accordingly, as suggested by the Rules for such a case, the original synonymic reference to this previously illustrated, though undescribed, species appears here "without date following the trivial name," thus permitting herein official establishment of the new species.

Leperditella obesa Harris, n. sp.

Plate 3, figures 5a-5c

Carapace subsymmetrically elliptical in lateral profile, anterior end slightly the more produced, higher, and more acutely rounded, posterior end bluntly and evenly rounded, post-cardinal angle the more abrupt; long straight hingement contact not distinctly channeled, possibly more tightly appressed along anterior quarter; free marginal contact channeled, particularly along venter, ventral periphery of left valve indented by a row of 40 to 50 fairly coarse pores; finely and evenly punctate surface abruptly inflated behind and below median point, leperditellid antero-median sulcate depression not observed, though near-median "muscle scar" appears as a darkened spot or slight depression before and above area of maximum inflation.

Holotype specimen MCZ No. 4523; length: 1.25 mm; height: 0.85 mm; thickness: 0.67 mm, from Oil Creek horizon, in Zone 59 of West Spring Creek Simpson section.

Range: This form occurs commonly in the upper Oil Creek;

recovered through a stratigraphic range of 100 feet on the U. S. Highway 77 section, and 500 feet in that of West Spring Creek. It has been recovered from the upper Oil Creek in subsurface samples from the Fox oil field of Oklahoma.

Remarks: This tumid form becomes less bulbous or nodose with stratigraphic succession, the older form from Zone 64 of the West Spring Creek section being abruptly inflated subcentrally, while that developed in Zone 59 of the section is evenly convex in the corresponding area, a development possibly justifying subspecific differentiation. A similar nodosity-stratigraphic relationship is noted in *L. bulbosa* Harris and the species *L. valida* Harris, n. sp., from the lower Oil Creek and Joins, respectively.

The species differs from *L. tumida* (Ulrich) in relatively longer hingement, in distinct sulcus, and abrupt inflation of post-central area.

The trivial name is the Latin adjective, obesa, meaning "fat, plump"; referring to the extremely inflated lower body of the carapace.

LEPERDITELLA POROSA Harris, n. sp.

Plate 3, figures 7, 8

Carapace semicircular in lateral outline, with ventral margin strongly arched, anterior nose slightly higher and sharper, antero-cardinal angle the more acute; carapace rather strongly and evenly inflated, with maximum thickness at or immediately above center; surface coarsely porate to reticulate, ridges and intervening pores approximately equal in width; internally in the dorsal half occurs a low, post-median sulcate ridge that appears as a narrow, darkened band on the moistened surface.

Holotype adult left valve MCZ No. 4524; length: 1.26 mm; height: 0.85 mm; paratype nepionic specimen MCZ No. 4525; length: 0.52 mm; height: 0.37 mm; thickness: 0.25 mm, from Corbin Ranch shales, in Zone 4 of Oklahoma Highway 99 Simpson section.

Range: Commonly occurring in Corbin Ranch formation at top of the Simpson section.

Remarks: Numerous molts of this coarsely porate species are observed in the Corbin Ranch member associated with *L. tumida* (Ulrich) and *Eoleperditia fabulites* (Conrad), and other forms.

The surficial pores appear coarser on the nepionic than on the adult forms; in fact, occasional adult specimens may appear essentially smooth, thus superficially resembling the aforementioned contemporary, *L. tumida* (Ulrich).

The surficial pores of the Simpson species are larger and more evident than those of *Aparchites chatfieldensis* Ulrich, from the Ordovician of Minnesota; furthermore, the Simpson species is more inflated, relatively higher, and more semicircular in lateral outline.

The trivial name is adapted from the Latin noun, porus, meaning "pore, hole"; and refers to the coarsely porate surface of the species.

Leperditella rex (Coryell and Schenck), 1941

Plate 3, figure 2

Leperditia inflata Ulrich 1892, Amer. Geologist, vol. 10, no. 5, p. 265, pl. 9, figs. 12-15 (not *Cypris inflata* Murchison 1839, Silurian Syst., p. 84, figs. A1-3=*Leperditia inflata* Jones and Kirkby 1863, British Assoc. Rept. for 1863 (1864), p. 80=*Paraparchites inflatus* Bassler and Kellett 1934, Geol. Soc. Amer., Spec. Pap. no. 1, p. 426); Coryell 1927, Ostracoda Plates and Text Figures, Columbia Univ., vol. 1, p. 121, pl. 9, figs. 12-15; Ellis and Messina 1952, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 1.

Leperditella inflata Ulrich 1894, Geology Minn., vol. 3, pt. 2, p. 636, text figs. 46a-d; Harris 1931, Okla. Acad. Sci., Proc., vol. 12, pp. 58, 59, pl. 12, fig. 8; Twenhofel and Shrock 1935, Invert. Paleontology, 1st. ed., fig. 161 E-F, p. 438; Öpik 1937, Univ. Tartu, Geol. Inst., Publ. no. 50, p. 8; Shimer and Shrock 1948, Index Foss. North Amer., p. 664.

Leperditella rex (Coryell and Schenck) nomen novum 1941, Jour. Paleontology, vol. 15, p. 177; Shimer and Shrock 1948, Index Foss. North Amer., pl. 280, fig. 31; Moore, Lalicker, and Fischer 1952, Invert. Foss., pp. 526-527, text fig. 14-3, 10; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, p. 250.

Leperditia rex Shimer and Shrock 1948, Index Foss. North Amer., p. 664.

Additional synonomy in Bassler and Kellett (1934, p. 374).

This small elongate form, higher and more inflated posteriorly, occurs commonly in the Corbin Ranch formation of topmost Simpson section. Numerous representatives average 0.90 mm in length. The shallow hingement channel is deeper posteriorly because of posterior umbonation of carapace above the dorsal margin.

Hypotype specimen MCZ No. 4526; length: 0.85 mm; height: 0.52mm, from Corbin Ranch limestone, in Zone 4 of Oklahoma Highway 99 Simpson section.

Range: The species is limited to the Corbin Ranch formation of the Simpson.

Remarks: A more slender subspecies, *minima* Harris n. subsp., occurs in underlying Bromide strata.

Leperditella rex (Coryell and Schenck) subsp. minima Harris, n. subsp.

Plate 3, figures 3a-3b

Leperditella inflata Harris (not Ulrich), Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th. p., fig. 11; ibid, Mch. 5-6, 1937, 4th, 5th pp. fig. 14.

The subspecies differs from *L. rex* (Coryell and Schenck) in more slender-elongate outline, somewhat less inflation of carapace, and smaller average size. The average length is approximately 0.85 mm and the average height is 0.45 mm.

Holotype specimen MCZ No. 4527; length: 0.85 mm; height: 0.50 mm; thickness: 0.37 mm, from Bromide horizon, at top of Zone 24 of Oklahoma Highway 99 Simpson section.

Range: Commonly occurring in the uppermost fossiliferous zone of the Bromide proper, the zone immediately below the Corbin Ranch formation.

Leperditella ? subcygnoides Harris, n. sp.

Plate 3, figures 9a-9c

Carapace medium in size, subquadrate in lateral profile, with forward swing scarcely noticeable, maximum dimensions through a point at or slightly below middle; dorsal and ventral margins subparallel, posterior nose higher and slightly truncated ventrally, anterior end lower and more broadly rounded, with flattened cardinal slope, sides subparallel in dorsal view; slight overlap or extension of right valve about free margins, with some peripheral channeling; a weakly defined, broad, antero-median sulcus with low, antero-jacent node may be observed on perfectly preserved specimens, about free margins of occasional forms is a slight thickening that is suggestive of a keel; surface apparently smooth.

Holotype specimen MCZ No. 4528; length: 1.20 mm; height: 0.77 mm; thickness: 0.65 mm, from basal McLish, in well core at 7,885 feet in Gulf No. 1 Johnson well, Fox field, Oklahoma.

Range: Lower McLish.

Remarks: The species differs from *Primitia elongata* Kraus var. *parallela* Chapman in less pronounced sulcus, smooth, rather than granulose, surface, and greater lateral inflation of valves. It possesses no broad median depression in the middle and lower body of the carapace, as does *P. bonnemai* Swartz, from the Silurian of Sweden.

The generic identity of the species may be questioned because of its non-leperditellid right valve overlap, though several authors have observed the somewhat arbitrary characteristic in several smooth forms.

The trivial name is adapted from the Latin prefix, sub, meaning "somewhat", and the Greek word, cygnoides, meaning "swanlike"; referring to the graceful curvature of the free marginal profile.

Leperditella tumida (Ulrich), 1894

Plate 3, figures 10a-10b

Leperditia tumida Ulrich 1892, Amer. Geologist, vol. 10, p. 264, pl. 9, figs. 1-3; Coryell 1927, Ostracoda Plates and Text Figures, Columbia Univ., vol. 1, p. 95, pl. 45, figs. 13-15; ibid, p. 121, pl. 9, figs. 1-3; Ellis and Messina 1952, Catalogue Ostracoda, Amer.Mus. Nat. Hist., Spec. Publ., vol. 1.

Leperditella tumida Ulrich 1894, Geology Minn., vol. 3, pt. 2, p. 636; Bassler 1932, Tenn. Geol. Survey,Bull. 38, pp. 65, 68; Harris, Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., fig. 5; Shimer and Shrock 1948, Index Foss. North America, p. 664, pl. 280, figs. 32-34.

Additional synonomy in Bassler and Kellett (1934, p. 375).

This excellent species, with pronounced inflation in posterior body of carapace emphasized by obscure antero-jacent sulcate depression, is characteristic of the Corbin Ranch formation at top of the Simpson group, where it occurs in abundance, on Oklahoma State Highway 99 occurring in the uppermost 12 to 15 feet of the section.

Hypotype specimen MCZ No. 4529; length: 2.40 mm; height: 1.50 mm; thickness: 1.32 mm, from Corbin Ranch strata in Zone 4 of Oklahoma Highway 99 Simpson section.

Remarks: This species has been recovered from the Lowville of Kentucky, Virginia, Tennessee, Pennsylvania, and Ontario, Canada; Bassler reported it from the Tyrone of Virginia.

Genus KAYINA Harris, n. gen.

Genotype: *K. hybosa* Harris, n. sp.

Carapace subquadrate to elongate in lateral profile, thickest and highest posteriorly, left valve larger than right about free margins, particularly along ventral margin; straight hingement; near post-cardinal area of the left valve occurs a pronounced shoulder or knob projecting upward and/or outward, smaller right valve without shoulder; an internal semi-partition suggests an obscure surficial sulcus, a feature in common with that of the genus *Leperditella* Ulrich; surface smooth, reticulate, papillose, or otherwise moderately sculptured, antero-central muscle scar or pit often visible.

Range: Ordovician.

Remarks: In the subelongate outline, straight hingement, and asymmetrical valves of the carapace (posterior knob or shoulder on left valve only) this genus resembles the genus *Phanassymetria* Roth. In the latter genus, however, the right valve is the larger and completely overlaps the smaller left valve, including the straight hingement; again, it is the right valve of Roth's genus, rather than the left, that possesses the inflated dorsal shoulder, as well as a secondary shoulder near the ventral edge. The genus *Milleratia* Swartz possesses similar outline and displays dorsal shoulder above straight hingement, but the shoulder occurs on both valves, is more centrally located, and sulcus or sulcate pit is much more pronounced.

The genus is named in honor of Dr. G. Marshall Kay of Columbia University, New York City, in recognition of his research with Ordovician Ostracoda.

KAYINA HYBOSA Harris, n. sp.

Plate 3, figures 11a-11d

Leperditella sp. Harris, Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., figs. 44a-c.

Medium-sized carapace, subrhomboidal-elongate in lateral profile, highest and thickest in posterior quarter, maximum length above median line, wedge-shaped in dorsal profile; dorsal line straight with hingement obscured behind post-dorsal projection of left valve, dorsal angles exceeding 100 degrees, the anterior the greater; ventral margin sloping downward from higher, evenly rounded, produced anterior nose, posterior nose above the median line, broadly rounded dorsally and truncated below; left valve larger and extending beyond right along ventral margin; surface smoothly convex, an outward- and upward-projecting bulbous knob is situated before the post-cardinal angle of the left valve, right valve without bulbous projection.

Holotype specimen MCZ No. 4530; length: 1.40 mm; height: 0.85 mm; thickness: 0.71 mm; paratype specimen MCZ No. 4530A; length: 1.07 mm; height: 0.75 mm; thickness: 0.76 mm, from Tulip Creek horizon, in Zone 36 of Oklahoma Highway 99 Simpson section.

Range: Occurring rather abundantly in Tulip Creek Zones 34-36 of Oklahoma Highway 99 Simpson section.

Remarks: This species differs from *Leperditella ? dorsicornis* Ulrich in its more asymmetrical lateral profile, less central location of post-dorsal shoulder, and absence of distinct sulcus.

The trivial name is adapted from the Greek word, hybos, "hump-backed" referring to the prominent hump or knob near post-cardinal angle of left valve.

KAYINA ? POROSA Harris, n. sp.

Plate 3, figures 12a-12b

Kloedenia B Harris, Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., fig. 59.

Medium-sized carapace, subquadrate in lateral profile, with slight forward swing, maximum height through posterior quarter, maximum length and thickness through center; dorsal line straight and slightly channeled, ventral margin subparallel to dorsum, faintly incised centrally; anterior end rather evenly rounded with slightly protruding central nose, posterior end abruptly rounded; periphery of the free margins (particularly the ventral margin of the left valve) thickened by a low, narrow ring of shell growth; surface flatly convex, a slightly depressed medio-dorsal area emphasizes a low post-dorsal bulge that protrudes above the hingeline, the two latter features particularly noticeable on left valve; surface indented with rounded, rather irregularly-spaced, coarse reticulations, rounded subcentral "muscle scar" in front of center.

Holotype specimen MCZ No. 4531; length: 1.50 mm; height: 1.10 mm, from Bromide horizon, near base of Zone 22 of Oklahoma Highway 99 Simpson section.

Range: Two specimens recovered from the type locality in Zone 22 of the Bromide.

Remarks: This species differs from *Leperditella ? dorsicornis* Ulrich in its less pronounced post-dorsal umbonate bulge and near-median sulcus, flatter convexity, and ornate surface. The species is assigned tentatively to the genus *Kayina* Harris, n. gen. because of its post-dorsal bulge.

The trivial name is adapted from the Latin noun, porus, meaning "pore"; referring to the reticulate surface of the form.

Genus SCHMIDTELLA Ulrich, 1892

Genotype: *S. crassimarginata* Ulrich, 1892

Schmidtella Ulrich 1892, Amer. Geologist, vol. 10, p. 269; Bassler 1913, 1927, 1937, Zittel-Eastman Textbk. Paleontology, 2d ed., p. 737; Zittel 1915, Gründzuge der Paläontologie, Abth. 1 (Invert.), p. 594; Bradfield 1935, Amer. Paleontology, Bull., vol. 22, no. 73, p. 139; Teichert 1937, Meddel. om. Gronland, Bd. 119, no. 1, p. 45; Kay 1940, Jour. Paleontology, vol. 14, p. 241; Schmidt 1941, Senckenberg. Naturforsch. Ges., Abh., vol. 454, pp. 18, 20, 22; Cooper 1942, Jour. Paleontology, vol. 16, p. 775; Shimer and Shrock 1948, Index Foss. North Amer., p. 664, pl. 280, figs. 35-37; Ellis and Messina 1952, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 1; Moore, Lalicker, and Fischer 1952, Invert. Foss., pp. 526, 527, text figs. 14-3, 12a-b; Piveteau 1953, Traité de Paléontologie, p. 276; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, pp. 231, 251, 256, 275; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 171.

Additional synonomy in Bassler and Kellett (1934, p. 471).

Carapace not exceeding 3 mm in length; short, subovate, broadly umbonate; thickest above and generally behind center, compressed in ventral slope so that profile in end view is wedge-shaped; left valve overlaps right with maximum overlap along ventral margin; hingement contact straight and channeled below dorsum; surface smooth or very finely punctate.

Range: Ordovician to Devonian.

Remarks: Numerous representatives of this smooth genus, heart-shaped in end view, occur in post-Oil Creek formations of the Simpson group. Representatives of the coarsely punctate genus *Paraschmidtella* Swartz, occur in the Joins and/or Oil Creek, but they are succeeded in McLish, Tulip Creek, and Bromide by members of the genus *Schmidtella* Ulrich.

Several of the species of Ulrich's genus display obscure anteromedian "muscle scar", thus indicating reverse orientation of valves as originally described. Such reversed orientation results in an orientation in this genus similar to that in the kindred genus, *Paraschmidtella* Swartz, many members of which display definite anterior sulcus before posterior inflation.

SCHMIDTELLA AFFINIS Ulrich, 1894

Plate 3, figures 13a-13c, 14

Schmidtella affinis Ulrich 1894, Geology Minn., vol. 3, pt. 2, p. 641, pl. 43, figs. 45-47; Bassler 1915, U. S. Nat. Mus., Bull. 92, p. 1147; Coryell 1927, Ostracoda Plates and Text Figures, Columbia Univ., vol. 1, p. 81, pl. 43, figs. 45-47; Harris 1931, Okla. Geol. Surv., Bull. 55, pp. 40, 89, 90, pl. 11, figs. 4a-b; Bassler and Kellett 1934, Geol. Soc. Amer., Spec. Pap. no. 1, p. 471; Kay 1940, Jour. Paleontology, vol. 14, pp. 236, 241, pl. 29, figs. 1-4; Triebel 1941, Senckenbergiana, vol. 23, nos. 4-6 pp. 302, pl. 1, fig. 11; Decker 1951, Amer. Assoc. Pet. Geol., Bull., vol. 35, p. 913; 1952, ibid, vol. 36, p. 135; Ellis and Messina 1952, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 1.

Schmidtella umbonata Harris (not Ulrich) 1931, Okla. Acad. Sci., Proc., vol. 12, pp. 58, 59, pl. 13, figs. 9a-b; Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th, p., figs. 30-30a; ibid, March 5-6, 1937, 4th, 5th pp., figs. 48a-b.

The highly inflated carapace (deeply excavated internally), wide umbonate dorsal surface, and subcircular outline are characteristic features of this simple species. It differs from *S. crassimarginata* Ulrich in more circular outline and lack of prominent marginal furrow on all valves. It differs from the Tulip Creek contemporary, *S. brevis* Ulrich, in slightly larger size, slightly less circular lateral profile, more umbonate dorsum, and relatively less inflation of carapace.

Hypotype specimen MCZ No. 4532; length: 1.12 mm; height: 0.91 mm; hypotype right valve MCZ No. 4532A; length: 1.10 mm; height: 0.90 mm, from Tulip Creek horizon, 13 feet below top of Zone 32 of U. S. Highway 77 Simpson section.

Range: This medium sized, subcircular, inflated form with pronounced ventral overlap ranges from McLish shales into the Tulip Creek and lower Bromide with little, if any, variation, separate valves occurring most commonly. It is most abundant in Tulip Creek strata.

SCHMIDTELLA ASYMMETRICA Harris, n. sp.

Plate 3, figures 15, 16a-16c; plate 5, figures 1a-1c

Schmidtella asymmetrica Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th. p., fig. 35; ibid, March 5-6, 1937, 4th, 5th pp., fig. 51.

Medium-sized smooth or finely perforate carapace, subovate in lateral profile; wedge-shaped in dorsal and end views as a result of its higher, thicker, and more bluntly rounded posterior end in contrast with the lower, thinner, and produced anterior and ventral margins; posterior nose slightly above the mid-line, with rounded cardinal angle, anterior end the lower and more produced, resulting in some forward swing, antero-cardinal slope longer and truncated; hingement line straight and relatively short, dorsum rather straight as a result of slight and fairly even umbonation, the straight hinge of the right valve is grooved to receive the dorsal edge of the left, groove being widest at cardinal angles; left valve overlaps right about free margins with maximum overlap a graceful curve across venter, ventral margin of smaller right valve but gently curved, practically straight and subparallel to dorsum; internally on occasional valves there is the semblance of a slight, narrow, centrally located vertical semi-partition.

Holotype specimen MCZ No. 4533; length: 0.72 mm; height: 0.50 mm; paratype specimen MCZ No. 4534; length: 0.75 mm;

height: 0.52 mm; paratype right valve MCZ No. 4535; length: 0.67 mm; height: 0.45 mm, from Tulip Creek horizon, 10 feet below top Zone 31 of U. S. Highway 77 Simpson section.

Range: This species generally occurs as an index fossil of the Tulip Creek, though ranging into lowermost Bromide. It has been recovered in the intervals: 550-650 feet below top of Simpson on U. S. Highway 77; 550-750 feet on West Spring Creek; 120-200 feet on Oklahoma Highway 99; and 250-400 feet at Rock Crossing in Criner Hills. This species and *S. affinis* Ulrich and *S. brevis* Ulrich, together with the conodont *Prioniodus aculeatus* Stauffer, constitute the major fauna in many of the thin blue and tan limestone lentils of the Tulip Creek.

Remarks: This smaller than average schmidtellid is readily recognizable in lateral profile by its forward swing, high, thick posterior nose, fairly straight dorsum and thinning anterior and ventral quarters. *S. affinis* Ulrich is larger, is subcircular, rather than noticeably asymmetrical in lateral profile, is more highly convex, and thickest near the median dorsum, rather than post-dorsally. *S. brevis* Ulrich is circular in lateral outline, very highly inflated, with arched, rather than fairly straight, dorsum.

The trivial name is adapted from the Greek prefix, a, "not", and noun, symmetros, "symmetry"; referring to the asymmetrical outline of the carapace.

Note: Article 25 of International Code of Zoological Nomenclature decrees as invalid the status of "new species" for a form illustrated, but undescribed, in any publication appearing since December 31, 1930. Accordingly, as suggested by the Rules for such a case, the original synonymic reference to this previously illustrated, though undescribed, species appears here "without date following the trivial name", thus permitting herein official establishment of the species.

Schmidtella brevis Ulrich, 1894

Plate 4, figures 10a-10c

Schmidtella brevis Ulrich 1894, Geology Minn., vol. 3, pt. 2, p. 642, pl. 45, figs. 34, 35; Coryell 1927, Ostracoda Plates and Text figures, Columbia Univ., vol. 1, p. 95, pl. 45, figs. 34, 35; Kay 1940, Jour. Paleontology, vol. 14, pp. 236, 241, 242, pl. 29, figs. 4, 8; Ellis and Messina 1952, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 1.

Schmidtella circularis Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 36 (2 views).

Additional synonomy in Bassler and Kellett (1934, p. 471).

This medium-sized, strongly inflated, subglobular species is further characterized by its subcircular lateral outline, short hingement, rather bluntly and broadly rounded posterior end and slightly produced, gracefully rounded anterior end; thickest through a point slightly above and behind the median line.

Hypotype female left valve MCZ No. 4536; length: 0.85 mm; height: 0.70 mm; hyptoype male left valve MCZ No. 4537; length: 0.90 mm; height: 0.67 mm; from Tulip Creek horizon, in Zone 31 of West Spring Creek Simpson section.

Range: This species is abundant in the Tulip Creek, bedding planes of some limestones displaying literally hundreds of specimens. In the formation it is associated with *S. asymmetrica* Harris, n. sp., *S. affinis* Ulrich, *S. crassimarginata* Ulrich, *Primitopsis elegans* Harris, n. sp., and other species. The form is reported from the Guttenberg of Iowa, where it is likewise associated with schmidtellids and *Primitiopsis* (*Macronotella*) *multipunctata* (Kay) Harris, a form very similar to *P. elegans* Harris, n. sp.

SCHMIDTELLA CRASSIMARGINATA Ulrich, 1892

Plate 4, figures 1a-1c

Schmidtella crassimarginata Ulrich 1892, Amer. Geologist, vol. 10, p. 269, pl. 9, figs. 27-30; Ellis 1903, N. Y. State Museum, Bull, 66, Misc. 2, p. 632; Raymond 1905, Carnegie Museum, Annals, vol. 3, no. 2, p. 534; Coryell 1927, Ostracoda Plates and Text Figures, Columbia Univ., vol. 1, p. 81, pl. 43, figs. 42-44; ibid, p. 121, pl. 9 figs. 27-30; Swartz 1936, Jour. Paleontology, vol. 10, pl. 83A, figs. 3a, b; Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 23; ibid, March 5-6, 1937, 4th, 5th pp., fig. 17; Öpik 1937, Univ. Tartu, Geol. Inst., Publ. no. 50, p. 9; Schmidt 1941, Senckenberg. Naturforsch. Ges., Abh., vol. 454, pp. 20, 23; Ellis and Messina 1952, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 1; Moore, Lalicker, and Fischer, 1952, Invert. Foss., pp. 526, 527, text fig. 14-3, 12a-b.

Additional synonomy in Bassler and Kellett (1935, p. 471).

This sub-circular, fairly large form with slight forward swing and thickened post-dorsal area is further characterized by the distinct fossa or channel that borders the ventral periphery; the channel is best developed post-ventrally.

Hypotype specimen MCZ No. 4538; length: 1.10 mm; height: 0.85 mm, from Bromide horizon, near base of Zone 22 of Oklahoma Highway 99 Simpson section.

Range: This largest schmidtellid (some attaining a length of 1.50 mm) ranges from McLish shales into lower Bromide; the McLish form possibly subspecific. The species has been recorded from Chazy, Stones River, and Black River strata of Alabama, New York, Wisconsin, and Illinois.

SCHMIDTELLA EXCAVATA Harris, n. sp.

Plate 4, figures 2a-2b, 3

Schmidtella excavata Harris, Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., fig. 53.

Carapace elongate-ovate laterally, female relatively higher and shorter, maximum length and height through center, thickest immediately above center; dorsal umbo a low curve, highest posteriorly, with slightly longer anterior slope, ventral curvature slightly incised before central bulge; posterior end evenly and broadly curved, anterior nose lower, more acutely rounded, and with straighter dorsal slope; surface smooth with faint, narrow sulcus often observable in antero-median area, the sulcus appearing internally as a low, bead-like "muscle scar", surface further characterized by a deeply excavated, narrow channel immediately within thickened peripheral ridge, the ridge most prominent ventrally and anteriorly, widest anteriorly, internal edge of keel is beveled; left valve overlaps right with maximum overlap ventral, hingeline and inner face of peripheral keel faintly channeled to receive beveled edges of left.

Holotype female right valve MCZ No. 4539; length: 0.82 mm; height: 0.60 mm; paratype male right valve MCZ No. 4540; length: 0.72 mm; height: 0.50 mm, from Tulip Creek horizon, in top of Zone 36 of Oklahoma Highway 99 Simpson section.

Range: This species was recovered only from Tulip Creek strata in Zones 35 and 36 of Oklahoma Highway 99 Simpson section, and Zone 7 of Rock Crossing section in Criner Hills.

Remarks: The species differs from *S. crassimarginata* Ulrich in its deeply channeled peripheral fossa and associated thickened, accenting keel; furthermore, the Tulip Creek index form is smaller and less inflated. The species differs from the subspecies *incisa* Harris, n. subsp., in the overlying Bromide, in absence of deep notch at near-median point of ventral keel.

The trivial name is an adjectival form of the Latin verb, excavus, meaning "to hollow out, excavate"; referring to the excavated channel bordering the periphery.

Note: Article 25 of International Code 25 of Zoological Nomenclature decrees as invalid the status of "new species" for a form illustrated, but undescribed, in any publication appearing since December 31, 1930. Accordingly, as suggested by the Rules for such a case, the original synonymic reference to this previously illustrated, though undescribed, species appears here "without date following the trivial name", thus permitting herein official establishment of the new species.

SCHMIDTELLA EXCAVATA subsp. INCISA Harris, n. subsp.

Plate 4, figures 4, 5

The variety is characterized by prominent median to anteromedian notching of outer margin of thickened peripheral ridge bordering the distinct fossa; the ridge is slightly thickened or inflated on either side of the notch or incision, the posterior inflation more pronounced and projecting.

Holotype male right valve MCZ No. 4541; length: 0.77 mm; height: 0.60 mm; paratype female right valve MCZ No. 4542; length: 0.98 mm; height: 0.75 mm, from Bromide horizon, approximately 75 feet below top of the Mill Creek Simpson section.

Range: This species, with distinct ventral notching of peripheral ridge, is recorded only from the type locality in the Bromide.

The subspecific name is derived from the Latin word, incisus, "cut into"; referring to the notched ventral peripheral keel.

SCHMIDTELLA MINUTA Harris, n. sp.

Plate 4, figures 6a-6c, 7

Carapace tiny, ovate, inflated, length approximating 0.6 mm (height approximating 0.4 mm), male slightly more slender-elongate; maximum length through center, thickest above and behind center, so that anterior end displays the longer and flatter slope;

dorsal umbonation strongly arched above widely and flatly channeled hinge line, cardinal wings exposed slightly beyond median umbonation, antero-dorsal angle the flatter; ventral margin rather evenly curved (that of male and smaller right valve somewhat flattened); ends evenly rounded, with posterior generally the higher and less produced, anterior end with slight forward swing; left valve overlaps right about free margins, ventral overlap appearing more prominent because of faint channeling within periphery of smaller right valve; surface smooth.

Holotype female specimen MCZ No. 4543; length: 0.57 mm; height: 0.45 mm; thickness: 0.39 mm; paratype male specimen MCZ No. 4544; length: 0.56 mm; height: 0.37 mm; thickness: 0.34 mm, from Tulip Creek horizon, in Zone 36 of Oklahoma Highway 99 Simpson section.

Range: Commonly occurring in the Tulip Creek shales and limestones and ranging into the Bromide.

Remarks: This tiny, inflated, bulbous form resembles exfoliated forms of *Cryptophyllus simpsoni* (Harris), but does not possess the dorsal horn nor concentric rings of that species. It is smaller, less inflated, and less subcircular in outline than *S. brevis* Ulrich, and possesses cardinal wings and peripheral depression not observed in the larger associate. The trivial name is the feminine form of the Latin adjective, minutus, "minute"; referring to the small size of the species.

SCHMIDTELLA OVALIS Harris, n. sp.

Plate 4, figures 8, 9a-9c

Aparchites ovalis Harris, Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp. fig. 54.

Carapace elongate-ovate in lateral profile (typically egg-shaped), maximum dimensions through center, height of adult approximately 1 mm, thickness averaging three-fourths the height; curvature of dorsal umbonation above the short and deeply channeled straight hinge line faintly flattened; umbonal area proper very narrow; ends bluntly and subequally rounded, the anterior the sharper; left valve weakly and rather evenly overlapping the right about free margins, the larger left valve of some specimens tending to project beyond, rather than embrace, the right at ends; evenly biconvex surface finely perforate, appearing smooth, periphery subrounded, not carinate.

Holotype adult specimen MCZ No. 4545; length: 1.20 mm; height: 0.93 mm; thickness: 0.74 mm; paratype nepionic specimen MCZ No. 4556; length: 0.95 mm; height: 0.75 mm; thickness: 0.61 mm, from Tulip Creek horizon, in Zone 35 of Oklahoma State Highway 99 Simpson section.

Range: Recovered from Tulip Creek horizons at type locality and in Criner Hills.

Remarks: This gracefully ovate, symmetrical species with abbreviated hingement differs from other schmidtellids in its short and narrow umbonal projection. It possesses a much shorter hingement than *Primitia ovata* Jones and Holl, from Silurian erratics near Berlin. It lacks the "posterior marginal rim" and anteromedian vertical compression of *P. lenticularis* Jones and Holl, from in Silurian Wenlock of England. From the Onondaga form of Pennsylvania, *Aparchites ? lenticularis* Swartz and Swain, the Simpson species differs in its more symmetrically ovate, rather than subcircular, outline, and in presence of distinct umbo.

The trivial name is the Latin word, ovalis, meaning "ovate or egg-shaped"; referring to the ovate lateral profile of the carapace.

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Schmidtella transversa Harris, n. sp.

Plate 4, figures 11a-11c

Schmidtella transversa Harris, Oklahoma City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., fig. 37.

Schmidtella umbonata Kay (not Ulrich) 1940, Jour. Paleontology, vol. 14, pp. 236, 242, pl. 29, figs. 9-11.

This tiny, smooth, subelliptical bilaterally subsymmetrical schmidtellid is further characterized by a lowly rounded median umbo (with narrow cardinal area) that projects above a deeply channeled elongate hingement with rounded cardinal angles;

posterior end possibly more bluntly rounded and less produced than anterior; ventral margin broadly arcuate; surface fairly evenly convex, with maximum dimensions through a near-median point; occasional faint umbonal depression; left valve overlap pronounced ventrally.

Holotype specimen MCZ No. 5447; length: 0.55 mm; height: 0.32 mm, from Tulip Creek horizon, near base of Zone 34 of Oklahoma Highway 99 Simpson section.

Range: Not so abundant in upper Tulip Creek and lower Bromide.

Remarks: This tiny, elongate, subsymmetrical schmidtellid is much smaller and much more elliptical in lateral profile than *S. umbonata* Ulrich, from the "upper third of Trenton" of Minnesota; furthermore, it lacks the narrow peripheral border of the northern form. In outline it resembles *S. fabiformis* Kesling and Kilgore, from the Devonian of Michigan, but the Simpson form is relatively higher and possibly more bilaterally symmetrical than that in the younger horizon.

The trivial name is adapted from the Latin adjective, transversus, meaning "transverse"; referring to the deeply furrowed channel traversing the length of the hingement.

Note: Article 25 of International code of Zoological Nomenclature decrees as invalid the status of "new species" for a form illustrated, but undescribed, in any publication appearing since December 31, 1930. Accordingly, as suggested by the Rules for such a case, the original synonymic reference to this previously illustrated, though undescribed, species appears here "without date following the trivial name", thus permitting herein official establishment of the new species.

Genus PARASCHMIDTELLA Swartz, 1936

Genotype: *P. dorsopunctata* Swartz, 1936

Eridoconcha Ulrich and Bassler (partim)

Aparchites Harris (partim) (not Jones) 1931, Okla. Geol. Survey, Bull. 55, p. 87, pl. 5, figs. 4a, 4b; Okla. Acad. Sci. Proc., vol. 12, pp. 57, 59, pl. 13, fig. 3.

Paraschmidtella Swartz 1936, Jour. Paleontology, vol. 10, p. 563; Kay 1940, Jour. Paleontology, vol. 14, pp. 240, 244, 245; Schmidt 1941, Senckenberg. Naturforsch. Ges., Abh., vol. 14, pp. 18, 19, 20, 21; Agnew 1942, Jour. Paleontology, vol. 16, p. 759; Cooper 1942, Jour. Paleontology, vol. 16, p. 775; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, pp. 231, 256, 275; Howe 1955; La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 141.

Shell small, not exceeding 2 mm in length, elliptical to subquadrate in lateral profile; broad thickened umbos generally projecting above the straight hingement; anterior nose generally more pointed and produced, thus effecting slight retral swing in some species, periphery of anterior nose often slightly thickened with beaded inflation or rim (noticeable particularly on nose of right valve); left valve overlaps right about free margins, with maximum overlap ventral; hingement of left valve grooved to receive dorsal edge of right; surface rather strongly convex, thickest in post-dorsal quarter; upper half to two-thirds of carapace characterized by coarse punctae or reticulations.

Range: Ordovician to Devonian; apparently limited to Chazyan strata in Oklahoma.

Remarks: Several of the older Simpson species of this genus possess leperditellid features of outline, retral swing, straight hingement, and slight sulcus. They resemble members of the genus *Schmidtella* Ulrich in locus of maximum inflation; i. e., in dorsal quarter (heart-shaped in end view or in transverse section).

This genus is represented in the Simpson by seven species and one subspecies . . . all occurring either in the Joins or Oil Creek. Accordingly, the Chazyan element of the Simpson is readily recognizable in outcrop and subsurface samples by the presence of these coarsely punctate, inflated paraschmidtellids.

PARASCHMIDTELLA MULTICAVATA Harris, n. sp.

Plates 4, figures 13a-13c

Carapace subcircular to subquadrate in lateral profile, with dorsal area inflated to form a low, rounded, umbonate boss that is highest posteriorly; dorsal and ventral margins subparallel, the ventral the straighter (particularly true of smaller right valve), ends and cardinal angles rather evenly rounded; straight hinge line depressed below the widely flattened umbonate dorsal face; gently convex surface dotted with approximately three dozen (holotype=33) large circular pores in fairly uniform distribution, with intervening flattened ridges, a narrow non-punctate band encircles the porate area, narrow, terminal, peripheral channels disappear at dorsal and ventral angles.

Holotype left valve MCZ No. 4548; length: 1.24 mm; height: 1.00 mm, from Oil Creek horizon, at base of Zone 55 of West Spring Creek Simpson section.

Range: This readily recognizable species is abundant in a 75-foot zone near top of the Oil Creek. It has been recovered from outcrops at the western end of the Arbuckle Mountains, on U. S. Highway 77, and from subsurface strata south of Dougherty, Oklahoma, and West Texas.

Remarks: The species is approximately thrice the size of *Aparchites variolatus* Ulrich and Bassler, from the Silurian of Maryland; a form likewise displaying approximately three dozen large pores, yet is more circular in lateral profile, and lacks dorsal umbonation and terminal peripheral fossae of the Simpson species.

The trivial name is adapted from the Latin adjective, multicavus, "possessing many holes"; referrnig to the coarsely punctate surface of the species.

Paraschmidtella oviforma Harris, n. sp.

Plate 4, figures 14a-14b

Carapace roundly ovate in lateral profile, highest posteriorly; longer and flatter in antero-dorsal slope, more abruptly rounded at post-dorsal slope, straight hingement along fairly flat dorsum, ventral outline a gentle, broad curve; ends evenly rounded, the anterior lower and more produced; carapace thickest centrally to post-centrally, rather evenly inflated above a distinct excavation bordering the flattened periphery of the free margins, central and post-central area of the surface with approximately two dozen scattered, rounded pores possibly more prominent and larger posteriorly, a short, narrow antero-median sulcate depression lies on and below the equatorial line, and contains several of the pores.

Holotype left valve MCZ No. 4549; length 1.12 mm; height: 0.85 mm, from Oil Creek horizon, above middle of Zone 91 of U. S. Highway 77 Simpson section.

Range: Oil Creek.

Remarks: This species, another member of the coarsely punctate Oil Creek paraschmidtellids, is not so umbonate as its contemporaries; the outline is distinctly ovate, the marginal fossa and surficial pores prominent features, and the near-median shallow sulcus distinctive.

The form possesses the ovate lateral profile of some specimens of *Aparchites ? variolatus* Ulrich and Bassler var. *huntonensis* Roth, a Devonian form of Oklahoma. The Simpson form, however, possesses a near-median sulcus, instead of a poorly developed pit; its pores are fewer and rounded, not polygonal; its marginal fossa is distinctive; and finally, it is larger than the Hunton variety.

The trivial name is a combination of the Latin words, ovum, meaning "egg", and forma, "shape"; referring to the ovate lateral profile of the species.

PARASCHMIDTELLA PAUCIPERFORATA Harris, n. sp.

Plate 4, figures 15a-15b, 16

Ovate, umbonate, inflated carapace, with deeply depressed relatively short hinge line, thickest at or above median point; female carapace rather evenly rounded from post-cardinal angle through posterior and ventral margins, male carapace more elongate, with flatter venter; anterior end produced at median line, periphery of anterior nose of right valve thickened into a low bead-like ridge; left valve overlaps right about free margins, with maximum overlap ventral, valves slightly separated or flared at anterior nose; surface strongly convex (especially that of female), and further characterized by a few coarse, and several finer, punctae scattered over the inflated median and lower parts of the carapace, respectively, often eroded smooth, a faint antero-median sulcus tends to accentutate post-jacent inflation of carapace.

Holotype specimen MCZ No. 4550; length: 1.10 mm; height: 0.80 mm; thickness: 0.62 mm; paratype smooth specimen MCZ No. 4551; length: 1.12 mm; height: 0.80 mm; thickness: 0.62 mm, from Oil Creek horizon, in Zone 59 of West Spring Creek Simpson section.

Range: Middle Oil Creek.

Remarks: This species, commonly occurring in its stratigraphic range, is readily identified by its ovate shape and strongly inflated carapace. The pores and sulcus are often obliterated, though the latter is preserved on internal casts. Smooth specimens, such as paratype No. MCZ No. 4551, may be actually a new species of

Lerperditella Ulrich, since no paraschmidtellid pores are evident.

The form differs from *Paraschmidtella perforata* (Harris) in its larger size, deeper channeling of hingement, fewer coarse pores and numerous finer pores, better defined sulcus, and more prominent beading in nose of right valve. The species is twice the length of *P. dorsopunctata* Swartz, from the Lower Devonian of Pennsylvania. It appears to be the ancestral form of *P. umbopunctata* Harris, n. sp., a contemporary in the West Spring Creek Simpson section.

The trivial name is derived from the Latin adjectives, paucus "few", and perforatus, "perforated"; referring to the few perforations on the carapace.

PARASCHMIDTELLA PERFORATA (Harris) Swartz, 1936

Plate 4, figures 17a-17b

Aparchites perforata Harris 1931, Okla. Geol. Survey, Bull. 55, p. 87, pl. 5, figs. 4a, 4b; Okla. Acad. Sci., Proc., vol. 12, pp. 57, 59, pl. 13, fig. 3; Schmidt 1941, Senckenberg. Naturforsch. Ges., Abh., vol. 454, p. 21; Hayes, 1952, Shale Shaker, vol. 3, no. 2, p. 17; 1955, Shale Shaker, Digest, p. 10.

Aparchites perforatus Harris, Bassler and Kellett 1934, Geol. Soc. Amer., Spec. Pap. no. 1, p. 160.

Paraschmidtella perforata (Harris) Swartz 1936, Jour. Paleontology, vol. 10, p. 563; Schmidt 1941, Senckenberg. Naturforsch. Ges., Abh., vol. 454, pp. 20, 21.

This small subcircular to slightly elongate Oil Creek index fossil is recovered with valves intact. The left valve is the larger, as with other species of the genus. Anterior nose of the smaller right valve is thickened with slight bead-like development. The centrally concentrated pores, subcircular shape, and small size characterize the species.

Paratype specimen No. MCZ 4552; length: 0.79 mm; height: 0.56 mm, from Oil Creek horizon, 10 feet below middle of Zone 50 of West Spring Creek Simpson section.

PARASCHMIDTELLA PERFORATA subsp. DISPERSA Harris, n. subsp.

Plate 4, figures 18-22

The subspecies differs from *P. perforata* (Harris) Swartz in its larger size, more elongate outline, more pronounced posterior inflation, and presence of antero-dorsal sulcus, small indistinct "eye tubercle", and more widely dispersed pores. It differs from *P. pauciperforata* Harris, n. sp., a closely related Oil Creek descendant, in greater number and dispersion of pores, more prominent anterior sulcus, and presence of distinct "eye tubercle".

Holotype left valve MCZ No. 4553; length: 1.05 mm; height: 0.77 mm; paratype molt right valve MCZ No. 4554; length: 0.90 mm; height: 0.69 mm; paratype molt right valve MCZ No. 4555; length: 0.85 mm; height: 0.55 mm; paratype right valve MCZ No. 4556; length: 1.00 mm; height: 0.65 mm; paratype nepionic molt MCZ No. 4557; length: 0.70 mm; height: 0.47 mm; thickness: 0.32 mm; paratype left valve MCZ No. 4558; length: 0.80 mm; height: 0.55 mm, from Joins horizon, in Zone 101 (42 feet above base of Simpson) of U. S. Highway 77 Simpson section.

Range: This subspecies, fairly abundant, and *P. ? trifoveolata* Harris, n. sp., scarce, constitute the only two representatives of the genus recovered from the Joins.

Remarks: The subspecific name is obtained from the Latin adjective, dispersus, "scattered"; referring to the scattered arrangement of surficial pores.

Paraschmidtella reticulata Harris, n. sp.

Plate 5, figures 2a-2c

Carapace ovate with possible slight retral swing, thickest above center; dorsal margin straight except for slight central bulge, ventral margin of right valve gently curved (that of larger left valve more convex); hingeline long and depressed in a narrow, shallow channel, hingement of left valve grooved along entire length, dorsal angles approximately equal, the anterior more abruptly angled, the posterior rounding into broadly curving posterior end, anterior nose the more sharply rounded and produced in median line; highly convex central area of surface characterized by a reticulate network of approximately three dozen (holotype=35) rounded to subpolygonal coarse pores in subconcentric arrangement, narrow intervening ridges becoming sharper toward dorsum, a non-reticulate band circumvents the reticulate area, a wide antero-median sulcus contains four or five of the reticulations, ends noticeably excavated immediately within the periphery.

Holotype right valve MCZ No. 4559; length: 1.20 mm; height: 0.87 mm; thickness: 0.35 mm, from Oil Creek horizon, at base of

Zone 55 of West Spring Creek Simpson section.

Range: Identical 75-foot range in upper Oil Creek as *P. multicavata* Harris, n. sp.

Remarks: This species resembles its aforementioned contemporary in excavated ends and coarsely sculptured surface, though differing in lateral profile, umbonation, sulcation, and in shape and arrangement of surficial pores.

PARASCHMIDTELLA ? TRIFOVEOLATA Harris, n. sp.

Plate 5, figures 3a-3c

This small, subovate, slightly umbonate species with faint retral swing is further characterized by three (possibly four) coarse antero-dorsal pores and an elongate narrow peripheral excavation immediately within the ventral margin, lower edge of fossa with raised rim; hingement is straight and relatively long, depressed below inflated dorsal body of carapace; thickest and highest through a point behind pores; anterior nose the more acutely rounded; ventral surface channeled between edge of shell and basal edge of rim about marginal fossa.

Holotype left valve MCZ No. 4560; length: 0.67 mm; height: 0.42 mm, from Joins horizon, in Zone 67B of West Spring Creek Simpson section.

Range: Rarely occurring in the Joins.

Remarks: The small size, inflated carapace, and three surficial pores characterize this unusually small Simpson paraschmidtellid. An additional pore, behind the uppermost pore of the holotype, appears on another specimen recovered from the type locality, this pore possibly the imprint of a sand grain. The species resembles *P. perforata* (Harris) Swartz in size and lateral profile; it differs in the limited number and concentration of pores in its antero-dorsal area, excavated venter, and narrow fossa with postjacent rim near ventral border. The species appears ancestral to the Oil Creek genus *Hilseweckella* Harris, n. gen.

The trivial name represents a combination of the Latin prefix, tri, "three", and the contrived adjective, foveolata, "pitted"; referring to the few coarse pits of the surface.

Paraschmidtella umbopunctata Harris, n. sp.

Plate 5, figures 4a-4c, 5

Medium-sized, subovate, umbonate carapace further characterized by five to ten coarse pores located on a prominent, abruptly inflated, dorsal boss in the median longitude, with faint sulcus at its lower front edge; straight hingement depressed below inflation, with equal cardinal angles, the posterior the more rounded, ventral margin of lower left valve strongly and evenly arched, that of smaller right valve a flatter curve; ends subequal, the posterior the more gracefully curved, with slight channeling immediately within the periphery (not so evident on male), anterior nose more pointed and produced and slightly thickened or beaded; left valve overlaps right above free margins, with maximum overlap ventral, where larger left valve is slightly thickened; carapace not so highly convex, thickest through dorsal boss, a few, small, shallow punctae dispersed below the prominent boss.

Holotype male right valve MCZ No. 4561; length: 1.12 mm; height: 0.77 mm; paratype female left valve MCZ No. 4562; length: 1.12 mm; height: 0.82 mm, from Oil Creek horizon, in middle of Zone 91 of U. S. Highway 77 Simpson section.

Range: Recovered from the Oil Creek of U. S. Highway 77, at Norris Ranch, near Bromide, and from subsurface samples in Crane County, Texas.

Remarks: The raised boss with coarse pores characterizes the species, the pores varying in number from three or four, to eight or ten. The more abruptly erect bosses possess the fewer pores (possibly a varietal feature). The form differs from *P. perforata* (Harris) in larger size and in its prominent punctate boss.

The trivial name is combined from the Latin words, umbo, "shield", and punctatus, "spotted with punctures"; having reference to the prominent punctate boss of the species.

Genus HILSEWECKELLA Harris, n. gen.

Genotype: *H. rugulosa* Harris, n. sp.

Small (0.7 to 1 mm), rather gently convex, elongate-ovate carapace, with anterior nose the more sharply rounded; hingement straight and channeled; peripheral channel bordering the free margins bounded and emphasized by prominent, narrow, lateral ridges, the general surface within the peripheral channel coarsely sculptured by irregularly raised, rugose ridges with intervening depressed areas or broad reticulations.

Range: Ordovician.

Remarks: The inflated carapace (heart-shaped in end view), coarse surficial pores, depressed hingeline, and channeled marginal area suggest relationship with the genus *Paraschmidtella* Swartz (the feature last-mentioned was not emphasized in the original description of *Paraschmidtella* Swartz, but in many Simpson representatives the marginal channeling is evident at one or both ends of the carapace). In its small size and elevated horizontal ridges the new genus resembles the genus *Bassleratia* Kay, but it differs in the possession of the rugose dorsal area.

The genus is established in honor of Mr. W. J. Hilseweck of Blackwood and Nichols Oil Company, Dallas, Texas, in recognition of assistance in collection and identification of Simpson Ostracoda.

Hilseweckella rugulosa Harris, n. sp.

Plate 5, figures 6a-6b

Carapace small (less than 1 mm in length), elongate-ovate, with straight, slightly channeled hingement, flatly and rather evenly biconvex, with maximum dimensions through central or near-central point; cardinal angles equal, ventral curvature even and broad; anterior nose (at median line) the more sharply rounded, ends with fairly straight dorsal truncation; surface is characterized by an encircling peripheral ridge that projects beyond and above the hingement and post-dorsal slope, above posterior nose the ridge bifurcates and extends across lower surface as two parallel ridges (the inner the more elevated), separated by a widened trough or channel of constant width the two ridges again coalesce below and behind the antero-dorsal angle, immediately above the ventral trough is an irregular, shorter trough with super-jacent, large, near-median subpolygonal pore bounded by several, large, irregular depressions, the series separated and defined by a narrow, elevated, rounded, ramose ridge, face of free margin is flattened.

Holotype left valve MCZ No. 4563; length: 0.60 mm; height: 0.42 mm; thickness: 0.18 mm, from Oil Creek horizon, in Zone 87 of U. S. Highway 77 Simpson section.

Range: Occurs sparsely in Oil Creek.

Remarks: The species scarcely resembles *Moorea ? perplexa* Ulrich from the Trenton of Minnesota, the latter species being more subcircular in lateral profile, lacking distinct peripheral channel, and less continuously connected, ramose, surficial ridge. Surficial rugosity superficially resembles irregular surface of certain species of the genus *Octonaria* Jones; e. g., *O. stigmata* Ulrich, from the Devonian of Indiana. The latter species is much more elongate, possesses retral swing, flatter venter, and several elongate subparallel surficial ridges, without peripheral keel and near-median subpolygonal pore.

The trivial name is adapted from the Latin word, rugulosus, "full of wrinkles"; referring to the ramose surficial ridges of the species.

Genus CRYPTOPHYLLUS Levinson, 1951

Genotype: *Eridoconcha oboloides* Ulrich and Bassler, 1923

Eridoconcha of authors (partim)

Schmidtella of authors (partim)

Cryptophyllus Levinson 1951, Jour. Paleontology, vol. 25, pp. 553-558; Henningsmoen 1953, Norsk. Geol. Tidsskrift, vol. 31, pp. 256, 275; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser., no. 1, p. 38.

Medium sized equivalved carapace (not exceeding 2 mm in length), subovate to subquadrate in lateral profile, some species displaying retral swing; umbonate, subtriangular inflation of umbo in some forms, the larger posterior lobe of some species produced backward into a short, subspinose extension; long straight hingement depressed or channeled below umbonate dorsum (particularly in non exfoliated specimens), cardinal angles rounded, posterior angle the flatter on forms with retral swing; maximum convexity of surface above median line, generally in umbonal area, surface characterized by one or more concentric ridges paralleling free margins and converging at cardinal angles, the outermost ridge borders the free margin, additional ridges, if any, separated by narrow V-shaped grooves, the number of concentric ridges present dependent on number of retained molts.

Range: Ordovician to Devonian.

Remarks: The outermost corrugation of this genus constitutes likewise the outermost margin of the carapace; the outermost corrugation of the genus *Eridoconcha* Ulrich and Bassler lies a short distance within the peripheral margin. Furthermore, the rings of the newer genus are separated by V-shaped, rather than U-shaped, troughs, as are the rings of *Eridoconcha* Ulrich and Bassler. Representatives of these two genera display the rare phenomenon of retaining molts with development in age and size, each and every molt with a single peripheral (*Cryptophyllus* Levinson) or near-peripheral (*Eridoconcha* Ulrich and Bassler) concentric ridge. Additional ridges, if present, represent the retained nepionic molts of previous instars, the outermost ring being that of the latest and largest. Levinson noted evolutionary tendency toward decrease in size and tendency to shed the molts. For instance, the Chazy forms are larger, with many rings; the uppermost Ordovician forms are smaller, with two- and three-ridged forms uncommon, while the single-ridged forms are abundant. Similarly, many large multi-ridged specimens are observed in the Chazyan of Oklahoma, while many smaller single- and double-ridged forms occur in the younger Tulip Creek and Bromide strata.

CRYPTOPHYLLUS GIBBOSUM Harris, n. sp.

Plate 5, figures 7a-7c, 8, 9a-9c

Eridoconcha gibbosa Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 22; ibid, March 5-6, 1937, 4th, 5th pp., fig. 15.

Eridoconcha rugosa Levinson (not Ulrich) 1950, Jour. Paleontology, vol, 24, p. 68, text fig. 3.

Cryptophyllus oboloides Levinson (not Ulrich and Bassler) 1951, Jour. Paleontology, vol. 25, pp. 557, 558, pl. 77, figs. 9a-b.

Carapace subsymmetrically ovate laterally with but faint retral swing; dorsal margin of adult specimen (with molts retained) highly umbonate immediately ahead of center (longer, lower, and straighter dorsal profile when molt is exfoliated), post-dorsal slope slightly longer and flatter; hingeline fairly short, deeply and widely channeled; rather strongly convex carapace thickest through umbonal area, peripheral ring fairly wide and somewhat flattened, four to six wide molt rings separated by relatively shallow troughs, faint umbonal depression often observed, no umbonal spine observed.

Holotype specimen MCZ No. 4564; length: 0.92 mm; height: 0.77 mm; paratype specimen MCZ No. 4565; length: 1.00 mm; height: 0.77 mm; paratype nepionic specimen MCZ No. 4566; length: 0.80 mm; height: 0.52 mm, from Tulip Creek horizon, in Zone 36 of Oklahoma Highway 99 Simpson section.

Range: McLish shales, Tulip Creek, and Bromide (not in topmost Corbin Ranch formation).

Remarks: This species differs from *Cryptophyllus oboloides* (Ulrich) in its more elongate-subelliptical, rather than subcircular, lateral profile and in its larger size (length is 1.12:0.74; height 0.83:0.67); furthermore, Ulrich states that troughs separating the outermost rings of the Black River species of Minnesota are simply impressed lines, not wide depressions. This most commonly occurring form of the upper Simpson section varies slightly in shape and molt rings in various parts of the section (possibly subspecific differences); the form appears possibly more subcircular in McLish strata.

The trivial name is an adjectival form of the Latin word, gibbus, meaning "humped, gibbous"; referring to the inflated nature of the carapace.

Note: Article 25 of International Code of Zoological Nomenclature decrees as invalid the status of "new genus" for a form illustrated, but undescribed, in any publication appearing since December 31, 1930. Accordingly, as suggested by the Rules for such a case, the original synonymic reference to this previously illustrated, though undescribed, species appears here "without date following the trivial name", thus permitting herein official establishment of the new species.

CRYPTOPHYLLUS MAGNUM (Harris) Levinson, 1951

Plate 5, figures 10a-10b

Eridoconcha magnus Harris 1931, Okla. Geol. Survey, Bull. 55, p. 91, pl. 5, figs. 3a, 3b; 1931, Okla. Acad. Sci., Proc., vol. 12, pp. 57, 59, pl. 12, fig. 1; Hayes 1952, Shale Shaker, vol. 3, no. 2, p. 17; 1955, Shale Shaker, Digest, p. 110.

Eridoconcha magna Harris, Bassler and Kellett 1934, Geol. Soc. Amer., Spec. Pap. no. 1, p. 310; Keenan 1951, Jour. Paleontology, vol. 25, p. 565.

Cryptophyllus magnus (Harris) Levinson 1951, Jour. Paleontology, vol. 25, pp. 557, 558.

This large, rugged form with numerous flattened molt rings and high, subacuminate umbo above deeply channeled elongate hingement has been recovered from Oil Creek strata of various outcrops in the Arbuckle Mountains and from the subsurface of Oklahoma and Texas. The umbonal spine is not observed externally, but the spine and slight sulcus is well displayed in casts.

Holotype right valve; length: 1.98 mm; height: 1.38 mm; hypotype right valve MCZ No. 4567; length: 1.52 mm; height: 1.07 mm, from Oil Creek horizon, in Zone 85 of U. S. Highway 77 Simpson section.

Range: This is an excellent index fossil of the Oil Creek, where it is associated with coarsely punctate species of *Paraschmidtella* Swartz. Drilling action often breaks and partially exfoliates the large form, exposing umbonal spine and faint sulcus.

CRYPTOPHYLLUS NUCULOPSIS Harris, n. sp.

Plate 5, figures 11a-11b

Eridoconcha nuculopsis Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 32; ibid, March 5-6, 1937, 4th, 5th pp., fig. 57.

This small ovate form with eight or nine low, widened molt rings generally retained is readily recognizable by distinctive forward swing from a prominent post-dorsal umbo (hingement straighter when initial molts exfoliated), small teat-like umbonal projection rarely preserved.

Holotype specimen No. MCZ 4568; length: 0.70 mm; height: 0.42 mm, from Tulip Creek horizon, at top of Zone 31 of U. S. Highway 77 Simpson section.

Range: An excellent index fossil of the Tulip Creek.

Remarks: The species displays pronounced forward swing not observed in any other known representative of the genus, and though associated with other members of its genus in the Simpson, its asymmetrical profile is readily observable. It differs from the branchiopod, *Estheria ortoni* Clarke, in its thicker and smaller shell, fewer concentric bands, and in lack of interlacing striae among the bands, as well as in reversed orientation.

The pronounced forward swing of this species results in an asymmetrical lateral outline, suggestive of the genus *Nuculopsis* Girty (with similar orientation), hence, the trivial name of the species.

Note: Article 25 of International Code of Zoological Nomenclature decrees as invalid the status of "new species" for a form illustrated, but undescribed, in any publication appearing since December 31, 1930. Accordingly, as suggested by the Rules for such a case, the original synonymic reference to this previously illustrated, though undescribed, species appears here "without date following the trivial name", thus permitting herein official establishment of the species.

CRYPTOPHYLLUS SIMPSONI (Harris) Levinson, 1951

Plate 5, figures 12, 13a-13b, 14a-14b, 15a-15b

Eridoconcha simpsoni Harris 1931, Okla. Geol. Survey, Bull. 55, p. 90, pl. 11, figs. 1a-1d, pl. 14, figs. 1a-1b; 1931, Okla. Acad. Sci., Proc., vol. 12, p. 59, pl. 12, figs. 2a-2b; Bassler and Kellett 1934, Geol. Soc. Amer., Spec. Pap. no. 1, p. 310; Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 27 (2 views); ibid, March 5-6, 1937, 4th, 5th pp., fig. 11; Kay 1940, Jour. Paleontology, vol. 14, p. 235; Keenan 1951, Jour. Paleontology, vol. 25, p. 565; Decker 1951, Amer. Assoc. Petroleum Geologists, Bull., vol. 35, p. 913; 1952, ibid, vol. 36, p. 135.

Cryptophyllus simpsoni (Harris) Levinson 1951, Jour. Paleontology, vol. 25, pp. 557, 558.

This small, compact, corrugated form with occasionally preserved umbonal spine and numerous, rounded, high-standing molt rings is characteristic of the Tulip Creek and Bromide members of the Simpson (not in topmost Corbin Ranch formation). In the Oklahoma Highway 99 Simpson section the species ranges upward from Tulip Creek Zone 38, through the Bromide, and disappears at the disconformable Bromide-Corbin Ranch contact. As in *Cryptophyllus gibbosum* Harris, n. sp., so in this species also, there is the possibility of subspecific differences in various stratigraphic levels.

Holotype specimen; length: 0.60 mm; height: 0.50 mm; thickness: 0.45 mm; paratype left valve MCZ No. 4570; length: 0.62

mm; height: 0.52 mm; paratype left valve MCZ No. 4571; length: 0.62 mm; height: 0.52 mm; paratype specimen MCZ No. 4572A; length: 0.62 mm; height: 0.50 mm, from Tulip Creek horizon, at base of Zone 22 of U. S. Highway 77 Simpson section.

Genus MACRONOTELLA Ulrich, 1894

Genotype: *M. scofieldi* Ulrich, 1894

Macronotella Ulrich 1894, Geology Minn., vol. 3, pt. 2, p. 683; Boucek 1936, Neues Jahrb. Mineralogie, Geologie, Paläontologie, Abt. B, Bd. 76, p. 69; Öpik 1937, Univ. Tartu, Geol. Inst. Publ. no. 50, p. 23; Teichert 1937, Meddel, om Gronland, Bd. 119, no. 1, p. 58; Kay 1940, Jour. Paleontology, vol. 14, pp. 240, 244; Thorslund 1940, Sver. Geol. Unders., ser. C, no. 436, pp. 180, 181; Schmidt 1941, Senckenberg, Naturforsch. Ges., Abh., vol. 454, pp. 17-19; Cooper 1942, Jour. Paleontology, vol. 16, p. 775; Shimer and Shrock 1948, Index Foss. North Amer., p. 664; Hessland 1949, Univ. Upsala, Geol. Inst., Bull., vol. 33, pp. 120, 145, 148, 189, 190; Ellis and Messina 1952, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 1; Moore, Lalicker, and Fischer 1952, Invert. Foss., pp. 524, 525, Text fig. 14-2, 1; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, pp. 231, 268; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 116.

Additional synonomy in Bassler and Kellett (1934, p. 406).

Carapace roundly ovate to elongate-ovate in lateral profile, with maximum thickness near center, dorsal margin generally with slight central arch; hingement straight, elongate, slightly channeled; valves generally equal; surface characterized by perforations, coarse pores, or reticulations in subconcentric arrangement, with a prominent median to antero-median, smooth spot.

Range: Ordovician to Devonian.

Macronotella elegans Harris, n. sp.

Plate 4, figures 12a-12c

Carapace subovate in lateral profile with slight forward swing, female relatively shorter and higher with shorter hingeline, thickest and highest through center; post-median area of dorsal margin faintly arched above channeled hingement, thus resembling post-dorsal inflation of the genus *Paraschmidtella* Swartz, dorsal angles approximately equal, ventral margin an evenly curved oval, posterior nose slightly higher and sharper than anterior; valves appear equal, but right projects faintly beyond left about free margins; surface evenly convex with subconcentrically arranged coarse pores, except for a narrow, smooth peripheral border and a smooth, circular, central muscle scar.

Holotype male specimen MCZ No. 4575; length: 0.62 mm; height: 0.47 mm; thickness: 0.37 mm, from Oil Creek horizon, in Zone 64 (60-70 feet below *Pseudomera* (*Pliomerops*) *nevadensis* (Walcott) Cooper zone of West Spring Creek Simpson section.

Range: Oil Creek Zones 54-64 of West Spring Creek section and equivalent strata.

Remarks: The female of this species resembles *M. ulrichi* Ruedemann, from the Mohawkian, except for its straighter hingement, its smaller size, and its forward swing.

The trivial name is obtained from the Latin word, elegans, "neat, elegant"; referring to the prominent surficial pores.

Macronotella mcgeheei Harris, ns. sp.

Plate 9, figures 14a-14b

Carapace roundly ovate in lateral profile, with dorsal margin arched centrally, flatly and rather evenly convex, thickest behind center; anterior slope of dorsal umbonation longer and less concave than posterior, free margins evenly rounded, posterior end the more sharply rounded; hingement narrowly channeled; gently convex surface rather densely and coarsely perforate except for prominent antero-median smooth spot and a smooth, narrow, peripheral band.

Holotype left valve MCZ No. 4573; length: 1.12 mm; height: 0.90 mm, from Oil Creek horizon, in upper part of Zone 52 of West Spring Creek Simpson section.

Range: Upper Oil Creek.

Remarks: This species differs essentially from *M. ulrichi* Ruedemann in its flatter convexity. Its cardinal angles are somewhat alate, while those of *M. kuckersiana* Bonnema are distinctly rounded; furthermore, the Simpson form is faintly umbonate at median hingement, a feature lacking in the more subcircular European species.

The species is named in honor of Mr. J. R. McGehee, geologist with Shell Oil Company, Denver, Colorado, in appreciation of assistance to Dr. C. E. Decker and the writer in collecting and identification of Simpson fossils.

MACRONOTELLA UPSONI Harris, n. sp.

Plate 9, figures 15a-15b

Carapace elongate-ovate in lateral profile, with maximum length and height through center, and maximum thickness subcentrally; dorsal margin slightly thickened and arched centrally (particularly true of right valve), ventral margin evenly and strongly arcuate, ends evenly and rather sharply rounded, anterior end possibly the more produced and the more sharply rounded, antero-cardinal angle possibly the more obtuse; hingement deeply excavated; left valve generally extends slightly beyond lower margin of right valve; surface faintly impressed in antero-dorsal area below hingement (a feature not so evident on left valve nor on posterior end of right valve), marginal contact of valves deeply channeled, peripheral edge of valves slightly thickened, surface appears smooth, but is probably punctate in perfect preservation.

Holotype right valve ? MCZ No. 4576; length: 1.12 mm; height: 0.77 mm; paratype specimen MCZ No. 4575; length: 1.30 mm; height: 0.95 mm, from Oil Creek horizon, 15 feet below top of Zone 82 of U. S. Highway 77 Simpson section, and from Oil Creek horizon in Stanolind No. 1 Todd well, Crockett County, Texas, in a core at the depth of 7,097 feet, respectively.

Range: Oil Creek.

Remarks: The species lacks the coarse surficial pores of *M. ulrichi* Ruedemann, and is more elongate-ovate, rather than subcircular, in lateral profile. It is longer and smoother than its upper Oil Creek contemporary, *M. mcgeheei* Harris, n. sp.

The species is named in honor of Mr. M. E. Upson, Gulf Oil Company geologist, Fort Worth, Texas, who recovered the species from the subsurface of West Texas.

Family *PRIMITIIDAE* Ulrich and Bassler, 1923

Subfamily *EUPRIMITIINAE* Hessland, 1949

Genus PRIMITIELLA Ulrich, 1894

Genotype: *P. constricta* Ulrich, 1894

Primitiella Ulrich 1894, Geology Minn., vol. 3, pt. 2, p. 647; Ruedemann 1901, N. Y. State Museum, Bull. 49, p. 73; Zittel 1915, Grundzuge der Paläontologie, Abth. 1 (Invert.), p. 594; Öpik 1935, Univ. Tartu, Geol. Inst., Publ. no. 44, p. 7; Boucek 1936, Neues Jahrb. Mineralogie, Geologie, Paläontologie, Abt. B, Bd. 76, p. 42; Kay 1940, Jour. Paleontology, vol. 14, pp. 239, 240, 241, 262; Schmidt 1941, Senckenberg. Naturforsch. Ges. Abh., vol. 464, pp. 25, 26; Cooper 1942, Jour. Paleontology, vol. 16, p. 775; Shimer and Shrock 1948, Index Foss. North Amer., p. 665; Hessland 1949, Upsala Univ. Geol. Inst., Bull., vol. 33, pp. 121, 133, 144, 206-208, 211, 225, 228; Ellis and Messina 1952, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 1; Moore, Lalicker, and Fischer 1952, Invert. Foss., pp. 526, 527, text fig. 14-3, 5; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, pp. 229, 268; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 153.

Additional synonomy in Bassler and Kellett (1934, p. 461).

Carapace small, straight-hinged, elongate in lateral profile; equivalved; a broad, obscure, median depression generally present (essentially in dorsal half), a narrow border about free margins.

Range: Ordovician to Devonian.

PRIMITIELLA CONSTRICTA Ulrich subsp. VARICATA Harris, n. subsp.

Plate 6, figures 2a-2b

Carapace small (approximately 0.7 mm in length), elongate-subrhomboidal in lateral profile, highest and thickest posteriorly; long, straight hinge line slightly channeled in posterior half below umbonate dorsal margin, post-cardinal angle approximately a right angle, antero-dorsal angle flatter, ventral margin subparallel to dorsum, though occasionally incised centrally, anterior nose evenly rounded and produced subcentrally in slight forward swing, posterior end bluntly and obliquely truncated or excavated; hingement apparently that of simple contact; surface evenly and gently convex, smooth, without visible centro-dorsal mesial scar except on dampened surface, a low, obscure, narrow keel rises on post-dorsal shoulder and circumvents free margin of the carapace, with maximum development ventrally.

Holotype right valve MCZ No. 4577; length: 0.73 mm; height: 0.46 mm; thickness: 0.22 mm, from Bromide outcrop, at top of Zone 24 of Oklahoma Highway 99 Simpson section.

Range: This smooth, flattened form has a limited range in middle Bromide.

Remarks: The subspecies differs from *P. constricta* Ulrich in its more abruptly and obliquely truncated or excavated thicker posterior end and absence of distinct mesial depression. It differs from *P. limbata* Ulrich in the fact that the thickened peripheral ridge does not circumvent the entire carapace, being absent along the hinge line; furthermore, posterior truncation is more abrupt and oblique in Ulrich's form.

The subspecific name is the adjectival form of the Latin word, varix, "a dilated vein"; referring to the low keel circumventing free margin of the carapace.

Genus HAPLOPRIMITIA Ulrich and Bassler, 1923

Genotype: *Primitia minutissima* Ulrich, 1894

Primitia of authors (partim)

Haploprimitia Ulrich and Bassler 1923, Md. Geol. Surv., Silurian vol., p. 297; Boucek 1936, Neues Jahrb. Mineralogie, Geologie, Paläontologie, Abt. B, Bd. 76, pp. 43-44; Öpik 1937, Univ. Tartu, Geol. Inst., Publ. no. 50, pp. 10, 13, 14, 16; Kay 1940, Jour. Paleontology, vol. 14, pp. 241, 248; Schmidt 1941, Senckenberg. Naturforsch. Ges., Abh., vol. 454, pp. 25, 26; Cooper 1942, Jour. Paleontology, vol. 16, pp. 771, 774; Hessland 1949, Upsala Univ. Geol. Inst., Bull., vol. 33, pp. 144, 205, 206, 208, 224, 225, 227, 228; Ellis and Messina 1953, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 2; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, pp. 229, 268; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 86.

Additional synonomy in Bassler and Kellett (1934, p. 324).

Carapace small (not exceeding 1 mm in length), elongate-ellipitical in lateral profile; valves appearing equal, but in some forms left valve is observed extending ever so faintly beyond lower margin of right; straight hinged; a narrow, vertical, slit-like furrow characterizes the middle of the dorsal margin.

Range: Ordovician to Devonian.

HAPLOPRIMITIA ANGUSTA Harris, n. sp.

Plate 6, figures 3a-3b

Carapace elongate-ovate in lateral profile (approximating 1 mm in length), strongly inflated, subcircular in transverse section, longest and thickest through center, highest anteriorly because of slight forward swing; dorsal contact even, though generally faintly and narrowly depressed, tightly appressed in casts; valves apparently equal, but in slightly weathered specimens and casts the left valve may be observed barely projecting beyond ventral margin of the right; a narrow, median, sulcate slit slants slightly obliquely forward from near-median line to a point well below the hinge line, where it widens and flattens into the dorsal slope, the occasional sulcus displays a low, antero-jacent node, peripheral edge of each valve is slightly thickened into a peripheral ridge, ridge of left valve slightly higher than that of right and polished at post-cardinal angle; surface very finely reticulate, though generally weathered smooth in outcrop specimens, where casts are numerous.

Holotype specimen MCZ No. 4578; length: 0.80 mm; height: 0.47 mm; thickness: 0.45 mm; paratype specimen MCZ No. 4579; length: 0.72 mm; height: 0.41 mm; thickness: 0.42 mm; paratype largest specimen MCZ No. 4580; length: 0.97 mm, from McLish shales, at top of Zone 67 of Oklahoma Highway 99 Simpson section.

Range: Observed only in McLish Zones 66-68 of Oklahoma Highway 99 Simpson section.

Remarks: This species is peculiar in its vertically oblique sulcate slit and reticulate surface, though the latter feature is rarely preserved. The species differs from the genotype, *H. minutissima* (Ulrich), in its reticulate surface, slanting (not vertical) sulcate slit, relatively more slender-elongate axis, and more highly inflated carapace. The species is identical in measurements and shape with *H. inconstans* Öpik, Ordovician of Estonia, and differs only in the reticulate surface. The species is much more inflated, smaller, and less semicircular in lateral outline than *H. pragae* Schmidt, from Caradoc beds.

The trivial name is obtained from the Latin adjective, angustus, "narrow, small"; referring to the very narrow sulcate slit of the species.

HAPLOPRIMITIA ANGUSTA var. DELTATA Harris, n. var.

Plate 6, figures 4a-4b

The variety differs from the contemporary type in its larger size and extreme inflation of posterior end, the form exhibiting the shape of a flaring wedge (deltoid) in dorsal view. Many eroded and distorted (flattened and sheared) specimens, as well as numerous casts, may be obtained from the type locality. It is possible that this form represents large females of the type species. Occurrence of complete series from tiny molt to large adult, all displaying characteristic extreme posterior inflation, induces one to establish the variety.

Holotype specimen MCZ No. 4581; length: 0.97 mm; height: 0.62 mm; thickness: 0.60 mm; paratype specimen MCZ No. 4582; length: 1.14 mm; height: 0.67 mm; thickness: 0.70 mm, from McLish shales, at top of Zone 67 of Oklahoma Highway 99 Simpson section.

Range: Observed only in McLish Zones 66-68 of Oklahoma Highway 99 Simpson section, where, in association with the type, it occurs quite commonly.

Remarks: *Primitia semicultrata* Chapman, from lower Devonian of Australia, displays the identical deltoid profile in dorsal view, but the Australian form exhibits higher sulcus, more elongate outline, and no channeled hingement.

The varietal name is adapted from the fourth letter of the Greek alphabet, delta, meaning "triangular or wedge-shaped"; referring to the wedge-shaped dorsal profile of the form.

Genus ECHINOPRIMITIA Harris, n. gen.

Genotype: *E. imputata* Harris, n. sp.

Tiny, subquadrate, elongate carapace with valves even along straight hingement; right valve apparently overlapping left about free margins; typical near-median sulcus with antero-jacent spine; smooth, punctate, papillose, or reticulate surface further characterized by a second prominent spine on post-dorsal shoulder, a row of spines or spinose ridge within ventral margin, and possibly other minor spines scattered about the surface; free margins thickened, rimmed, or keeled.

Range: Ordovician.

Remarks: The genus differs from other small, straight-hinged, sulcate euprimitian genera in extreme development of the lateral spine immediately in front of the sulcus, a spine normally assuming the proportions of a low node. The peripheral thickening, keel, or rim about free margins is characteristic of the genera, *Primitiella* Ulrich and *Euprimitia* Ulrich and Bassler, but the latter genera do not possess the echinoprimitian spine in front of sulcus, nor the secondary spinose ridge or row of spines within the lower margin.

The generic name is formed by adding to the word, primitia, the prefix, echino, which is adapted from the Greek word, echinatus, "prickly"; in reference to the spiny surface of the genus.

ECHINOPRIMITIA IMPUTATA Harris, n. sp.

Plate 6, figures 5a-5b

Tiny carapace subquadrate in lateral profile, with ventral margin slightly incurved behind maximum anterior height, length approximately twice the height; anterior cardinal angle practically a right angle, post-cardinal angle flatter, anterior end bluntly rounded, posterior nose evenly rounded and produced in median line; valves even along straight, elongate hinge line, right valve apparently overlapping left slightly about compressed free margins; finely punctate surface featured by a deep antero-median sulcus with slender, antero-jacent, upward-, outward-, and backward-projecting spine, a second similar outward-projecting spine near post-dorsal angle, a row of six to ten spines within and paralleling venter and lower posterior border.

Holotype specimen MCZ No. 4583; length: 0.47 mm; height: 0.27 mm, from Bromide horizon, 6 feet below top of Zone 3 of Rock Crossing Simpson section.

Range: Several excellent specimens recovered from Bromide Zones 3 and 4 of Rock Crossing section.

Remarks: This ornate species, presaging an end member in spinose development, possesses the small size and spinose surface of *Kiesowia verrucosa* Kay, from the Ion of Minnesota, but the Simpson form is more quadrate in outline, possesses a smaller and more slender spine before the sulcus (rather than on dorsal edge), has fewer spines (not nodes) post-dorsally, and displays submarginal row of spines along venter.

The trivial name is obtained from the Latin adjective, imputata, "unpruned"; referring to the many surficial spines of the species.

Genus EOPRIMITIA Harris, n. gen.

Genotype: *Primitia bonnemai* Swartz, 1936

Primitia of authors (partim)

Carapace small (ordinarily less than 1 mm in length), straight hinged, elongate-ovate, with some forward swing in lateral profile; valves generally equal, but in some forms the left overlaps or projects beyond right ventrally or about free margins; convex surface with small, vertical, slightly inclined, or curving near-median antero-dorsal sulcus, with occasional low, antero-jacent "eye tubercle" or obscure knob; surface otherwise smooth, punctate, striate, papillose, or reticulate.

Range: Ordovician to Devonian.

Remarks: This genus is erected to receive innumerable simple sulcate forms long assigned to the genus *Primitia* Jones and Holl, when *Beyrichia mundula* Jones was considered the genotype. Warthin and others have directed attention to the fact that *Beyrichia strangulata* Jones (not *B. mundula* Jones) is the correct and official designated genotype of the genus *Primitia* Jones and Holl. Research proves that dimorphic *B. strangulata* Jones is more closely related to true beyrichian and eurychiline forms than to the simple, straight-backed, sulcate forms long considered typical of the genus *Primitia* Jones and Holl . . . hence, *Primitia* Jones and Holl (with genotype *B. strangulata* Jones) cannot be adopted for the aforementioned simple forms. Swartz has investigated the form considered to be *B. mundula* Jones and has discovered it to be leperditellid, rather than definitely sulcate and primitian in aspect. Öpik, in studying the species, directs attention to definite overlap of left valve, a true leperditellid feature. Accordingly, *B. mundula* Jones cannot be employed as genotype for the aforementioned simple, sulcate forms. Swartz designated *Primitia bonnemai* Swartz as typical of these simple forms, and the writer designates it as genotype of the genus *Eoprimitia* Harris, n. gen.

EOPRIMITIA ARCUATA Harris, n. sp.

Plate 6, figures 6a-6b

Carapace small, elongate-ovate in lateral profile, wedge-shaped in dorsal view by reason of thicker posterior end, highest through slightly umbonate posterior shoulder, anterior nose produced in median line to effect slight, obliquely forward swing, post-dorsal angle practically a right angle, anterior angle flatter, ventral margin with longer, flatter anterior curvature and abruptly rounded posterior curvature; long, straight, channeled hingement, with maximum depth and width posteriorly; surface smoothly convex (possibly finely punctate); possessing deep antero-median sulcus with low antero-jacent bulb.

Holotype right valve MCZ No. 4585; length: 0.55 mm; height: 0.37 mm, from Oil Creek horizon, in Zone 84 of U. S. Highway 77 Simpson section.

Range: Not uncommonly occurring in Oil Creek.

Remarks: This species is closely related to McLish forms, *Haploprimitia angusta* Harris, n. sp. and *H. angusta* var. *deltata* Harris, n. var. It differs from the former in its inflated, slightly umbonate posterior end, being somewhat wedge-shaped, rather than lanceolate, in dorsal profile; and from the latter it differs in smaller size, higher posterior end, and more dorsal location of sulcus; the species is apparently smooth, rather than finely perforate.

The trivial name involves the participle of the Latin verb, arcuo, "to bend"; referring to the graceful curvatures of the narrow anterior and the higher posterior ends, respectively.

EOPRIMITIA BAILYANA (Jones and Holl) Harris

Plate 10, figures 9a-9c, 10

Cythere bailyana Jones and Holl 1868, Ann. Mag. Nat. Hist., 4th ser., vol. 2, p. 57, pl. 7, figs. 7a, 7b; Salter and Etheridge 1881, Geol. Survey Gr. Brit. and Mus. Prac. Geology, Mem. 3, appen., p. 410; Woodward 1877, Catalogue Brit. Foss. Crus., p. 97; Coryell 1927, Ostracoda Plates and Text Figures, Columbia Univ., N. Y., p. 205, pl. 7, fig. 7; Bassler and Kellett 1934, Geol. Soc. Amer., Spec. Pap. no. 1, p. 268.

Bythocypris incisa Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 14; ibid, March 5-6, 1937, 4th, 5th pp., fig. 39.

Bairdia micra Öpik 1937, Univ. Tartu, Geol. Inst., Publ., no. 50, p. 55, pl. 13, figs. 27-29.

The original description comments that this form is bean-shaped; straight-backed, ends essentially rounded, and equally attenuated, with an incurved, compressed mid-ventral area; dorsal profile is arcuate-ovate, laterally compressed.

The Simpson form, though slightly higher posteriorly, agrees essentially with the Ordovician form of Ireland. The American form is slightly compressed, equivalved, incised centro-ventrally, with dorsal contact of valves even, or slightly channeled. A slight antero-median sulcate depression is observed near dorsum of the hypotype.

Hypotype specimen MCZ No. 4649; length: 0.72 mm; height: 0.35 mm; thickness: 0.26 mm, from Bromide horizon, 26 feet below top of Zone 3 of Rock Crossing Simpson section.

Range: Commonly occurring in the Bromide. The species was reported originally as a form rarely occurring in an encrinital limestone from the mountains near Kildare, Ireland (known as the Chair of Kildare), from strata of Caradoc-Bala age. Öpik reported the form as *Bairdia micra* Öpik, form the Kukruse Ordovician of Estonia.

Remarks: This species is not a deformed *Bythocypris cylindrica* (Hall) Ulrich, with which it occurs. It possesses a dissimilar lateral outline and it lacks the ventral overlap of the latter species. *B. constricta* Teichert (Ordovician of Arctic Canada) possesses the characteristic ventral incision of this species, but the anterior end is decidedly higher. The antero-dorsal sulcate depression may be readily overlooked.

An associate form occurring in beds of Caradoc-Bala age in Ireland and also in the Simpson of Oklahoma is *Aparchites maccoyii* (Salter) Jones.

Eoprimitia cooperi Harris, n. sp.

Plate 6, figures 10a-10b, 11a-11c

Primitia cooperi Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 13.

Carapace tiny, elongate-subrhomboidal with long, straight hinge line, length approximately twice the height, rather gently convex (not tumid) in transverse section; anterior end rounded and generally more produced than posteror, posterior end with fairly abrupt cardinal angle, antero-cardinal angle more obtusely rounded, ventral margin parallel to dorsum, slightly incised centrally (more convex in molts); dorsal contact even and rather tightly appressed; valves appear equal about free margins, but actually left faintly overlaps the right; surface of perfect specimen finely perforate and longitudinally striate, striations often irregularly continuous among many small pores, a small, shallow, porelike, near-median sulcus with low, indistinct, antero-jacent bulb is localized immediately above equatorial line.

Holotype specimen MCZ No. 4588; length: 0.68 mm; height: 0.40 mm; thickness: 0.22 mm; paratype specimen MCZ No. 4588A; length: 0.57 mm; height: 0.32 mm, from Bromide horizon, in Zone 9 of U. S. Highway 77 Simpson section.

Range: Rather commonly occurring in upper Bromide (not in Corbin Ranch formation).

Remarks: This species displays identical proportions of *Primitiella constricta* Ulrich, but lacks the peripheral border of Ulrich's form. The Simpson form is further differentiated by its finely striate surface.

The species honors Dr. G. A. Cooper, Head Curator, U. S. National Museum, Washington, D. C., in recognition of his thorough brachiopodal research of the Simpson.

Note: Article 25 of International Code of Zoological Nomenclature decrees as invalid the status of "new species" for a form illustrated, but undescribed, in any publication appearing since December 31, 1930. Accordingly, as suggested by the Rules for such a case, the original synonymic reference to this previously illustrated, though undescribed, species appears here "without date following the trivial name", thus permitting herein official establishment of the new species.

EOPRIMITIA MOOREI Harris, n. sp.

Plate 6, figures 7a-7c

This tiny, biconvex, elongate-ovate form with long, straight hinge line and subparallel sides is further characterized by its subsymmetrical lateral profile with slight forward swing, vertical antero-median furrow, and abrupt truncation of free marginal body to produce a shelf-like shoulder completely encircling free margins of either valve, shoulder widest and most prominent ventrally.

Holotype specimen MCZ No. 4585; length: 0.62 mm; height: 0.35 mm; thickness. 0.25 mm, from Oil Creek horizon, in Zone 84 of U. S. Highway 77 Simpson section.

Range: A common form in Oil Creek strata.

Remarks: In lateral profile and position of sulcus this species resembles *Eoprimitia duplicata* (Ulrich), but the Simpson form lacks the peripheral false border that obscures the actual contact of the valves. This species is named in recognition of Simpson ostracodal research in the subsurface of West Texas by Mr. L. R. Moore, micropaleontologist for Gulf Oil Company, Amarillo, Texas.

EOPRIMITIA QUADRATA Harris, n. sp.

Plate 6, figures 8, 9a-9b

Aparchites quadratus Harris, Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 5th p., fig. 40.

This tiny, high, flattened, subquadrate species with subcarinate free margins and channeled hinge line is further characterized by an obscure antero-dorsal sulcate depression with "eye tubercle" (the two latter features admirably displayed on siliceous casts); valves equal about free margins; surface smooth and very lowly convex.

Holotype right valve MCZ No. 4586; length: 0.60 mm; height: 0.40 mm; paratype specimen MCZ No. 4587; length: 0.55 mm; height: 0.37 mm, from Bromide horizon, 15 feet below top of Zone 3 of Rock Crossing section, and at top of Zone 8 of U. S. Highway 77 Simpson sections, respectively.

Range: The species occurs quite commonly in upper Bromide outcrops (not in overlying Corbin Ranch formation).

Remarks: This smooth, flattened, subquadrate form generally occurs as separate valves. The form resembles *Jonesella obscura* Ulrich in lateral profile, thickness, and location of sulcus. The sulcus of the Simpson form, however, is generally obscure, not so deep, nor emphasized by a low U-shaped ridge about it. The Simpson species is flatter than *Milleratia* (*Primitia*) *gibbera* (Ulrich) from Richmond strata, and lacks the distinct narrow sulcus and adjacent nodose development of the Minnesota form.

The trivial name is obtained from the Latin adjective, quadratus, "squared"; referring to the subquadrate lateral profile of the species.

Note: Article 25 of International Code of Zoological Nomenclature decrees as invalid the status of "new species" for a form illustrated, but undescribed, in any publication appearing since December 31, 1930. Accordingly, as suggested by the Rules for such a case, the original synonymic reference to this previously illustrated, though undescribed, species appears here "without date following the trivial name," thus permitting herein official establishment of the new species.

EOPRIMITIA ? SUBNODOSA Harris, n. sp.

Plate 6, figure 12

Carapace small, subovate to semicircular in lateral profile (female relatively higher, shorter, and more semicircular), sides flattened and subparallel, maximum dimensions through lower part of sulcus; dorsal margin irregular above deeply and widely channeled, straight hingeline, dorsal margin low at cardinal angles and in mid-part, with low, shoulder-like, intermediate prominences, ventral margin evenly convex, ends evenly rounded below, anterior end the higher and with more abrupt cardinal angle, entire free margin flattened or truncated and widest ventrally; valves apparently equal along flattened free margin; a deeply depressed median sulcus with antero-jacent knob (and "horse-shoe" lobing suggested about lower part) lies above the mid-line and, with decreasing depth, extends toward dorsal margin, a post-median knob-like shoulder projects slightly above the dorsal margin, a faint, knob-like, rounded shoulder behind antero-cardinal angle projects but slightly above hingement; shoulder, channeled dorsal surface, and truncated free margins are exceedingly finely and densely papillose, though often worn smooth.

Holotype specimen MCZ No. 4589; length: 0.72 mm; height: 0.45 mm; thickness: 0.35 mm, from Tulip Creek horizon, in Zone 53 of Oklahoma Highway 99 Simpson section.

Range: Several specimens obtained from middle and upper Tulip Creek.

Remarks: The generic identity of this species is questioned because of the prominent knobs on either side of the median sulcus; it may be a species of *Milleratia* Swartz. The species differs from *Milleratia cincinnatiensis* (Miller) in more bilobate appearance, more semicircular lateral profile, papillose surface, and greater exposure of hingement below umbonation.

Genus EUPRIMITIA Ulrich and Bassler, 1923

Genotype: *Primitia sanctipauli* Ulrich, 1894

Primitia of authors(partim)

Euprimitia Ulrich and Bassler 1923, Md. Geol. Surv., Silurian vol., p. 299; Bassler and Kellett 1934, Geol. Soc. Amer., Spec. Pap. no. 1, p. 17; Öpik 1937, Univ. Tartu, Geol. Inst., Publ. no. 50, p. 19; Kay 1940, Jour. Paleontology, vol. 14, pp. 239-241, 252, 262; Schmidt 1941; Senckenberg. Naturforsch. Ges. Abh., vol. 454, p. 25; Cooper 1942, Jour. Paleontology, vol. 16, p. 774; Hessland 1949, Upsala Univ. Geol. Inst., Bull., vol. 33, pp. 121, 130, 134, 145, 205, 241, 243, 267; Moore, Lalicker, and Fischer 1952, Invert Foss., pp. 526-527, text fig. 14-3, 7; Ellis and Messina 1953, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 2; Henningsmoen 1953, Norsk. Geol. Tiddskr., Bd. 31, pp. 229-230, 268; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 75.

Carapace small, straight-hinged, subovate to subquadrate in lateral profile; hingement apparently simple; surface characterized by a central sulcus, reticulate ornamentation, and elevated keel about the free margins.

Range: Ordovician and Silurian.

EUPRIMITIA ELEGANS Harris, n. sp.

Plate 6, figures 13a-13b

Carapace tiny (approximately 0.5 mm in length), subquadrate in lateral profile, sides extremely compressed and parallel; dorsum flattened, hinge long and straight, ventral margin lowly and evenly rounded, anterior end evenly rounded and centrally produced, antero-cardinal angle flattened, flatly truncated posterior end making right angle at dorsal contact and abruptly rounded ventrally; flattened surface characterized by: fine reticulations, antero-median "muscle pore" or sulcate depression, slight inflation of carapace below and behind sulcus, and peripheral thickening, the thickening assuming the aspect of a smooth, widened, beveled dorsum becoming ridged about anterior end and keeled ventrally to develop into a prominent outward- and downward-flaring posterior wing, with maximum development at post-ventral angle.

Holotype left valve MCZ No. 4591; length: 0.52 mm; height: 0.32 mm; thickness: 0.11 mm, from Bromide horizon, approximately 75 feet below top of Mill Creek Simpson section.

Range: Many separate valves recovered only from Bromide of Mill Creek Simpson section.

Remarks: This excellent species is apparently closely related to *Moorea punctata* Ulrich, from the Decorah of Minnesota. Both forms display proportionate size, perforate or punctate surface, and marginal wing. Ulrich reported no sulcate depression in the median area (hence, the generic difference) and neither did he observe a smooth, thickened band on the flattened and beveled dorsum to represent a continuation of the marginal ridge or wing. The near-median pit may be overlooked, since it is often filled or covered with extraneous material, though it is readily visible on moistened surface.

The trivial name is obtained from the Latin adjective, elegans, "neat, elegant"; referring to the neat appearance of this finely reticulate, flattened, alate species.

Genus HALLIELLA Ulrich, 1891

Genotype: *H. retifera* Ulrich, 1891

Halliella Ulrich 1891, Cin. Soc. Nat. Hist., Jour., vol. 13, pt. 2, p. 184; Bassler 1913, Zittel-Eastman Textbk. Paleontology, 2nd ed., p. 258; Kay 1934, Jour. Paleontology, vol. 8, pp. 332, 335; Öpik 1937, Univ. Tartu. Geol. Inst., Publ., no. 50, p. 18; Kay 1940, Jour. Paleontology, vol. 14, pp. 241, 252, 253; Schmidt 1941, Naturforsch. Ges., Abh., 454, p. 51; Cooper 1942, Jour. Paleontology, vol. 16, pp. 771, 774; Shimer and Shrock 1948, Index Foss. North Amer., p. 665; Warthin 1948, Jour. Paleontology, vol. 22, p. 646; Hessland 1949, Upsala Univ. Geol. Inst., Bull., vol. 33, pp. 205, 243; Ellis and Messina 1952, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 1;

Moore, Lalicker, and Fischer, Invert. Foss., pp. 532, 533, text fig. 14-6, 2; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, pp. 229, 233, 240, 248, 273; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 85.

Additional synonomy in Bassler and Kellett (1934, p. 322).

Carapace small, elongate-ovate in lateral profile, with straight hingement generally depressed below umbonate dorsum; broad sulcus and coarsely reticulate surface, with thickened border about free margins.

Range: Ordovician to Devonian.

Remarks: The genus differs essentially from the genus *Euprimitia* Ulrich and Bassler in its more prominent sulcus, coarser reticulations, and thickened border without elevated keel.

Halliella labiosa Ulrich, 1894

Plate 6, figures 14, 15, 16a-16b

Halliella labiosa Ulrich 1894, Geology Minn., vol. 3, pt. 2, p. 656, pl. 46, figs. 43-46; Coryell 1927, Ostracoda Plates and Text Figures, vol. 1, p. 95, pl. 46, figs. 43-46; Harris 1931, Okla. Geol. Surv., Bull. 55, p. 92; Kay 1934, Jour. Paleontology, vol. 8, pp. 329, 332-334, pl. 44, figs. 17, 18; Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 25; ibid, March 5-6, 1937, 4th, 5th pp., figs. 35a-b; Schmidt 1941, Senckenberg. Naturforsch. Ges., Abh. 454, p. 52; Shimer and Shrock 1948, Index. Foss. North Amer., p. 665, pl. 281, figs. 15-17; Ellis and Messina 1952, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 1.

Halliella labrosa Bassler 1913, 1927, 1937, Zittel-Eastman Textbk. Paleontology, p. 738, fig. 1425h; Swartz 1936, Jour. Paleontology, vol. 10, pl. 85, fig. 1d.

Euprimitia labiosa (Ulrich) Kay 1940, Jour. Paleontology, vol. 14, pp. 236, 240, 252, pl. 31, figs. 16-18; Moore, Lalicker, and Fischer 1952, Invert. Foss., pp. 526, 527, text fig. 14-3, 7; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, pp. 229, 230.

Hallatia healeyensis Kay 1934, Jour. Paleontology, vol. 8, p. 335, pl. 45, figs. 5, 6; Ellis and Messina 1954, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 4.

Additional synonomy in Bassler and Kellett (1935, p. 322).

This semicircular, deeply sulcate, peripherally flattened and keeled form with semi-coarse reticulations on rather flatly convex surface occurs rather commonly in various Bromide sections in the Arbuckle Mountains (not in overlying Corbin Ranch formation). It has been reported from the Hull, Ion, and Prosser of Canada, Iowa, and Minnesota, respectively.

Hypotype specimen MCZ No. 4592; length: 0.77 mm; height: 0.55 mm; thickness: 0.44 mm; hypotype eroded left valve MCZ No. 4592A; length: 0.90 mm; height: 0.57 mm; hypotype eroded right valve MCZ No. 4590; length: 0.82 mm; height: 0.53 mm, from Bromide horizon, in Zone 9 of U. S. Highway 77 Simpson section.

Remarks: Occurring with the ornate valves are smooth, eroded or exfoliated specimens, as illustrated. Such smooth, exfoliated specimens were discovered by Kay associated with *H. labiosa* Ulrich in the Decorah of Iowa. Kay observed the close similarity of the smooth forms to Ulrich's type, but considered differences sufficient to establish a new species, *Hallatia healeyensis* Kay. Numerous casts or exfoliated specimens of this (and other) species in Simpson outcrops has induced the writer to include *H. healeyensis* Kay in synonomy.

The deep sulcus, fairly coarse pores, and peripheral thickening (though rimmed in part) are considered criteria sufficient for assignment to the originally designated genus *Halliella* Ulrich.

Family *PRIMITIOPSIDAE* Swartz, 1936

Genus PRIMITIOPSIS Jones, 1887

Genotype: *P. planifrons* Jones, 1887

Primitiopsis Jones 1887, Silurian Ostrac. Gothland, Stockholm, p. 5; 1890, Geol. Soc. London, Quart. Jour., vol. 46, p. 2; Vogdes 1890, U. S. Geol. Surv., Bull. 63, p. 153; Öpik 1937, Univ. Tartu, Geol. Inst., Publ. 50, pp. 18, 24; Teichert 1937, Meddel, om Gronland, Bd. 119, no. 1, p. 45; Cooper 1942, Jour. Paleontology, vol. 16, p. 775; Hessland 1949, Univ. Upsala, Geol. Inst., Bull., vol. 33, p. 239; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, pp. 230, 240, 268; 1954, ibid, Bd. 34, heft 1, p. 159; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. 1, p. 154.

Additional synonomy in Bassler and Kellett (1934, p. 465).

Carapace small (less than 2 mm in length), relatively short, ovate to sub-quadrate in lateral profile; long, straight hingement; right valve slightly larger than left, with ventral overlap faintly perceptible; surface reticulate, with definite near-median to antero-median pit or "muscle scar", female dimorph possessing true posterior "brood-pouch".

Range: Ordovician to Devonian.

Remarks: Jones established the genotype, *Primitiopsis planifrons* Jones, in 1887. Noting the terminal "brood-pouch" on the species Jones directed attention to " . . . the small anterior chamber . . . partitioned off from the rest of the cavity by a cross wall . . . this constituting the generic distinction". Jones considered the terminal "brood-pouch" a feature of the Recent arch hinged ostracodal genus *Chlamydotheca* Saussure. Again, Jones observed and noted the near-median muscle pore, but he failed to recognize the significance of the pit in orienting the carapace; accordingly, overlooking the fact that the more forward location (opposite pouched end) of the pit marked the anterior end. Three of the five Simpson species display "muscle pit" ahead of center (exclusive of posterior "brood-pouch") and, thus, effect an orientation opposite that advanced by Jones and some later authors. On representatives of this genus the terminal (posterior) pouch is considered a true "brood-pouch". Occasional male dimorphs are discovered in the Simpson without the "brood-pouch".

Primitiopsis bassleri Harris, 1931

Plate 6, figures 17a-17b

Primitiopsis bassleri Harris 1931, Okla. Geol. Survey, Bull. 55, p. 91, pl. 11, figs. 2a-2d; 1931, Okla. Acad. Sci., Proc., vol. 12, p. 57, pl. 13, figs. 1a-1b; Bassler and Kellett 1934, Geol. Soc. Amer., Spec. Pap. no. 1, p. 465; Swartz 1936, Jour. Paleontology, vol. 10, pl. 83C, figs. 2a-2b; Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p. fig. 9; ibid, March 5-6, 1937, 4th, 5th pp., fig. 18; Kay 1940, Jour. Paleontology, vol. 14, pp. 241, 261; Schmidt 1941, Senckenberg. Naturforsch. Ges., Abh., vol. 454, p. 52; Hessland 1949 Univ. Upsala, Geol. Inst., Bull., vol. 33, pp. 205-207, 229, 239, 240; Levinson 1950, Jour. Paleontology, vol. 24, pp. 67-68, figs. 4a-b; Kesling 1951, Univ. Mich., Contrib. Mus. Paleontology, vol. 9, p. 108; Decker 1951, A.A.P.G., Bull., vol. 35, p. 913; 1952, ibid, vol. 36, p. 135. *Macronotella* of authors (partim).

This species with characteristic coarse, subcircular pores is an index fossil of the Bromide (not in overlying Corbin Ranch formation). Along an imaginary line between muscle-pore and smooth ventral band four to six pores may be observed. Of interest and perplexity is the fact that practically all right valves are perfectly smooth, whereas opposing reticulate valves display the smooth band only about the periphery. Literally hundreds of right valves are worn ? perfectly smooth, possibly during life of the crustacean while spinning on the right side on the muddy bottom, in fashion similar to Recent fresh-water Ostracoda observed spinnnig on the surface. The female dimorph is relatively shorter and higher than the male and displays well-developed posterior excavation, or brood pouch.

Paratype specimen MCZ No. 4593; length: 0.92 mm; height: 0.60 mm; thickness: 0.45 mm, from Bromide horizon at top of Zone 12 of U. S. Highway 77 Simpson section.

Remarks: This coarsely reticulate primitiopsid is characteristic of the Bromide, while the finely reticulate form, *P. elegans* Harris, n. sp., precedes it stratigraphically as a commonly occurring index fossil of the Tulip Creek. The "muscle spot" is located very near the center, but careful scrutiny will discover it nearer the more sharply produced anterior end (opposite that of the "brood-pouch").

Primitiopsis elegans Harris, n. sp.

Plate 8, figure 18

Primitiopsis bassleri var. Harris, Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., fig. 55.

This species differs from *P. bassleri* Harris essentially in possession of greater number of surficial pores (smaller in size and more densely concentrated). One may observe 10 to 12 pores along an imaginary line between "muscle spot" and smooth ventral peripheral band. The form is also relatively shorter and higher and displays a shorter hinge line.

Holotype left valve MCZ No. 4594; length: 0.76 mm; height: 0.57 mm; thickness: 0.20 mm, from Tulip Creek horizon, 8 feet above base of Zone 32 of U. S. Highway 77 Simpson section.

Range: This finely reticulate species is an excellent index fossil of the Tulip Creek, preceding *P. bassleri* Harris in the section; the two forms are not contemporary, though there is the possibility of an intermediate subspecies. As in its successor, *P. bassleri* Harris, the muscle scar of the Tulip Creek form appears ahead of center. This Tulip Creek species is very similar to *Primitiopsis* (*Macronotella*) *multipunctata* (Kay) Harris, from Guttenberg of Iowa, and to *P.* (*Macronotella*) *elongata* (Teichert) Harris, from Ordovician of Arctic Canada; the hingement of the Simpson species appears shorter, the smooth peripheral band is better developed, cardinal angles are more rounded, and muscle spot possibly higher and nearer anterior end. Comparison of a series of the Guttenberg species with that of the Tulip Creek may reveal them identical.

The trivial name is obtained from the Latin adjective, elegans, "neat, elegant"; having reference to the neat appearance of the finely reticulate surface.

Primitiopsis excavatus Harris, n. sp.

Plate 6, figures 20a-20b

Primitiopsis sp. Harris, Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., fig. 30.

Subrhomboidal carapace short and high, thickest and highest posteriorly, with maximum length above median line, somewhat wedge-shaped in dorsal profile; anterior end evenly rounded through cardinal and ventral angles and produced in or slightly above median line, posterior end obliquely truncated and displaying abruptly rounded cardinal and ventral angles, ventral margin strongly truncated at the front end; straight hingement contact evenly and tightly appressed; right valve overlaps left along ventral margin; surface minutely and densely perforate (perforations best preserved on posterior extremity), muscle scar immediately above and before center, tiny spines on anterior periphery of perfect specimens, a prominent feature is a low, vertical shoulder near posterior end that disappears on dorsal and ventral slopes, shoulder most prominent below median line because of contrasting lower, post-jacent, excavated, shelf-like extremity of carapace.

Holotype specimen MCZ No. 4595; length: 077 mm; height: 0.58 mm; thickness: 0.47 mm, from Tulip Creek horizon, at base of Zone 34 of Oklahoma Highway 99 Simpson section.

Range: The species was recovered from 10-foot interval near top of the Tulip Creek in Oklahoma Highway 99 Simpson section.

Remarks: The subrhomboidal outline, obliquely truncated, high posterior end, low, rounded anterior end, and prominent, vertical posterior shoulder constitute identifying features of this species. In lateral profile it resembles *Aparchites oblongus* Ulrich, but in dorsal profile the Simpson form is considerably thinner; Ulrich's form is smoother and possesses no posterior shoulder.

The trivial name is obtained from the Latin prefix, ex, "out, from", and word, cavatus, "hollowed"; referring to hollowed out posterior shoulder of the form.

PRIMITIOPSIS MINUTIPERFORATUS Harris, n. sp.

Plate 6, figures 21a-21b

Primitiopsis microperforata Harris Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., fig. 72.

Carapace elongate, distinctly symmetrically ovate in lateral profile, longest and highest through center, thickest slightly below and behind center; ends evenly rounded, anterior slightly the more acute, ventral profile evenly and rather strongly convex; dorsal margin long and straight, with closely appressed hingement; right valve faintly overlaps left ventrally and extends ever so faintly beyond it anteriorly and posteriorly; rather strongly convex surface very finely and densely perforate and displaying obscure median muscle scar, extending from post-cardinal angle to a point near mid-region of the ventral margin of female valve is a thin, carinate, backward-projecting wing or "brood-pouch", male form agrees with female in characteristics, with exception of missing posterior "brood-pouch".

Holotype female specimen MCZ No. 4596; length: 1.15 mm; height: 0.80 mm; thickness: 0.62 mm; paratype male specimen MCZ No. 4597; length: 1.29 mm; height: 0.90 mm; thickness: 0.70 mm, from McLish horizon, at middle of Zone 66 of Oklahoma Highway 99 Simpson section.

Range: Recovered only from McLish shales in Zones 66-68 of Oklahoma Highway 99 Simpson section.

Remarks: In lateral profile and size the form resembles

Aparchites millepunctatus (Ulrich), but the Simpson form possesses primitiopsid "brood-pouch" and is possibly more inflated. The species is larger and much more finely punctate than *P. bassleri* Harris.

The trivial name is a combination of Latin words, minutus, "minute", and perforatus, "perforated"; referring to the finely punctate surface of the species.

Article 25 of International Code of Zoologic Nomenclature decrees as invalid the status of "new species" for a form illustrated, but undescribed, in any publication appearing since December 31, 1930. Accordingly, as suggested by the rules for such a case, the original synonymic reference to this previously illustrated, though undescribed, species appears here "without date following the trivial name," thus permitting herein official establishment of the new species.

PRIMITIOPSIS MINUTUS Harris, n. sp.

Plate 6, figure 19

This tiny, compact, subquadrate primitiopsid is further characterized by its abbreviated carapace with posterior truncation, faint median sulcus with "muscle scar", and numerous fine surficial pores; dorsal and ventral margins are straight and parallel, the dorsal slightly the longer, anterior end evenly rounded, posterior end obliquely truncated, that of female flatly truncated, thus suggesting an eroded or broken "brood-pouch"; faint spines border the margin from anterior end to post-ventral angle.

Holotype specimen MCZ No. 4598; length: 0.65 mm; height: 0.45 mm; thickness: 0.38 mm, from Bromide horizon, at base of Zone 3 of Rock Crossing Simpson section.

Range: Not uncommonly occurring in upper Tulip Creek and throughout the Bromide (not in topmost Corbin Ranch formation).

Remarks: This species was considered originally the molt of *P. bassleri* Harris; but critical attention to the occurrence and character of the form reveals it consistent in size, shape, and surficial ornamentation. Intermediate stages between this small form and the larger species are questionably established; indeed, this small specie, is the only form occurring in some horizons.

The trivial name is adopted from the Latin word, minutus, "minute"; referring to the contrasting size of this smallest of Simpson primitiopsids.

Family *HOLLINIDAE* Swartz, 1936

Genus EOHOLLINA HARRIS, n. gen.

Genotype: *Beyrichia irregularis* Spivey, 1939

Ulrichia Harris (partim) 1931, Okla. Acad. Sci., Proc., vol. 18, pp. 58, 59, pl. 13, fig. 5; Okla. City Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 16; ibid, March 5-6, 1937, 4th, 5th pp., fig. 47.

Beyrichia Spivey (partim) 1939, Jour Paleontology, vol. 13, p. 172, pl. 21, figs. 1-2.

Bromidella Kay (partim) 1940, Jour. Paleontology, vol. 14, pp. 237, 263, pl. 34, figs. 12-15.

Carapace small (generally less than 1 mm in length), ovate-elliptical to subquadrate in lateral profile, with definite forward swing; long, straight hingement depressed or channeled below umbonate anterior and posterior dorsal nodes; near-median sulcus with antero-jacent isolated, rounded knob, a prominent, umbonate, bulbous inflation lies on dorsum between sulcus and post-cardinal angle, a somewhat similar, lower inflation occurs behind antero-cardinal angle, subsulcate and post-ventral area of carapace strongly inflated with elongate, inclined, lobate swelling, peripheral flange about free margins, female with antero-ventral marginal "brood pouch", entire surface otherwise smooth, punctate, granulose, pustulose, or reticulate.

Range: Ordovician and Silurian.

Remarks: This genus is a close counterpart of the Devonian and Mississippian genus *Hollina* Ulrich and Bassler, differing essentially in size only. Further research in "muscle scar" patterns, transmitted light features, hingement detail, and possibly surficial features should undoubtedly further corroborate the ancestral relationship of this tiny genus to its larger and much later descendant. Ulrich and Bassler, in revising the Beyrichiidae Ulrich and Bassler 1908, stipulated that representatives of the genus *Beyrichia* McCoy are rather large, averaging from 2 to 3 mm in length. They stated, furthermore, that very few true trilobed beyrichian species occur in the Ordovician. Later authors concur in the latter opinion, a few contending that the genus has no representatives whatever in the Ordovician. The genus *Eobeyrichia* Henningsmoen was erected for some Ordovician beyrichian forms of Norway, but the genus is trilobed, with subsulcate zygal ridge uniting the post-dorsal and antero-sulcate lobes, with post-ventral inflation (so primary a feature of *Eohollina* Harris, n. gen.) either absent or secondary; furthermore, the Baltic representatives average twice the size of the Maquoketa, Ion, and Simpson forms of America.

The Greek prefix, eos, "dawn", explains the ancestral relationship of this early genus to its larger descendant, *Hollina* Ulrich and Roessler.

Eohollina depressa (Kay) Harris

Plate 7, figures 1a-1b, 2a-2d

Ulrichia initialis Harris (not Ulrich) 1931, Okla. Acad. Sci., Proc., vol. 12, pp. 58, 59, pl. 13, fig. 5.

Ulrichia papillosa Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 16.

Ulrichia inflata Harris, Okla, City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., fig. 24.

Bromidella depressa Kay, Jour. Paleontology, vol. 14, pp. 237, 263, pl. 34, figs. 12-15.

Carapace small (less than 1 mm in length), elongate-ovate with forward swing, thickest through post-ventral inflation; ventral margin of male sub-parallel to dorsum, that of female more convex, antero-cardinal angle much flatter than abrupt post-cardinal angle (especially true of female); surface characterized by antero-median sulcus with antero-jacent, rounded, raised knob and evenly convex anterior end tending to become umbonate or slightly nodose behind antero-cardinal angle, sulcus extends to ventral margin in female form, behind sulcus a slightly elongate, bulbous knob lies on the dorsal surface and projects above the straight, slightly channeled hingement, extending obliquely upward and backward from a subsulcate position to a point below the post-dorsal knob is a large, rounded to club-like, post-ventral swelling, a narrow, vertical marginal swelling borders high posterior nose, female carapace with elongate "brood-pouch" on ventral to antero-ventral margin, carapace depressed among various posterior swellings, surface otherwise perforate except for occasional traces of papilli on the large post-ventral lobe.

Hypotype male right valve MCZ No. 4599; length: 0.85 mm; height: 0.40 mm; hypotype female left valve MCZ No. 4599A; length: 0.65 mm; height: 0.42 mm; hypotype specimen MCZ No. 4599B; length: 0.75 mm; height: 0.52 mm, from Bromide horizon, 13 feet below top of Zone 10 (male type), and near base of Zone 22 (female and specimen types) of U. S. Highway 77 and Oklahoma Highway 99, respectively.

Range: As an index fossil of the Bromide, this species is preceded in the underlying Tulip Creek by the subspecies, *papillata* Harris, n. subsp. Kay originally reported the species from the Ion of Iowa.

Remarks: The Bromide species differs from the Tulip Creek variety in its more elongate post-dorsal knob and in the absence of prominent papilli or pustulose growths on the surficial nodes. The perfectly preserved surface is finely perforate, though odinarily eroded and appearing smooth. The species differs from *Eohollina (Beyrichia) irregularis* (Spivey) Harris, from the Maquoketa of Iowa, in its finely perforate, rather than granulose, surface, and in absence of distinct nodes or pustules on surficial nodes, and in proportionately more slender-elongate outline (especially true of male).

Note: Article 25 of International Code of Zoologic Nomenclature decrees as invalid the status of "new species" for a form illustrated, but undescribed, in any publication appearing since December 31, 1930. Accordingly, as suggested by the Rules for such a case, the original synonymic reference to this illustrated, though undescribed, species appears here "without date following the trivial name," thus effecting official recognition of the new species described and illustrated by Kay in the interim.

Eohollina depressa (Kay) subsp. papillata Harris, n. subsp.

Plate 7, figures 3a-3b

Ulrichia papillosa Harris, Okla. Geol. Soc., Field Conf. Guidebk., Mrach 5-6, 1937, 4th, 5th pp., fig. 47.

This small form with ventral to post-ventral "brood-pouch" and definite forward swing is further characterized by a recurved sulcus and several papillose knob-like inflations: a bulbous (often tuberculate) knob bounds either side of the sulcus dorsally and projects above the hingement within the cardinal angles, the narrow sulcus bends about an antero-jacent low, rounded knob situated above the median line, elongate-ovate, papillose post-ventral swelling of carapace obtains obliquely in the angle of sulcus and "brood pouch", posterior margin slightly inflated and finely beaded in perfect specimens, anterior half of carapace with four to six irregular, scattered low pustules or knoblets.

Holotype female left valve MCZ No. 4600; length: 0.67 mm; height: 0.50 mm; paratype specimen MCZ No. 4601; length: 0.67 mm; height: 0.50 mm, from Tulip Creek horizon, in Zone 36 of Oklahoma Highway 99 Simpson section.

Range: A commonly occurring form in the Tulip Creek member of the Simpson.

Remarks: The subspecies differs essentially from the type in its more pustulose or tuberculate surface, particularly noticeable on the knobs and anterior end; furthermore, the post-dorsal knob is rounded, rather than slightly elongate. The form differs essentially from *E.* (*Beyrichia*) *irregularis* (Spivey) Harris, Maquoketa species, in absence of spine-like extension of post-dorsal knob and in stronger development of antero-dorsal knob.

The subspecific name is obtained from the Latin adjective, papillatus, "nipple, pimple"; referring to the papillose surface of the species.

Note: Article 25 of International Code of Zoologic Nomenclature decrees as invalid the status of "new species or variety" for a form illustrated, but undescribed, in any publication appearing since December 31, 1930. Accordingly, as suggested by the Rules for such a case, the original synonymic reference to this previously illustrated, though undescribed, subspecies appears here "without date following the name", thus permitting herein official establishment of the new subspecies.

Genus BELLORNATIA Kay, 1934

Genotype: *B. tricollis* Kay, 1934

Bellornatia Kay 1934, Jour. Paleontology, vol. 8, pp. 328, 342; 1940, ibid, vol. 16, p. 757; Cooper 1942, ibid, p. 774; Shimer and Shrock 1948, Index Foss. North Amer., p. 669; Moore, Lalicker, and Fischer 1952, Invert. Foss., pp. 526-527, text fig. 14-3; 14;

Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, pp. 219, 267; Ellis and Messina 1954, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ. vol. 4; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 17.

Carapace small (attaining length of 1.5 mm), elliptical in lateral profile; valves equal; straight, channeled hingement; pronounced marginal ridge entire, a second (inter-marginal) ridge is suspended from dorsal angles of outer ridge, definite near-median sulcus bounded by "horse-shoe" lobing or pronounced nodes.

Range: Ordovician.

BELLORNATIA MCLISHI Harris, n. sp.

Plate 7, figures 4a-4b

Carapace small, elliptical in lateral profile, with slight forward swing, highest anteriorly, subtriangular in dorsal view because of extreme posterior thickness; all of long, straight hinge (excepting posterior fifth) depressed below dorsal flange, ventral outline flatly convex and inclined upwardly posteriorly; lateral surface a raised, ovate keeled medallion that slopes uniformly from its highest post-ventral point to lowest point antero-dorsally, in the depression of the medallion is a wide median sulcus with raised, thickened "horse-shoe" lobe bordering it laterally and ventrally, the lobe is nodose anteriorly, becomes ridge-like ventrally, and widens and grades into high-standing carapace posteriorly, a second lower and thinner keel lies below the high-standing medallion keel, joining the larger keel anteriorly on the hinge line the smaller keel continues about the free margins parallel to the high-standing keel, and dwindles in its high and erect posterior escarpment, the ridges are separated by an excavated channel with supporting pillar-like shell structures in posterior end of occasional valves, other channeling separates the second ridge from the peripheral border, the latter channeling uniform in width on right valve, but becomes slightly constricted ventrally on left valve.

Holotype right valve MCZ No. 4602; length: 0.83 mm; height: 0.47 mm; thickness: 0.23 mm; paratype left valve MCZ No. 4603; length: 0.80 mm; height: 0.42 mm, from McLish shale, at base of Zone 66 of Oklahoma Highway 99 Simpson section.

Range: Several specimens recovered from McLish Zones 66-68 of Oklahoma Highway 99 Simpson section.

Remarks: The generic identity of the species may be questioned because of its failure to fulfill precise qualifications of the genus *Bellornatia* Kay, as exemplified in the genotype, *B. tricollis* Kay. The Simpson form is definitely more ctenobolbine than the species from Iowa; furthermore, it possesses a deeper sulcus, though lacking the surficial nodes of the type species. It displays, however, the bellornatian characteristics of depressed hingement, practically entire marginal ridge with suspended inner marginal ridge, and sulcus bounded by horse-shoe lobing.

Genus CTENOBOLBINA Ulrich, 1890

Genotype: *Beyrichia ciliata* Emmons, 1855

Beyrichia of authors (partim)

Ctenobolbina Ulrich 1890, Cin. Soc. Nat. Hist., Jour., vol. 13, p. 108; Bassler 1913, 1927, 1937, Zittel-Eastman Textbk. Paleontology, 2nd ed., p. 738; Boucek 1936, Neues Jahrb. Mineralogie, Geologie, Paläontologie, Abt. B, Bd. 76, p. 64; Öpik 1937, Univ. Tartu, Geol. Inst., Publ. no. 50, pp. 32, 35, 36, 39; Schmidt 1941, Senckenberg. Naturforsch. Ges., Abh., vol. 454, pp. 30, 33-40, 46; Cooper 1942, Jour. Paleontology, vol. 16, pp. 770, 771; Shimer and Shrock 1948, Index Foss. North Amer., p. 669; Ellis and Messina 1952, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 1; Moore, Lalicker, and Fischer 1952, Invert. Foss., pp. 526, 527, text fig. 14-3, 14; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, pp. 192, 195, 200, 206, 208, 211, 212, 239, 266, text fig. 3 (11-12); Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 39; Kesling 1955, Univ. Mich., Contrib. Mus. Paleontology, vol. 12, no. 13, p. 267.

Additional synonomy in Bassler and Kellett (1934, p. 248).

Carapace small, straight hinged, obliquely subovate in lateral profile, with distinct forward swing; surface with deep anteromedian sulcus with antero-jacent rounded, isolated knob on inflated anterior quarter, carapace obliquely inflated in post-ventral area behind and below sulcus, inflated area possibly keeled, surface otherwise smooth, punctate, papillose, pustulose, reticulate, or granulose.

Range: Ordovician to Devonian.

Remarks: This genus develops into the genus *Winchellatia* Kay by the expansion of post-ventral inflation into an outward- and backward-projecting strong spine.

CTENOBOLBINA ABRUPTA Harris, n. sp.

Plate 8, figures 18a-18b, 19, 20

Ctenobolbina A Harris, Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., fig. 9.

Adult carapace averaging 1.5 mm in length, with forward swing in typical ctenobolbine obliquely subovate lateral profile, highest before middle, thickest post-ventrally; dorsal margin essentially straight, though some specimens with slight arch on either side of sulcus; hingement slightly channeled; prominent antero-median sulcus with antero-jacent tubercle recurved toward lower margin of carapace, occasionally not indenting lower part, widest dorsally, post-ventral surface strongly and obliquely inflated, inflation dorsally sloping into sulcus, while abruptly truncated ventrally and thickened by a low, short keel (inflation of female more rounding and with less keel-like development), marginal wing or false border thick and well developed, venter flattened and slightly channeled, flatly convex surface apparently smooth.

Holotype left valve MCZ No. 4604; length: 0.97 mm; height: 0.62 mm; paratype left valve MCZ No. 4605; length: 0.97 mm; height: 0.62 mm; paratype left valve MCZ No. 4606; length: 0.75 mm; height: 0.50 mm, from Corbin Ranch horizon, at base of Zone 13 of Oklahoma Highway 99 Simpson section.

Range: A commonly occurring form in topmost Simpson Corbin Ranch formation.

Remarks: *C. subcrassa* Ulrich, from Stones River of Kentucky, most closely resembles this Simpson species, but it possesses in its slightly channeled ventral surface a transverse cancellated structure not present in the Simpson form. The latter species displays more pronounced post-ventral inflation, with superimposed shorter and less developed keel.

The trivial name is obtained from the Latin adjective, abruptus, "abrupt"; referring to the abrupt truncation of lower face of post-ventral inflation.

Ctenobolbina bispinata Harris, n. sp.

Plate 9, figures 1a-1b

Small, compact, strongly inflated ctenobolbine with definite forward swing, highest in anterior quarter and thickest through post-ventral inflation; recurving median sulcus is deeply excavated behind a low, rounded knob and becomes shallow on dorsal and ventral slopes, widest dorsally, a thin narrow carina or false border originates at base of short antero-cardinal spine and circumvents outer margin of carapace to terminate in a short backward-projecting spine beneath post-ventral inflation (carina of male valves extends from angle to angle and possesses no post-ventral spine, or but rudiment thereof), ventral contact of valves obscured by narrow tube-like shell growth that terminates in the antero-cardinal spine; surface, including antero-median knob and venter, uniformly sculptured with fine, rounded pores.

Holotype specimen MCZ No. 4607; length: 0.90 mm; height: 0.50 mm; thickness: 0.45 mm, from Bromide horizon, in Zone 3 of Rock Crossing Simpson section.

Range: Recovered from Bromide Rock Crossing zone and from Zone 10 of U. S. Highway 77 Simpson section.

Remarks: The species is similar in size, shape, and surficial perforations to *C. obliqua* Ulrich (Prosser of Minnesota), but it differs in possession of cardinal spines and absence of small post-sulcate spine-like tubercle.

The trivial name is obtained from the Latin prefix, bi, "two", and adjective, spinatus, "spined"; referring to spinose extensions of both cardinal angles.

Ctenobolbina cancellata Harris, n. sp.

Plate 9, figures 2a-2b

Ctenobolbina sp. Harris, Okla. City Geol. Soc., Field Conf. Guide-bk., March 5-6, 1937, 4th, 5th pp., fig. 27.

Carapace obliquely subovate-elongate in lateral profile, with long straight hingement and distinct forward swing, highest ahead of center, thickest post-ventrally; antero-cardinal angle slightly exceeding a right angle, posterior angle greater, anterior nose low and evenly rounded ventrally, but straightening toward cardinal angle, posterior nose high and rather sharply and evenly rounded; valves apparently equal, with free marginal contact finely beaded;

antero-median sulcus with low, rounded antero-jacent knob near equatorial line, carapace below and behind sulcus elevated into an obliquely elongate, rounded swelling without surmounting definite keel or ridge, anterior and ventral margins bounded by a wide, high, outward- and downward-projecting, triple-layered, fimbriate or cancellated keel (two uppermost layers of keel decidedly frilled), venter excavated between the keels, perfectly preserved surface sparingly papillose, generally smooth.

Holotype left valve MCZ No. 4608; length: 1.17 mm; height: 0.70 mm, from Tulip Creek horizon, in Zone 35 of Oklahoma Highway 99 Simpson section.

Range: Many specimens were recovered from Tulip Creek outcrops.

Remarks: This species differs from the subspecies, *varicata* Harris, n. subsp., in absence of short keel surmounting post-ventral inflation of carapace, in its smaller size, and less papillose surface. *C. polytropis* Öpik possesses the cancellose ventral frill, but the species is smooth and the sulcus bifurcates near the dorsal margin. *C. loculata* Ulrich somewhat resembles the Simpson form in marginal frill, but the frill of the Kinderhook form is undulating and covers definite ventral cavities. *C. fulcrata* Ulrich displays a simple frill covering several small ventral cavities.

The varietal name is an adjectival form of the Latin word, cancelli, "latticework"; referring to the cancellate marginal frill.

CTENOLBINA CANCELLATA subsp. VARICATA Harris, n. subsp.

Plate 9, figures 3a-3b

Ctenobolbina sp. Harris, Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., fig. 42.

The subspecies differs from the type in its larger size, more papillose surface, and presence of an oblique, short, thin, keel on carapace inflation below and behind sulcus.

Holotype specimen MCZ No. 4609; length: 1.30 mm; height: 0.75 mm, from Bromide horizon, at top of Zone 24 of Oklahoma Highway 99 Simpson section.

Range: An index fossil of the Bromide (not in overlying Corbin Ranch), occurring quite commonly in the lower part thereof.

Remarks: This fimbriate, papillose ctenobolbine is one of the most striking of Bromide Ostracoda. In its ornate papillose surface and raised keel, it represents a development of the smoother type species in the underlying Tulip Creek. *C. subcrassa* Ulrich (Stones River) exhibits the raised oblique keel, but it lacks the cancellated marginal frill.

The subspecific name is the adjectival form of the Latin noun, varix, "a dilated vein"; referring to the short, oblique ridge surmounting post-ventral inflation of the carapace.

CTENOBOLBINA INFLATA Harris, n. sp.

Plate 9, figures 6a-6b

Ctenobolbina inflata Harris, Okla. City, Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., fig. 61.

Carapace small (approximating 1 mm in length), with typical ctenobolbine forward swing, thickest through subcentral inflation; dorsal margin and slightly channeled hingement straight; median to antero-median sulcus rather flatly excavated, though occasionally deepened, rather low tubercle antero-jacent to sulcus, region post-ventral to sulcus abruptly and roundly inflated into a prominent local bulb with ventral slope more abrupt than dorsal, a weakly developed, downward-projecting, alate keel lies on ventral and antero-ventral slope of female (not developed on male), venter excavated below peripheral keel, surface appears smooth, though earlier molts display extremely fine papillose development.

Holotype specimen MCZ No. 4610; length: 0.79 mm; height: 0.52 mm; thickness: 0.49 mm; paratype right valve MCZ No. 4611; length: 0.90 mm; height: 0.55 mm, from Tulip Creek horizon, in Zone 36 of Oklahoma Highway 99 Simpson section.

Range: Rather commonly occurring in Tulip Creek strata.

Remarks: This species differs from *C. abrupta* Harris, n. sp. in weaker development of peripheral flange and sulcus, more highly inflated subsulcate bulge, and straighter dorsal margin, simpler features suggestive of an ancestral form. *C. tumida* Ulrich, Cincinnatian species, displays entire posterior end strongly inflated.

The trivial name is obtained from the Latin adjective, inflatus, "inflated"; referring to the abruptly inflated post-ventral area of the carapace.

Note: Article 25 of International Code of Zoologic Nomenclature decrees as invalid the status of "new species" for a form illustrated, but undescribed, in any publication appearing since December 31, 1930. Accordingly, as suggested by the Rules for such a case, the original synonymic reference to this previously illustrated, though undescribed, species appears here "without date following the trivial name," thus permitting herein official establishment of the new species.

CTENOBOLBINA PARVA Harris, n. sp.

Plate 9, figures 5a-5c

Ulrichia minuta Harris (not Ulrich), Okla. City Geol. Soc., Field Conf., Guidebk., Nov. 21, 1936, 7th p., fig. 20; ibid. March 5-6, 1937, 4th, 5th pp., fig. 31.

Carapace tiny (less than 0.5 mm in length), subquadrate in lateral profile, with slight forward swing, highest posteriorly and thickest subcentrally; long, straight dorsal margin with slightly channeled hingement, ventral margin flatly convex, posterior slope fairly straight, noses broadly rounded, the posterior the more abrupt; left valve possibly overlaps right about free margins; prominent median to antero-median centrally depressed sulcus with antero-jacent tubercle and post-ventral elongate, obliquely rounded swelling, a small vertically-elongate, subperipheral node within posterior nose, a somewhat similar thin, fairly short, erect, alate, subperipheral keel within anterior nose, imperceptible spinose development of post-cardinal angle (post-cardinal spine and anterior keel are generally eroded), flatly convex surface finely reticulate.

Holotype specimen MCZ No. 4612; length: 0.40 mm; height: 0.25 mm; thickness: 0.17 mm, from Bromide horizon, 15 feet below top of Zone 10 of U. S. Highway 77 Simpson section.

Range: Not uncommonly occurring in upper Bromide (not in overlying Corbin Ranch).

Remarks: This species differs from *Bolbina tuberculata* Henningsmoen, from Ordovician of Norway, in its smaller size, possession of submarginal anterior keel and single submarginal node on posterior nose, and absence of prominent tubercles.

This minute form is the smallest of ctenobolbines in the Simpson section, and it is readily identifiable by minute size and the presence of a short, vertical keel on either nose of the species.

The trivial name is obtained from the Latin adjective, parva, "small"; referring to the minute size of the species.

Ctenobolbina percarinata Harris, n. sp.

Plate 9, figures 7a-7b

This small, compressed, obliquely subovate ctenobolbine with length twice the height is further characterized by a deep antero-median sulcus with minor antero-jacent tubercle, weakly developed subcentral inflation, downward- and but slightly outward-projecting peripheral keel, and finely papillose surface.

Holotype specimen MCZ No. 4613; length: 0.92 mm; height: 0.47 mm; paratype right valve MCZ No. 4613A; length: 0.80 mm; height: 0.50 mm, from Tulip Creek horizon, in Zone 36 of Oklahoma Highway 99 Simpson section.

Range: Several specimens recovered from Tulip Creek outcrops.

Remarks: This form differs from known representatives of the genus *Ctenobolbina* Ulrich in its small size and compressed carapace. It lacks the post-ventral inflation of *C. inflata* Harris, n. sp., and the short post-ventral keel of *C. abrupta* Harris, n. sp.

The trivial name is obtained from the Latin prefix, per, "very much, extreme", and carina, "keel"; referring to the diagnostic long, recurving, peripheral keel.

Ctenobolbina projecta Harris, n. sp.

Plate 9, figures 8a-8b

Ctenobolbina alata Harris (not Ulrich), Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., fig. 71.

Exceedingly inflated carapace with typical ctenobolbine forward and downward swing, maximum thickness through subcentral inflated wing exceeds maximum anterior height; flattened venter with weakly developed, outwardly projecting, thin, narrow peripheral keel that extends from antero-cardinal angle to a point well up posterior slope (anteriorly the keel also projects slightly downwardly), ventral bicanaliculation of carapace is exceedingly shallow, the anterior phase possibly the deeper; long, straight hingement slightly channeled, while free marginal contact is marked by peripheral beads; a most prominent surficial feature is a laterally projecting, subcentral, alate inflation below and behind a pronounced, recurved sulcus with antero-jacent tubercle, this post-ventral inflation is rather abruptly truncated ventrally and subacuminate posteriorly, surface apparently smooth, though possibly papillose.

Holotype cast MCZ No. 4614; length: 1.12 mm; height: 0.68 mm; thickness: 0.73 mm; paratype specimen MCZ No. 4614A; length: 0.97 mm; height: 0.56 mm; thickness: 0.61 mm, from McLish horizon, in middle of Zone 66 of Oklahoma State Highway 99 Simpson section.

Range: Recovered commonly from McLish shales in Zones 64-68 of Oklahoma State Highway 99 Simpson section.

Remarks: The species resembles *C. abrupta* Harris, n. sp. in inflation of post-ventral area, but the McLish species is more inflated, possesses a more subquadrate profile, straighter hingement, and more vertical sulcus.

The trivial name is obtained from the Latin word, projectio, "projecting"; referring to the pronounced laterally-projecting post-ventral inflation of carapace.

Genus WINCHELLATIA Kay, 1940

Genotype: *W. longispina* Kay, 1940

Ctenobolbina of authors (partim)

Winchellatia Kay 1940, Jour. Paleontology, vol. 14, pp. 234, 239, 241, 253-254; Schmidt 1941, Senckenberg. Naturforsch. Ges., Abh., vol. 454, pp. 34, 35; Cooper 1942, Jour. Paleontology, vol. 16, pp. 770, 771, 774; Hessland 1949, Upsala Univ. Geol. Inst., Bull., vol. 33, p. 205; Moore, Lalicker, and Fischer 1952, Invert. Foss., pp. 524-525, text fig. 14-2, 12a-b; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, pp. 207, 212, 225, 235, 236, 266; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 193.

Carapace rarely exceeding 1.5 mm in length, typically ctenobolbine in long, straight hingement, definite antero-median sulcus with antero-jacent tubercle, and distinct forward swing; post-ventral inflation of carapace produced into a prominent backward-projecting spine, surface otherwise smooth, reticulate, punctate, papillose, or spinose, female dimorph bearing peripheral keel.

Range: Ordovician.

Remarks: The genus is established for reception of ctenobolbine forms with prominent post-ventral spine, rather than simple inflation with or without surmounting keel.

WINCHELLATIA CORNUTA Harris, n. sp.

Plate 9, figures 4a-4b

Carapace obliquely subovate-elongate in lateral profile, with slight forward swing; maximum length immediately below the long, straight hinge line, highest through sulcus, thickest subcentrally; dorsal angles slightly exceeding right angles, the posterior possibly the flatter, ventral margin strongly convex with long, steeply truncated posterior slope and bluntly rounded anterior slope, posterior nose high and sharply rounded; long, slightly recurved antero-median sulcus widest dorsally, lower region of carapace slightly inflated on either side of sulcus, a close-lying, backward-projecting, short, blunt spine characterizes the post-ventral inflation, carapace excavated below spine, flatly convex surface coarsely reticulate.

Holotype specimen MCZ No. 4615; length: 1.20 mm; height: 0.65 mm, from Tulip Creek horizon, in Zone 35 of Oklahoma Highway 99 Simpson section.

Range: Recovered only from the Tulip Creek type locality.

Remarks: The species differs from *W. longispina* Kay in its less prominent spine, in larger size, and in its coarsely reticulate surface.

The trivial name is obtained from the Latin adjective, cornuta, "horned"; referring to the small, close-lying post-ventral spine of the species.

WINCHELLATIA LONGISPINA Kay, 1940

Plate 9, figures 9a-9d, 10, 11a-11d

Ctenobolbina ventrospinosa Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 21; ibid, March 5-6, 1937, 4th, 5th pp., fig. 25.

Winchellatia longispina Kay 1940, Jour. Paleontology, vol. 14, pp. 235, 236, 254, 255, pl. 32, figs. 1-5; Triebel 1941, Senckenbergiana, vol. 23, pp. 336, 338, 340, pl. 8, figs. 89-91; Moore, Lalicker, and Fischer 1952, Invert. Foss., pp. 524, 525, text fig. 14-2, 12a-b; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, p. 212.

Carapace small, with typical ctenobolbine forward swing, anterior end inflated; curving, centrally widened and depressed near-median sulcus extends obliquely downward across the carapace and accents the inflated base of a slightly flaring subcentral spine pointing downward and backward, a low antero-jacent node borders central pit of the sulcus; marginal face broadly excavated anteriorly and antero-ventrally between the finely and evenly beaded periphery and a narrow, downward-projecting near-peripheral keel extending from post-cardinal angle through anterior curvature (keel missing in male adults and in all smallest molts, beginning on intermediate female molt as a linear series of beads on low ridge); surface ordinarily worn smooth, apparently finely punctate or granulose in perfect specimen.

Hypotype female right valve MCZ No. 4616; length: 0.90 mm; height: 0.53 mm; hypotype female left valve MCZ No. 4616A; length: 0.92 mm; height: 0.60 mm; hypotype male cast MCZ No. 4616B; length: 0.70 mm; height: 0.37 mm, from Bromide horizon, 15 feet below top of Zone 10 of U. S. Highway 77 Simpson section.

Range: Rather commonly occurring in the Bromide.

Remarks: This species has been described from the Guttenberg member of the Decorah of Iowa. As in the Guttenberg, so in the Bromide, the species generally occurs in fragmentary condition.

Note: Article 25 of International Code of Zoologic Nomenclature decrees as invalid the status of "new species" for a form illustrated, but undescribed, in any publication appearing since December 31, 1930. Accordingly, as suggested by the Rules for such a case, the original synonymic reference to this previously illustrated, though undescribed, form appears here "without date following the trivial name," thus indicating official deference to the species *Winchellatia longispina* Kay, established in the interim.

Genus TRUBINELLA Pribyl, 1950

Genotype: *Hippa latens* Barrande, 1872

Hippa Barrande 1872, Syst. Silurian Centre Boheme, 1st part, suppl., p. 516; Vogdes 1890, U. S. Geol. Survey, Bull. 63, p. 163; Boucek 1936, Neues Jahrb., Mineralogie, Geologie, Paläontologie, Bd. 76, Abt. B, pp. 33, 146; Schmidt 1941, Senckenberg. Naturforsch. Ges., Abh, vol. 454, pp. 25, 34, 35; Cooper 1942, Jour. Paleontology, vol. 16, p. 774; Hessland 1949, Upsala Univ. Geol. Inst., Bull., vol. 33, p. 205; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, pp. 225, 249, 273; Ellis and Messina 1954, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 5; Howe 1955, La. State Univ., Phys. Sci. Ser. no. 1, p. 92.

Trubinella Pribyl 1951 (new name for *Hippa* Barrande 1872, non Fabricius 1787), Ceska Akad. Umeni (Acad. Tcheque Sci.), Bull. Internat., vol. 50, no. 9, p. 102.

Additional synonomy in Bassler and Kellett (1934, p. 328).

Carapace small, straight-hinged, obliquely subovate in lateral profile, with definite forward swing; valves apparently equal; surface characterized by weakly developed antero-median sulcus with antero-jacent tubercle, imperceptible peripheral keel, otherwise smooth, punctate, pustulose, reticulate, or spinose.

Range: Ordovician to Silurian.

Remarks: This genus represents a weakly developed *Ctenobolbina* Ulrich.

TRUBINELLA TEISI Harris, n. sp.

Plate 9, figures 12a-12b

Carapace small (approximating 1 mm in length), obliquely subovate in lateral profile, with slight forward and downward swing, thickest subcentrally; dorsal margin straight, ventral margin rather evenly curved, anterior end lower and more broadly rounded than posterior; hingeline narrowly channeled; valves apparently equal; antero-median sulcus with very weakly developed antero-jacent tubercle, valves slightly inflated below sulcus, imperceptible peripheral keel, venter definitely excavated in bicanaliculate fashion between peripheral keels, surface finely perforate.

Holotype specimen MCZ No. 4617; length: 0.67 mm; height: 0.42 mm; thickness: 0.38 mm; paratype specimen MCZ No. 4617A; length: 0.92 mm, from Bromide horizon, 120 feet below top of Simpson in the Fitts oil field of Oklahoma.

Range: This form has been recovered from a finely crystalline limestone bed (10 to 15 feet in thickness) immediately below the "first" Bromide sand of the Fitts field, or approximately 120 feet below the top of the formation. The known geographic range of the species includes T. 1 N., R. 7 E.; T. 1 N., R. 8 E.; and T. 1 N., R. 7 E.

Remarks: This species is tentatively assigned to the genus *Trubinella* Pribyl because of its weakly developed ctenobolbine features. The form differs from *Hippa latens* Barrande in its much smaller size, absence of peripheral beading, and more truncated posterior end.

The species is named in honor of Mr. M. R. Teis, geologist with Delta Petroleum Corporation, Tulsa, Oklahoma, who supplied the writer with type specimens.

Genus ACANTHOBOLBINA Harris, n. gen.

Genotype: *A. loeblichi* Harris, n. sp.

Small, equivalved, straight-hinged forms with surface smooth, punctate, reticulate or papillose; surface further characterized by a prominent median to submedian spine beneath a definite median to antero-median sulcate depression.

Range: Ordovician.

Remarks: This genus is related to ctenobolbine forms with long, straight hingement, forward swing, near-median sulcus, antero-Jacent tubercle, and peripheral keel. It appears to be an end member in ctenobolbine development. The genus differs from the genus *Winchellatia* Kay in the respect that the single lateral spine is located below (not behind) the sulcus, and projects outward (rather than posteriorly). The genus *Monoceratella* Teichert possesses the single, subcentral, laterally-projecting spine, but lacks the deep, near-median, sulcate depression.

The generic name is obtained from the Greek noun, akantha, "thorn", plus the Greek noun, bulbos, "a bulb", plus the Latin suffix, ina, "denoting likeness"; referring to a bolbine form with subcentral spine.

ACANTHOBOLBINA LOEBLICHI Harris, n. sp.

Plate 9, figures 13a-13b

Small, equivalved, subquadrate, elliptical form with slight forward and downward swing; ends vertically truncated to form cardinal angles slightly exceeding 90 degrees, anterior end lower and more broadly rounded than posterior; central and subcentral part of carapace swollen, produced into an outward-projecting subcentral spine or horn, a semi-sulcate antero-median depression with obscure antero-jacent tubercle deeply indents the carapace above the spine; surface apparently smooth, periphery beaded.

Holotype specimen MCZ No. 4618; length: 0.87 mm; height: 0.45 mm, from Bromide horizon, 6 feet below top of Zone 3 of Rock Crossing Simpson section.

Range: Recovered from upper Bromide Zones 3 and 4 of Rock Crossing Simpson section.

Remarks: This species differs from *Neochilina binsenbachensis* Matern in the respect that the subcentral spine is below (not within) the sulcus, and has ctenobolbine forward swing (not bilaterally symmetrical). The species differs from *Monoceratella obliqua* Teichert, from the Ordovician of Greenland, in its distinct sulcus (rather than slight depression) above the spine, and in obtusely rounded (rather than alate) antero-cardinal angle.

This species is named in recognition of Simpson research by Dr. A. R. Loeblich, of the U. S. National Museum, Washington, D. C.

Genus BALLARDINA Harris, n. gen.

Genotype: *B. concentrica* Harris, n. sp.

Carapace small (less than 2 mm in length), compressed, thickest dorsally, elongate-ovate to obliquely subovate in lateral profile; hingement relatively long and straight, channeled; surface characterized by: a rather prominent antero-median lobate depression that may be enlarged posteriorly beneath the thickened dorsum, tubercle or short rim antero-jacent to sulcus, flattened venter with marginal thickening which, in some species, assumes the aspect of a narrow keel with adjacent peripheral channeling, surface otherwise smooth, punctate, reticulate, spinose, or pustulose.

Range: Ordovician.

Remarks: This genus is related to the genus *Ctenobolbina* Ulrich in its forward swing, antero-median sulcus with antero-jacent tubercle, and occasional peripheral keel. The genus differs from *Bassleratia* Kay in lacking a prominent antero-median knob, in its lobate sulcus, and peripheral keel.

The genus is named in honor of Mr. W. N. Ballard, consulting geologist in Oklahoma City, who aided Dr. C. E. Decker and the writer in the collection and identification of Simpson samples and fossils, respectively.

Ballardina concentrica Harris, n. sp.

Plate 10, figure 3

Carapace approximating 1.5 mm in length, flattened, obliquely subovate in lateral profile, with ctenobolbine forward swing, highest through center, thickest through dorsum; long, channeled, hingement centrally umbonate, dorsal surface widest behind center, cardinal angles subequal, the anterior perhaps more steeply truncated, ventral outline gently arcuate, convexity of peripheral flange exceeds convexity of body proper, posterior nose higher and more sharply rounded than lower, broader anterior end; surface characterized by narrow, erect, marginal keel (with bordering channel) that extends from antero-cardinal angle to a point approximately halfway up posterior slope, the generic character of oblique, lobate, antero-median depression is located between mid-height and hingement, the depression continues backward to the posterior quarter of carapace in a broad reniform curve, depression is bounded above by elongate swelling of dorsum and below by a narrow, erect ridge that displays tendency to connect anteriorly and posteriorly with dorsal swelling, a small rounded pit with weakly developed antero-jacent tubercle characterizes front end of wide depression, surface widely channeled between peripheral and inner ridges, finely punctate.

Holotype right valve MCZ No. 4619; length: 1.27 mm; height: 0.78 mm, from Oil Creek horizon, 15 feet below top of Zone 86 of U. S. Highway 77 Simpson section.

Range: Joins and Oil Creek.

Remarks: This species represents a development of its contemporary, *B. minuta* Harris, n. sp. It differs in its larger size and in development of lobate depression with bordering concentric ridge. With slight development of inner concentric ridge and localized "horse-shoe"-lobed sulcus this form develops into *Bellornatia mclishi* Harris, n. sp., from the McLish formation.

Ballardina minuta Harris, n. sp.

Plate 10, figure 1

The average length of this species is 0.7 to 1 mm. It resembles *B. concentrica* Harris, n. sp., its larger successor in the Oil Creek, in shape, dorsal thickening, and marginal ridge with adjacent channeled depression; it differs from the larger form in weaker development of surficial features (with exception of distinct dorsal, lobate depression and pronounced antero-jacent tubercle). Peripheral keel is limited to ventral and antero-ventral margins; the reniform dorsal sulcate depression is locally developed and does not extend backward beyond the median line, a semi-ridged swelling borders anterior and ventral sides of the sulcus; surface finely punctate.

Holotype right valve MCZ No. 4620; length: 0.70 mm; height: 0.46 mm, from Joins horizon, in Zone 69 of West Spring Creek Simpson section.

Range: Joins and lower Oil Creek.

Remarks: With increased size, posterior extension of lower part of sulcus, and development of concentric ridges this small form might become *B. concentrica* Harris, n.sp.; it is entirely possible that the larger species develops through molt stages of *B. minuta* Harris, n. sp.

The trivial name is obtained from the feminine form of the Latin adjective, minuta, "minute"; referring to the tiny size of the species.

Ballardina simplex Harris, n. sp.

Plate 9, figure 16; Plate 10, figure 2

Carapace small (approximating 1 mm in length), flattened, subquadrate to elongate-ovate in lateral profile, thickest through post-dorsal umbonation, highest in front of center; dorsal margin rather evenly and gently arched above long, channeled hingement, cardinal angles slightly exposed, the post-cardinal angle more abrupt, ventral margin gently convex (ventral margin of molt subparallel to dorsum), anterior end more produced than posterior and more sharply rounded; surface characterized by a prominent, obliquely lobate or reniform, antero-median sulcus with distinct antero-jacent tubercle (sulcus of molt substantially reduced in depth and size), carapace somewhat inflated post-dorsally, ventral and antero-ventral surface flattened with bordering, rounded peripheral thickening which extends well up posterior slope, surface slightly channeled and depressed within peripheral ridge, otherwise punctate.

Holotype right valve MCZ No. 4621; length: 0.95 mm; height: 0.62 mm; paratype right valve MCZ No. 4621A; length: 0.90 mm; height: 0.58 mm, from Oil Creek horizon, above middle of Zone 89 of U. S. Highway 77 Simpson section.

Range: Oil Creek.

Remarks: This species differs from its contemporary, *B. concentrica* Harris, n. sp., in its lower sulcate depression, more quadrate outline, and absence of distinct ridge about sulcus. Being quite variable in surficial features, the species displays gradation from rounded to lobate sulcus, shallow to deep channel, and elongate to ovate outline.

Genus HAPLOBOLBINA Harris, n. gen.

Genotype: *H. arcuata* Harris, n. sp.

Small, straight hinged carapace with anterior end produced and rounded in possible forward swing, posterior nose higher and more acutely angled; venter flattened beneath strong post-ventral inflation, thus effecting wedge-shaped dorsal and anterior profiles; surface smooth, punctate, reticulate, pustulose, or spinose, and further characterized by a low-to-prominent node immediately below the median hingement (possibly within a shallow depression), secondary low node or nodes may occur near cardinal angles.

Range: Ordovician.

Remarks: The genus differs essentially from *Aechmina* Jones and Holl in the respect that the near-median dorsal node is not produced into the characteristic aechmine spine; further differentiation is noted in the flattened or channeled venter, rather than the appressed aechmine venter. The genus *Neochilina* Matern displays a single prominent node located near mid-point of a carapace symmetrical in lateral profile, rather than a node located near hingeline of a carapace with definite forward swing.

The generic name involves the combination of the Greek adjective, aploos, "simple", plus the Greek noun, bolbos, "a bulb", plus the Latin suffix, ina, "denoting likeness"; referring to the simple bulb-like or bolbine appearance of the carapace.

HAPLOBOLBINA ARCUATA Harris, n. sp.

Plate 8, figures 6a-6c

Long, straight-hinged carapace, obliquely subelliptical in lateral profile, with ctenobolbine forward swing, noticeably inflated in the lower regions below and behind the center; anterior end rather evenly and gracefully rounded, posterior nose at acute cardinal angle, decidedly truncated along lower slope; a prominent, low node lies within a shallow basin immediately below and before mid-point of hingeline, a second, low, obscure node lies in antero-cardinal angle; wide, somewhat flattened venter slightly excavated or channeled near peripheral contact, surface otherwise finely reticulate or perforate.

Holotype right valve MCZ No. 4622; length: 0.95 mm; height: 0.57 mm, from Oil Creek horizon, in Zone 84 of U. S. Highway 77 Simpson section.

Range: Rarely occurring in the Oil Creek.

Remarks: The species is ctenobolbine in lateral profile (definite forward swing and high posterior nose); furthermore, it displays the inflated post-ventral area and flattened or channeled venter, features observed on many ctenobolbine species. The form differs from representatives of the genus *Ctenobolbina* Ulrich in lacking the pronounced sulcus with antero-jacent tubercle.

The trivial name is obtained from the Latin word, arcuata, "a curvature, arch" referring to the graceful curvature of the free margins in lateral profile.

Family *BEYRICHIIDAE* Ulrich, 1894

Genus DICRANELLA Ulrich, 1894

Genotype: *D. bicornis* Ulrich, 1894

Ulrichia Jones (partim) 1893 (not 1890), Geol. Soc. London. Quart. Jour., vol. 49, p. 294, pl. 12, figs. 15, 16.

Dicranella Ulrich 1894, Geology Minn., vol. 3, pt. 2, p. 664; Zittel 1915, Grundzuge der Paläontologie, Abt. 1 (Invert.), p. 594; Kay 1940, Jour. Paleontology, vol. 14, pp. 239, 241, 260; Schmidt 1941, Senckenberg. Naturforsch. Ges., Abh., vol. 454, pp. 24, 28; Cooper 1942 Jour. Paleontology, vol. 16, pp. 770, 774; Shimer and Shrock 1948, Index Foss. North Amer., p. 669; Ellis and Messina 1952, Catalogue Ostracoda, Amer. Mus. Nat.

Hist., Spec. Publ., vol. 1; Moore, Lalicker, and Fischer 1952, Invert. Foss., pp. 526, 527, text fig. 14-3, 6a-b; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, pp. 219, 267; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 61; Kesling 1955, Univ. Mich., Contrib. Mus. Paleontology, vol. 12, no. 13, pp. 261, 262, 266.

Additional synonomy in Bassler and Kellett (1934, p. 286).

Carapace generally less than 2 mm in length, elongate-ovate to elliptical in lateral profile; hinge straight; surface characterized by two diverging dorsal horns which, in some forms, are separated by a slight pit or sulcus, female with broad frill-like "brood-pouch", surface smooth, papillose, punctate, reticulate, or spinose.

Range: Ordovician.

DICRANELLA FRAGILIS Harris, n. sp.

Plate 7, figures 5, 6

Dicranella bicornis Harris (not Ulrich) 1931, Okla. Acad. Sci., Proc., vol. 12, pp. 58, 59, pl. 13, fig. 7; Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 24; ibid, March 5-6, 1937, 4th, 5th pp., fig. 23.

This species is similar to *D. bicornis* Ulrich in outline, proportions, and "brood-pouch"; it differs in its smaller size, with horns rounded in section, rather than triangular, absence of prominent basal swelling on anterior horn, and the fact that outline of valve body is defined by the abrupt inner margin or face of the high-standing "brood-pouch" platform, instead of being defined by a linear ridge; surface very finely papillose in perfect specimens, generally eroded smooth.

Holotype right valve MCZ No. 4623; length: 1.07 mm; height: 0.75 mm; paratype right valve MCZ No. 4623 A; length: 1.05 mm; height: 0.77 mm, from Bromide horizon, near base of Zone 22 of Oklahoma Highway 99 Simpson section.

Range: An index fossil of the upper 60 to 100 feet of the Bromide (not in Corbin Ranch).

Remarks: The trivial name is obtained from the Latin adjective, fragilis, "brittle, fragile"; referring to the delicate nature of the carapace and horns.

Dicranella macrocarinata Harris, 1931

Plate 7, figures 7a, 7b, 8a, 8b

Dicranella macrocarinata Harris 1931, Okla. Geol. Survey, Bull. 55, p. 92, pl. 14, figs. 3a, b; Bassler and Kellett 1934, Geol. Soc. Amer., Spec. Pap. no. 1, p. 286; Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 29; ibid, March 5-6, 1937, 4th, 5th pp., fig. 36.

This form, averaging 1.5 mm in length, occurs rather commonly in the Tulip Creek, probably ranging into basal Bromide. Though papillose in the perfect specimen, the outcrop specimen is generally eroded smooth. The heavy, subparallel horns are characteristic of the species. The slender, non-pouched dimorph (male) occurs less commonly than the pouched female.

Holotype female left valve; length: 1.41 mm; height: 1.05 mm; paratype female right valve MCZ No. 4624A; length: 1.37 mm; height: 1.11 mm, from Tulip Creek horizon, in Zone 36 of Oklahoma Highway 99 Simpson section.

Remarks: This species is more rugged than *D. fragilis* Harris, n. sp.; it is papillose, and the lower part of the carapace is not abruptly depressed at the contact of the inner margin of the "brood-pouch".

Genus EURYCHILINA Ulrich, 1889

Genotype *E. reticulata* Ulrich, 1889

Eurychilina Ulrich 1889, Geol. Surv. Canada, Contr. Can. Micro. Paleontology, pt. 2, p. 52; Ruedemann 1901-1902, N. Y. State Mus., Bull. 49, p. 76, pl. 5, fig. 3; Bassler 1913, 1927, 1937, Zittel-Eastman Textbk. Paleontology, 2nd ed., p. 738; Zittel 1915, Grundzüge der Paläontologie, Abt. 1 (Invert.), p. 594; Öpik 1935, Univ. Tartu, Geol. Inst., Publ. no. 44, p. 9; 1937, ibid, no. 50, pp. 21, 22, 29; Teichert 1937a, Meddel. om Gronland, Bd. 119, no. 1, p. 50; 1937b, Univ. Copenhagen, Mus. Mineralogy, Geology, Commun. Paleontology, no. 59, p. 109; Kay 1940, Jour. Paleontology, vol. 14, pp. 239, 241, 249, 251, 262; Schmidt 1941, Senckenburg. Naturforsch. Ges., Abh., vol. 454, pp. 28, 33; Cooper 1942, Jour. Paleontology, vol. 16, pp. 767, 774; Shimer and Shrock 1948, Index Foss. North Amer., p. 673; Warthin 1948, Jour. Paleontology, vol. 22, p. 645; Hessland 1949, Upsala Univ. Geol. Inst., Bull., vol. 33, pp. 121, 124, 126-128, 130, 144, 205, 253, 254; Ellis and Messina 1952, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 1; Moore, Lalicker, and Fischer 1952, Invert. Foss., pp. 526, 527, text fig. 14-3, 13a-b; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, pp. 227, 228, 267; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 75.

Additional synonomy in Bassler and Kellett (1934, p. 313).

Carapace oblong to semi-elliptical in lateral profile, hinge-line long and straight, surface characterized by a deep antero-median sulcus with low, antero-jacent knob, wide frill circumvents free margin of shell, "brood-pouch" well developed in female, surface otherwise smooth, reticulate, papillose, punctate, or spinose.

Range: Ordovician to Devonian.

EURYCHILINA CULTRATA Harris, n. sp.

Plate 7, figures 11a-11b

Eurychilina sp. Harris, Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp. fig. 73.

Carapace symmetrically elliptical in lateral profile, averaging 1 mm in height, maximum dimensions through center; ventral surface and ends flatter and produced laterally into a high-standing, outward-projecting, peripheral, carinate wing with maximum development at venter, a deep median to antero-median sulcus dies out near dorsal margin, knob antero-jacent to sulcus is indistinct surficially, but well displayed internally; evenly convex surface exceptionally strongly inflated.

Holotype right valve MCZ No. 4625; length: 1.60 mm; height: 0.93 mm; thickness: 0.47 mm, from McLish horizon, at top of Zone 68 of Oklahoma Highway 99 Simpson section.

Range: Recovered only from McLish Zones 66-68 of Oklahoma Highway 99 Simpson section.

Remarks: The species differs from *E. reticulata* Ulrich in wider and more upright keel.

The trivial name is adapted from the Latin word, culter, "a knife"; referring to the ventral carinate wing of the species.

Eurychilina papillata Harris, n. sp.

Plate 7, figures 9, 10a-10b

Dimorphic carapace elongate-elliptical, with slight forward swing, female relatively higher than male because of "brood-pouch", thickest through "eye tubercle" and in the areas below and behind the sulcus; long straight dorsal contact of valves even, flattened ventral surface bearing a row of beads bordering either side of the contact, ventral surface of "brood-pouch" also flatly truncated and bordered laterally by an alate process of approximately 30 closely-spaced outward-projecting spines (well developed in female, more bead-like in male), "brood-pouch" of female extends from post-ventral area to a point halfway up anterior slope.

Holotype male specimen MCZ No. 4626; length: 1.55 mm; height: 0.87 mm; paratype female right valve MCZ No. 4626A; length: 1.67 mm; height: 1.02 mm, from Bromide horizon, 6 feet below top of Zone 3 of Rock Crossing Simpson section.

Range: This species was recovered only from Bromide Zones 3 and 5 ? from the Rock Crossing Section.

Remarks: This species differs from *E. reticulata* Ulrich in a papillose (rather than reticulate) surface, in possession of peripheral beads, and in absence of radii in marginal wings.

The trivial name is the adjectival form of the Latin noun, papilla, "nipple, pimple"; referring to the surficial pimples or papilli.

Eurychilina simplex Harris, n. sp.

Plate 7, figures 13a-13b

Carapace tiny for the genus (averaging 1 mm in length), with maximum thickness through "eye tubercle"; a deep, narrow antero-median sulcus lies behind a prominent tubercle whose lower and anterior slopes grade evenly into the convexity of the carapace, but whose upper and posterior slopes are abruptly emphasized by the dorsal slope of the carapace and the deep sulcus, respectively; the lower rim of the sulcus is slightly depressed, with sloping (rather than vertical) plunge into the pit proper, a thin and narrow keel of uniform width and with radiating canali circumvents the free margins of the carapace; surface apparently smooth, possibly punctate or granulose.

Holotype left valve MCZ No. 4627; length: 1.01 mm; height: 0.60 mm; paratype right valve MCZ No. 4627A; length: 1.05 mm; height: 0.60 mm, from Oil Creek horizon, in Zone 64 of West Spring Creek Simpson section.

Range: Recovered only from the Oil Creek.

Remarks: This small umbonate form is an ancestral eurychilinid of the Simpson. Many exfoliated specimens have been recovered from Oil Creek cuttings and cores in Oklahoma and West Texas. The species differs from other eurychilinids in its small size and apparently smooth surface.

The trivial name is obtained from the Latin adjective, simplex, "simple"; referring to the simple unornate character of the carapace.

EURYCHILINA SUBRADIATA Ulrich, 1890

Plate 7, figures 12a-12c, 14a-14c

Eurychilina subradiata Ulrich 1890, Cin. Soc. Nat. Hist., Jour., vol. 13, pt. 1, p. 126, pl. 9, figs. 1a-c, 2a-c; Coryell 1927, Ostracoda Plates and Figures, Columbia Univ., N. Y., vol. 1, p. 87, pl. 44, figs. 3, 4; ibid, p. 109, pl. 9, figs. 1, 2; Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 18; ibid, March 5-6, 1937, 4th, 5th pp., figs. 34a-b; Kay 1940, Jour. Paleontology, vol. 14, pp. 236, 250, pl. 31, fig. 5; Huffman 1945, Jour. Geology, vol. 53, p. 160; Prouty 1946, A.A.P.G., Bull., vol. 30, pp. 1177, 1118; Shimer and Shrock 1948, Index Foss. North Amer., p. 675, pl. 283, figs. 17-19; Ellis and Messina 1952, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 1.

Eurychilina reticulata Harris (not Ulrich) 1931, Okla. Acad. Sci., Proc., vol. 12, pp. 58, 59, pl. 13, fig. 2.

Eurychilina radiata Harris, Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., figs. 33a-b.

Additional synonomy in Bassler and Kellett (1934, p. 316).

The outstanding characteristic of this flattened, fragile species is its thin, wide, marginal keel flaring downward and outward from male carapace or from "brood-pouch" of female. A wide, flatly excavated surficial channel between body of female carapace and peripheral keel marks the area of the underlying "brood-pouch". The Bromide forms are not distinctly pitted, as in Ulrich's type from the Decorah of Minnesota, though indistinct depressions are discernible.

Hypotype male left valve MCZ No. 4628; length: 1.70 mm; height: 0.97 mm; hypotype female left valve MCZ No. 4628A; length: 1.84 mm; height: 1.37 mm, from Bromide horizon, near base of Zone 22 of Oklahoma Highway 99 Simpson section.

Range: Lower and middle Bromide.

Remarks: The more commonly occurring male dimorph is identified by the absence of marginal "brood-pouch", peripheral flange obscuring no underlying pouch, but arising directly from the outer margin of the carapace.

EURYCHILINA VENTROSA Ulrich, 1894

Plate 7, figures 15a-15c

Eurychilina ventrosa Ulrich 1894, Geology Minn., vol. 3, pt. 2, p. 662, pl. 45, figs. 1-3; Coryell 1927, Ostracoda Plates and Text Figures, Columbia Univ., N. Y., vol. 1, p. 95, pl. 45, figs. 1-3; Ulrich 1927, Okla. Geol. Survey, Bull. 45, p. 15; Harris 1931, Okla. Acad. Sci., Proc., vol. 12, pp. 58, 59, pl. 12, fig. 6; Bassler and Kellett 1934, Geol. Soc. Amer., Spec. Pap. no. 1, p. 317; Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 8; ibid, March 5-6, 1937, 4th, 5th pp., figs. 16a-b; Kay 1940, Jour. Paleontology, vol. 14, pp. 236, 250, pl. 31, fig. 21; Shimer and Shrock 1948, Index Foss. North Amer., p. 675, pl. 283, figs. 21-22; Ellis and Messina 1952, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 1. Additional synonomy in Bassler and Kellett (1934, p. 317).

This elongate, flattened, subsymmetrical form is characterized by antero-ventral and ventral peripheral "brood-pouch" without attached lateral wings. The "eye tubercle" is obscure. The species ordinarily appears smooth, though occasionally exhibiting coarse pores.

Hypotype left valve MCZ No. 4629; length: 1.79 mm; height: 1.02 mm; hypotype specimen MCZ No. 4629A; length: 1.61 mm; height: 0.90 mm, from Bromide horizon, near base of Zone 22 of Oklahoma Highway 99 Simpson section.

Range: This is a somewhat commonly occurring, though generally fragmentary, form in the upper Tulip Creek and Bromide (not in topmost Corbin Ranch).

Genus BROMIDELLA Harris, 1931

Genotype: *B. reticulata* Harris, 1931

Bromidella Harris 1931, Okla. Geol. Survey, Bull. 55, p. 93; Bassler and Kellett 1934, Geol. Soc. Amer., Spec. Pap. no. 1, pp. 20, 223; Swartz 1936, Jour. Paleontology, vol. 10, pp. 546, 548; Kay 1940, ibid, vol. 14, pp. 240, 241, 263; Schmidt 1941, Senckenberg. Naturforsch. Ges., Abh., vol. 454, pp. 24, 28, 32, 33; Cooper 1942, Jour. Paleontology, vol. 16, p. 774; Moore, Lalicker, and Fischer 1952, Invert. Foss., pp. 524, 525, text fig. 14-2, 4a-b; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, pp. 226, 227, 267; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 24; Kesling 1955, Univ. Mich., Contrib. Mus. Paleontology, vol. 12, no. 13, pp. 266, 268.

Carapace dimorphic, attaining a length of 2 mm, subovate in lateral profile; long straight hingement deeply channeled; surface possesses eurychiline antero-median sulcus with antero-jacent knob; a curved, inflated ridge lies on dorsum; periphery bordered by frill, keel, or spines ("brood-pouch" on female dimorph), surface otherwise reticulate, papillose, punctate, or possibly smooth.

Range: Ordovician.

Remarks: This genus was oriented originally with sulcus, adjacent tubercle, and peripheral "brood-pouch" considered features of the posterior end. Such orientation is now reversed, since sulcus and antero-jacent tubercle are now considered characteristics of the anterior end.

The genotype of *Primitia* Jones and Holl is now recognized as *Beyrichia strangulata* McCoy. This form, *Primitia strangulata* (McCoy), so closely resembles the genus *Uhakiella* Öpik that the latter must be assigned to the genus *Primitia* Jones and Holl. The strong dorsal ridge of the genus *Bromidella* Harris differentiates it from the genus *Primitia* Jones and Holl. *Bromidella linarssoni* Hessland, lacking the strong dorsal bar, displays closer affinity to *P. strangulata* (McCoy) and, accordingly, should be assigned to the genus *Primitia* Jones and Holl.

The genus *Bromidella* Harris differs from the genus *Eobromidella* Harris, n. gen. in its less eurychiline lateral profile and in its more inflated dorsal ridge and more spinose surface and periphery.

BROMIDELLA RETICULATA Harris, 1931

Plate 8, figure 3

Bromidella reticulata Harris, Okla. Geol. Survey, Bull. 55, p. 93, pl. 14, figs. 6a, 6b; 1931 Okla. Acad. Sci., Proc., vol. 12, pp. 57, 59, pl. 13, fig. 6; Bassler and Kellett 1934, Geol. Soc. Amer., Spec. Pap. no. 1, pp. 21, 223, fig. 7 (11); Swartz 1936, Jour. Paleontology, vol. 10, p. 548, pl. 78, figs. 12a, 12b; Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 31; ibid, March 5-6, 1937, 4th, 5th pp., fig. 45; Kay 1940, Jour. Paleontology, vol. 14, pp. 235, 263; Triebel 1941, Senckenbergiana, vol. 23, nos. 4-6, pp. 348, 361, pl. 2, fig. 133; Schmidt 1941, Senckenberg. Naturforsch. Ges., Abh., vol. 454, p. 33, pl. 5, figs. 43a-b; Levinson 1950, Jour. Paleontology, vol. 24, pp. 66-67; Moore, Lalicker, and Fischer 1952, Invert. Foss., pp. 524, 525, text fig. 14-2, 4a-b.

The genus *Bromidella* Harris was established in 1931 upon evidence of many specimens of *B. reticulata* Harris from Zones 20 to 22 of U. S. Highway 77, and 35 to 48 of Oklahoma Highway 99 Simpson sections, respectively. At that time these aforementioned zones were considered within the Bromide formation, and the genus *Bromidella* Harris accordingly appropriately named. Subsequent research has convinced the writer that these so-called Bromide zones are of Tulip Creek age, with the ironic consequence of the species *B. reticulata* Harris being essentially a Tulip Creek index fossil . . . . . ranging into the lower Bromide, however. It does not occur in the Oil Creek, as previously reported in a typographical oversight.

The strong dorsal ridge of the species is barely distinguishable on small molts, and surficial spines are also subdued. The slender male dimorph is not as abundant as the pouched female.

Holotype female right valve MCZ No. 4630; length: 1.39 mm; height: 0.93 mm; hypotype male right valve MCZ No. 4630A; length: 1.32 mm; height: 0.75 mm, from Tulip Creek horizon, at top of Zones 36 and 35, respectively, of Oklahoma Highway 99 Simpson section.

BROMIDELLA SPIVEYI Harris, n. sp.

Plate 8, figure 2

Bromidella sp. Harris, Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., fig. 68.

Carapace sub-ovate (that of male elongate-elliptical), flatly convex, thickest behind the sulcus; straight hingement (with exception of angles) obscured by long, bromidelline, dorsal ridge that is thickened and highstanding in its anterior recurved portion and very slightly inflated in its posterior incurving portion immediately above and before post-dorsal angle, flattened and beveled dorsum of this ridge is faintly depressed centrally, sulcus narrow and deep with maximum dimensions at lower end, tubercle antero-jacent to upper part of sulcus is rounded and pronounced, "brood-pouch" about ventral and antero-ventral border of female specimen flattened basally and thickened on outer periphery by an irregularly and finely beaded keel, a low, indistinct, short, forward-projecting keel lies near the periphery of the anterior end of "brood-pouch", lowly convex ventral margin of male without "brood-pouch", entire surface papillose, that of dorsal ridge more finely so than the general surface.

Holotype female left valve MCZ No. 4632; length: 1.12 mm; height: 0.82 mm; paratype male right valve MCZ No. 4632A; 1.17 mm; height: 0.75 mm, from McLish shale, at base of Zone 61 of Oklahoma Highway 99 Simpson section.

Range: McLish shales.

Remarks: This species differs from *Bromidella reticulata* Harris in its smaller size, less pronounced surficial nodes and spines, and rather uniform dorsal plication; it undoubtedly represents an ancestral form of the larger and more ornate bromidellid.

This species honors Dr. R. C. Spivey, geologist with Shell Oil Company, Los Angeles, California, in acknowledgment of his research with Iowa Maquoketa Ostracoda.

Genus EOBROMIDELLA Harris, n. gen.

Genotype: *E. eurychilinoides* Harris, n. sp.

Carapace elongate-elliptical in lateral profile (2 to 3 mm in length), eurychiline in shape, profile, sulcus, and peripheral pouch (female); rather localized antero-median sulcus with antero-jacent tubercle, a pronounced, narrow dorsal bar of fairly uniform width and height projects slightly above the major portion of the long, straight hingement, the bar is recurved downward at anterior and posterior ends, typical eurychiline "brood-pouch" on female, most species possessing strong peripheral keel, surface otherwise smooth, punctate, spinose, reticulate, or pustulose.

Range: Ordovician.

Remarks: This genus possesses the dorsal bar of the genus *Bromidella* Harris, but the bar is not abnormally inflated terminally, being narrow, elongate, and rather uniform in width and height across the dorsum. Again, the genus is more elongate-elliptical (eurychiline), rather than elongate-ovate, as in *Bromidella* Harris. The deep sulcus varies from subcircular to elongate in shape. The genus resembles the genus *Laccochilina* Hessland in lateral profile, sulcus with antero-jacent tubercle, and peripheral keel, it differs essentially in the presence of the characteristic elongate-dorsal bar. The species, *Laccochilina centrotuberculata* Hessland, *L. dorsoplicata* Hessland, and *L. tarda* Henningsmoen should be assigned to the new genus.

The Greek prefix, eo, in the generic name indicates early or ancestral status.

Eobromidella eurychilinoides Harris, n. sp.

Plate 8, figures 1a-1b

Valve elongate-elliptical in lateral profile, with length approximately twice the height, maximum dimensions through strongly inflated submedian body; a low, elongate, straight, narrow, bluntly-rounded, keel-like, bromidelline dorsal ridge projects beyond and obscures the mid-three-fourths of the long, straight hingement, this ridge is flattened dorsally and beveled inward, termini of the ridge bend downward and merge gradually into the long slope of the upper half of the carapace, anterior downward extension of ridge longer and more abruptly recurved, antero-median sulcus deep and wide, deepest toward the base, upper end of sulcus with prominent, rounded, antero-jacent tubercle, entire free margin circumvented by a wide outward- and downward-projecting carinate keel that displays maximum development ventrally, entire surface (excepting peripheral keel) definitely papillose.

Holotype left valve MCZ No. 4631; length: 2.00 mm; height: 1.20 mm, from Tulip Creek horizon, in Zone 10a from Sycamore Creek Simpson section.

Range: Rarely occurring at its type locality in the Tulip Creek.

Remarks: This species displays close relationship with the genus *Eurychilina* Ulrich in general characteristics of shape, frill, sulcus, tubercle, and straight hingement; hence, the trivial name. The species differs from *Eobromidella* (*Laccochilina*) *tarda* (Henningsmoen) Harris, from the Ordovician of Norway, in its smaller size, more pronounced sulcus, and smaller antero-jacent tubercle. The Simpson form is larger than *Eobromidella* (*Laccochilina*) *dorsoplicata* (Hessland) Harris, from the lower Ordovician of Sweden, and possesses more coarsely papillose surface.

Genus COELOCHILINA Ulrich and Bassler, 1923

Genotype: *Eurychilina aequalis* Ulrich, 1890

Eurychilina of authors (partim)

Coelochilina Ulrich and Bassler 1923, Md. Geol. Survey, Silurian vol., p. 303; Bassler and Kellett 1934, Geol. Soc. Amer., Spec. Pap. no. 1, pp. 20, 245; Teichert 1937, Meddel. om Gronland, Bd. 119, no. 1, p. 50; Kay 1940, Jour. Paleontology, vol. 14, pp. 249, 251; Schmidt 1941, Senckenberg. Naturforsch. Ges., Abh., vol. 454, p. 28; Cooper 1942, Jour. Paleontology, vol. 16, p. 774; Shimer and Shrock 1948, Index Foss. North Amer., p. 673; Hessland 1949, Upsala Univ. Geol. Inst., Bull., vol. 33, p. 144; Moore, Lalicker, and Fischer 1952, Invert. Foss., pp. 524, 525, text fig. 14-2, 8; Ellis and Messina 1953, Catalogue Ostracoda, Amer. Museum Nat. Hist., Spec. Publ., vol. 2; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, pp. 228, 267; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 33.

Simple, elongate-ovate carapace with long, straight hingeline; surface with simple eurychiline sulcus, though lacking antero-jacent node; peripheral keel, frill, or "brood-pouch" present, surface otherwise smooth, punctate, pustulose, spinose, or reticulate.

Range: Ordovician to Silurian.

Coelochilina alata Harris, n. sp.

Plate 8, figures 4a-4c

Coelochilina A Harris, Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., figs. 8a-8b.

Carapace elongate-elliptical in lateral profile, with slight forward swing, maximum dimensions through center, ventral margin of body rather evenly and lowly convex, but outline of ventral frill more strongly convex, posterior nose slightly higher and sharper than anterior; hingement rather closely appressed; valves apparently equal; a downward- and outward-flaring keel bounds free margin of carapace except in post-cardinal area, frill attaining maximum development centrally and antero-ventrally, an imperceptible antero-median sulcate depression extends from dorsum to sub-median line (exceedingly weakly developed in some specimens), evenly convex surface finely punctate.

Holotype specimen MCZ No. 4633; length: 1.12 mm; height: 0.65 mm; thickness: 0.55 mm, from Corbin Ranch horizon, in Zone 4 of Oklahoma Highway 99 Simpson section.

Range: Topmost Corbin Ranch formation.

Remarks: The species somewhat resembles *Ctenobolbina ? dubia* Ulrich and Bassler (upper Silurian of Maryland) in lateral profile, weak sulcus, and peripheral keel, but the Oklahoma species is considerably larger (length, 1.50:1.00 and height, 1.00:0.62), is more bilaterally symmetrical, and possesses much wider and more flaring peripheral keel. The species differs from the genotype, *C. aequalis* (Ulrich), from the Ordovician of Kentucky, in the presence of the widely flaring peripheral keel, less distinct median sulcus, and in finely punctate surface.

The trivial name is obtained from the Latin adjective, alata, "winged"; referring to the widely flaring keel about free margins.

Coelochilina alatispinata Harris, n. sp.

Plate 8, figures 5a-5b

The smooth, forward-inclined carapace is further characterized by a peripheral keel extending from anterior through postcentral margins, the keel terminating behind mid-venter in a short horn pointing downward, outward, and slightly backward, the alar flange conforms in general to the convexity of the carapace, is but slightly incurved ventrally to form "brood-pouch" in female, and contains radiate rods or pores; a short, produced, flaring flange is located apparently on post-cardinal nose.

Holotype right valve MCZ No. 4634; length: 0.90 mm; height: 0.50 mm, from Tulip Creek horizon, 10 feet below top of Zone 31 of Oklahoma Highway 99 Simpson section.

Range: Recovered only from the type zone in the Tulip Creek.

Remarks: The species differs from the genotype, *C. aequalis* (Ulrich) (Ordovician of Kentucky), in the presence of the prominent post-ventral spine as termination of the peripheral keel, in less pronounced sulcus, in smaller size, and presence of post-cardinal alar extension. It differs from *Ctenobolbina projecta* Harris, n. sp. in presence of the prominent post-ventral spine and in smaller size.

The trivial name is obtained from the feminine form of the Latin adjectives, alata, "winged", and spinata, "spined"; referring to the peripheral keel or wing that terminates in a post-ventral spine.

Family *KLOEDENELLIDAE* Ulrich and Bassler, 1923

Genus BALTICELLA Thorslund, 1940

Genotype: *B. oblonga* Thorslund, 1940

Balticella Thorslund 1940, Sver. Geol. Unders., ser. c, no. 436, (Arsbok 34, no. 6), pp. 179-180; Agnew 1942, Jour. Paleontology, vol. 16, p. 757; Cooper 1942, Jour. Paleontology, vol. 16, p. 774, Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1. p. 15.

Original description: "Valves with long and straight hinge line, a primitioid sulcus somewhat behind the middle, the right valve overlapping the left, at least along the ventral side". Additional observations involve the following: Carapace elongate-ovate, inflated, with long straight hingement possibly channeled posteriorly, anterior end gracefully rounded and recurved to form a dorsal "prow", left valve overlaps right about free margins; surface smooth, punctate, reticulate, hispid, spinose, or pustulose, and further characterized by a prominent horn-like node in slight antero-median sulcate depression.

Range: Ordovician.

Remarks: This genus appears related to such genera as *Kloedenia* Jones and Holl, and *Welleria* Ulrich and Bassler, though possessing a more irregular dorsal profile, more pronounced ventral overlap, and more pronounced antero-median node. The orientation herein is the reverse of the original conception.

BALTICELLA DECKERI (Harris), 1931

Plate 8, figures 7a-7c

Leperditella ? deckeri Harris 1931, Okla. Geol. Survey, Bull. 55, p. 89, pl. 14, figs. 5a-5c; Bassler and Kellett 1934, Geol. Soc. Amer., Spec. Pap. no. 1, p. 373; Triebel 1941, Senckenbergiana, vol. 23, nos. 4-6, p. 312, pl. 3, figs. 28a-b.

Kloedenia ? deckeri Harris, Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., figs. 28a-b.

This species is limited to the Bromide formation (not in overlying Corbin Ranch). It is shorter and more inflated than the subspecies *elongata* Harris, n. subsp., from the underlying Tulip Creek. The genotype, *B. oblonga* Thorslund, from the Chasmops (Ordovician) of Sweden, is slightly larger, displays deeper sulcus and tuberculate surface.

Holotype specimen; length: 1.40 mm; height: 0.86 mm; thickness: 0.71 mm; hypotype specimen MCZ No. 4635; length: 1.31 mm; height: 0.85 mm; thickness: 0.76 mm, from Bromide horizon, at top of Zone 24 of Oklahoma Highway 99 Simpson section.

BALTICELLA DECKERI subsp. ELONGATA Harris, n. subsp.

Plate 8, figure 8

The subspecies differs from *B. deckeri* (Harris) in its more slender-elongate outline and straighter and longer contact of ventral overlap.

Holotype specimen MCZ No. 4636; length: 1.37 mm; height: 0.77 mm; thickness: 0.72 mm, from Tulip Creek horizon, in Zone 36 of Oklahoma Highway 99 Simpson section.

Range: The subspecies occurs in the Tulip Creek, as an ancestral form of *B. deckeri* (Harris) in the overlying Bromide.

Remarks: The subspecific name is obtained from the Latin adjective, elongata, meaning "elongate or extended"; referring to the slender-elongate carapace.

Genus GLYMMATOBOLBINA Harris, n. gen.

Genotype: *G. quadrata* Harris, n. sp.

Carapace sub-quadrate in lateral profile, flatly convex; straight-hinged, possibly umbonate; prominent antero-median sulcus with antero-jacent knob and an additional knob behind antero-cardinal angle, surface smooth, striate, punctate, reticulate, pustulose, or hispid.

Range: Ordovician.

Remarks: This genus possesses the deep sulcus of ctenobolbine and some kloedenellid species. It differs essentially from the genus *Kloedenella* Ulrich and Bassler, a close affinity, in more pronounced primary sulcus and less pronounced secondary sulcus; furthermore, the tubercle antero-jacent to primary sulcus is more isolated in the new genus.

The generic name is obtained from the Greek noun, glymmatos, "engraved or carved figure", plus the Greek word, bolbos, "a bulb", plus the Latin suffix, ina, "denoting likeness"; referring to the engraved or carved appearance in surficial nodes and depressions.

Glymmatobolbina quadrata Harris, n. sp.

Plate 8, figures 9a-9c

Kloedenia A Harris, Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th., 5th. pp., fig. 38.

Carapace flattened, subquadrate in all normal profiles; longest through center, highest through posterior umbonation, thickest post-ventrally; post-cardinal angle practically a right angle, antero-cardinal angle more rounded; the slightly inflated areas behind and below the sulcus are flattened dorsally and ventrally, respectively; surface characterized by a deep antero-median sulcus that is widest above, deepest behind, and recurved below a prominent, adjacent, rounded knob, a low rounded knob projects slightly above hingement behind antero-cardinal angle, surface smooth, possibly perforate.

Holotype left valve MCZ No. 4637; length: 1.57 mm; height: 0.95 mm, from Bromide horizon, in top of Zone 24 of Oklahoma Highway 99 Simpson section.

Range: Recovered only from the type zone in the Bromide.

Remarks: The species is readily identified by its subquadrate profile, deep sulcus, and rather flatly convex carapace. It lacks the post-ventral truncation and peripheral flange of ctenobolbine species.

The trivial name is obtained from the Latin adjective, quadratus, "squared"; referring to the subquadrate lateral profile of the species.

Family *ACRONOTELLIDAE* Swartz, 1936

Genus MONOCERATELLA Teichert, 1937

Genotype: *M. teres* Teichert, 1937

Monoceratella Teichert 1937, Rept. 5th Thule Exped. 1921-1924, vol. 1, no. 5, pp. 113, 114: Meddel. om Gronland, Bd. 119, no. 1, pp. 53, 54; Agnew 1942, Jour. Paleontology, vol. 16, p. 759; Cooper 1942, ibid, vol. 16, p. 775; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, pp. 234, 236, 269; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 122.

Carapace small (attaining a length of 2 mm), elongate-elliptical to subquadrate in lateral profile, with slight forward swing and higher posterior end; long, straight hingement channeled in many forms; surface smooth, punctate, reticulate, pustulose, hispid, or rugose, and further characterized by a laterally projecting submedian node or spine and possible slight thickening or nodose development near antero-cardinal angle.

Range: Ordovician.

Remarks: This genus appears somewhat similar to the genus *Balticella* Thorslund in its ctenobolbine lateral profile, though lateral spine occupies a ventral, rather than dorsal, position.

MONOCERATELLA BREVISPINATA Harris, n. sp.

Plate 8, figures 10a-10b

Carapace medium-sized (approximately 1.5 mm in length), elongate-ovate in lateral profile, with ctenobolbine forward and downward swing; dorsal margin slightly umbonate centrally and incised behind antero-cardinal node, ventral margin roundly truncated posteriorly, anterior end broadly rounded and low, posterior end more sharply rounded and high; long hingement straight and channeled; an outward-projecting, short, stout spine is located behind mid-point of ventral slope, a rounded node or bulge at antero-cardinal angle, rather gently convex surface with coarse, irregular perforations.

Holotype right valve MCZ No. 4638; length: 1.37 mm; height: 0.87 mm, from Tulip Creek horizon, in Zone 36 of Oklahoma Highway 99 Simpson section.

Range: Recovered rarely in the type zone of the Tulip Creek.

Remarks: The Simpson species lacks the long spine of the Canadian Ordovician form, *M. teres* Teichert.

The trivial name is obtained from the Latin words, brevis, and spinata, meaning "short spine", and referring to the abbreviated post-ventral spine of the species.

Family *TETRADELLIDAE* Swartz, 1936

Genus THOMASATIA Kay, 1934

Genotype: *T. falcicosta* Kay, 1934

Thomasatia Kay 1934, Jour. Paleontology, vol. 8, pp. 327, 328; 1940, ibid, vol. 14, p. 241; Schmidt 1941, Senckenberg. Naturforsch. Ges., Abh., vol. 454, pp. 50, 51; Agnew 1942, Jour. Paleontology, vol. 16, p. 760; Cooper 1942, ibid., p. 775; Shimer and Shrock 1948, Index Foss. North Amer., p. 669; Moore, Lalicker, and Fischer 1952, Invert. Foss., pp. 524, 525, text fig. 14-2, 9a-b; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, pp. 219, 267; Ellis and Messina 1954, Catalogue Ostracoda, Amer. Mus. Nat. Hist., Spec. Publ., vol. 4; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 185.

Carapace small (averaging less than 1 mm in length), subquadrate to subelliptical in lateral profile, with low, rounded, produced anterior nose, thickest through posterior quarter; hingement straight and slightly channeled; equivalved; surface characterized by: peripheral ridge about free margins that encloses and parallels a second similar and more elevated ridge, distinct antero-median sulcus with antero-jacent node, and smooth, papillose, punctate, or ridged inner region of the posterior quarter.

Range: Ordovician.

Remarks: The sulcus and its associated node are considered features of the anterior end, comparable to analogous features in such sulcate genera as *Ctenobolbina* Ulrich, *Primitiella* Ulrich, *Leperditella* Ulrich, *Eurychilina* Ulrich, and *Bromidella* Harris.

THOMASATIA AURICULA Harris, n. sp.

Plate 8, figures 11a-11b

Small carapace, equivalved, subrhomboidal in lateral profile, slightly incurved ventrally, deltoid in dorsal profile because of extreme height of posterior vertical ridge; hingement straight and channeled below irregular dorsal profile, anterior nose rounded, antero-dorsal and posterior margins obliquely truncated and subparallel, post-cardinal angle but slightly exceeding a right angle; surface characterized by papillose ridges and deep depressions; a continuous, low, rounded peripheral ridge closely borders free margins of the carapace except for slight invasion centroventrally, a second ridge that expands in width and height posteriorly rises anteriorly behind cardinal angle and, paralleling peripheral ridge, completely encircles a deep median sulcus with somewhat obliquely elongate antero-jacent knob, this ridge is generally suppressed or disconnected in the dorsal area immediately below and behind mid-point of hinge line, a third highest-standing posterior ridge rises within peripheral ridge on hingement in front of post-cardinal angle and in graceful curvature parallels and joins peripheral ridge in the post-ventral "Y" junction of the two aforementioned ridges, all ridges irregularly papillose, though often appearing smooth, depressions among the ridges broad and deep.

Holotype specimen MCZ No. 4639; length: 0.60 mm; height: 0.37 mm; thickness: 0.37 mm, from Bromide horizon, 6 feet below top of Zone 3 of Rock Crossing Simpson section.

Range: Recovered only from Bromide Zones 2 and 3 of Rock Crossing Simpson section.

Remarks: This species differs from *T. bromidensis* Harris, n. sp. in extreme height of posterior intermarginal ridge, papillose ridges, and isolated knob in front of sulcus. It is perhaps a provincial development of the genus.

The trivial name is obtained from the diminutive, auricula, "little ear", of the Latin noun, auris; referring to the ear-like appearance of the form with its various lobes and depressions.

THOMASATIA BROMIDENSIS Harris, n. sp.

Plate 8, figures 12a-12b, 16

Drepanella A Harris, Okla. City Geol. Soc., Field Conf. Guidebk., March 4-5, 1937, 4th, 5th pp., fig. 13.

Small, lowly convex carapace approximating 0.5 mm in length, subrhomboidal-ovate in lateral profile, ovate in dorsal profile, ends and dorsum and venter subparallel, respectively, thicker and higher posteriorly; antero-dorsal angle obtuse, post-dorsal angle slightly exceeding a right angle, anterior end gracefully rounded and produced below median line, thick posterior end sharply truncated and excavated behind vertical ridge; hingement contact narrowly grooved; valves apparently equal; a continuous low, rounded keel circumvents entire periphery of carapace, a second similar keel rises at hinge line behind antero-cardinal angle and, with subcircular sweep subparallel to outer ridge, circumvents widened antero-median sulcate depression and again joins dorsal margin behind mid-point, this second, inner keel is inflated (occasionally bulbous) posteriorly, constricted, suppressed, or missing immediately below post-median hingement connection, and ventrally separated from peripheral keel by narrow channeling, the sulcate antero-jacent tubercle assumes the proportions of a short, knob-like protuberance ventrally invading the wide sulcate depression from the lower curve of the inner ridge, knob often sub-isolated, posteriorly the dorsal keel continues about carapace above posterior channeling and fuses ventrally into the straight edge of the second keel, depressed surface among the ridges apparently smooth.

Holotype specimen MCZ No. 4640; length: 0.55 mm; height: 0.32 mm; thickness: 0.30 mm; paratype left valve MCZ No. 4640A; length: 0.57 mm; height: 0.35 mm, from Bromide horizon, in Zone 24 of Oklahoma Highway 99 Simpson section.

Range: Commonly occurring in the Bromide formation.

Remarks: This species differs from *T. auricula* Harris, n. sp. in its less contrasting posterior inflation, absence of papilli on the ridges, and the fact that antero-jacent node of the sulcus is generally connected basally to the adjacent ridge.

THOMASATIA SIMPLEX Harris, n. sp.

Plate 8, figures 15, 17a-17b

Drepanella sp. Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 28.

Drepanella simplus Harris, Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., fig. 43.

Flatly convex carapace approximating 0.5 mm in length, obliquely subrhomboidal in lateral profile, wedge-shaped in dorsal profile (thickest post-ventrally); posterior half of dorsal margin lowly umbonate above straight, slightly depressed hingement, ventral margin slightly incised centrally, but otherwise parallel to dorsum, anterior end gracefully rounded and produced below median line, antero-dorsal and post-ventral slopes truncated and parallel, posterior end truncated, with thickened periphery, post-cardinal angle approximately a right angle; surface chaacterized by a rounded peripheral ridge about free margins that is most prominent anteriorly and ventrally, a distinct irregularly crescentiform sulcus with low antero-jacent inclined posterior platform of carapace is generally more-or-less smooth and slightly inflated, but in some mature forms it consists of a bulbous post-median body bounded posteriorly and circumvented by a thickened lowly rounded band or ridge that continues forward ventrally to circumvent sulcus and node and dwindle into the hinge line behind antero-cardinal angle.

Holotype left valve MCZ No. 4641; length: 0.50 mm; height: 0.30 mm; paratype right valve MCZ No. 4641A; length: 0.55 mm; height: 0.31 mm, from Tulip Creek horizon, in Zone 36 of Oklahoma Highway 99 Simpson section.

Range: Rather commonly occurring in the Tulip Creek.

Remarks: The majority of the representatives of this species are simple in surficial irregularities, but some of the advanced forms are rugose to the extent that they exhibit a cytherelloidean appearance.

This species occurs stratigraphically lower than the more ornate species, *T. auricula* Harris, n. sp., and *T. bromidensis* Harris, n. sp.

The trivial name is obtained from the Latin word, simplex, "simple"; referring to the relatively simple ornamentation of the species.

Note: Article 25 of International Code of Zoological Nomenclature decrees as invalid the status of "new species", for a form illustrated, but undescribed, in any publication appearing since December 31, 1930. Accordingly, as suggested by the Rules for such a case, the original synonymic reference to this previously illustrated, though undescribed, species appears here "without date following the trivial name", thus permitting herein official establishment of the new species.

Genus BASSLERATIA Kay, 1934

Genotype: *B. typa* Kay, 1934

Bassleratia Kay 1934, Jour. Paleontology, vol. 8, pp. 328, 341, 343; 1940, ibid, vol. 14, p. 241; Schmidt 1941, Senckenberg. Naturforsch. Ges., Abh., vol. 454, pp. 50, 51; Agnew 1942, Jour. Paleontology, vol. 16, p. 757; Cooper 1942, ibid, p. 774; Shimer and Shrock 1948, Index Foss. North Amer., p. 669; Moore, Lalicker, and Fischer 1952, Invert. Foss., pp. 524, 525, text fig. 14-2, 2a-b; Henningsmoen 1953, Norsk. Geol. Tidsskr., Bd. 31, pp. 219-221, 267; Ellis and Messina 1954, Catalogue Ostracoda, Amer. Museum. Nat. Hist., Spec. Publ., vol. 4; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 15.

Carapace small (averaging less than 1 mm in length), subelliptical in lateral profile; equivalved; long hingement straight and slightly channeled; surface characterized by two prominent features: an entire marginal ridge that encloses a second subparallel ridge or inflation suspended from the hinge line, and a shallow antero-median sulcus with enclosed low knob (sulcus and knob are considered anterior features).

Range: Ordovician.

Remarks: The description of this genus is very similar to that of the genus *Thomasatia* Kay, the essential difference involving the notation of the more pronounced inner ridge of the latter. The genus *Thomasatia* Kay is apparently a more conservative ancestor of the genus *Bassleratia* Kay.

BASSLERATIA CORRUGATA Harris, n. sp.

Plate 8, figures 13a-13b

Carapace tiny, subovate with slight retral swing, inflated, thickest behind center; dorsal margin straight except for possible faint umbonation post-centrally, ventral margin evenly arcuate, cardinal angles obtuse and apparently equal, ends rather evenly rounded, the posterior the lower, more produced, and more broadly rounded; hingement slightly channeled; valves apparently equal; a low, rounded peripheral keel circumvents the entire carapace, invading it slightly posteriorly and attaining weakest development dorsally, a second similar keel beginning within antero-cardinal angle is suspended from the dorsal margin within and parallel to the outer keel and, separated therefrom by a shallow channel of approximately constant width, circumvents free margins and rejoins dorsum post-centrally, this second keel is weakly developed post-dorsally; in a narrow antero-dorsal sulcus lies a gibbous, vertically-elongate knob, with a short, horizontal, bar-like development extending posteriorly from either extremity, the upper bar is shorter and occasionally inflated posteriorly.

Holotype specimen MCZ No. 4642; length: 0.55 mm; height: 0.35 mm; thickness: 0.27 mm, from Oil Creek horizon, 26 feet above base of Zone 48 of West Spring Creek Simpson section.

Range: Rare in upper Oil Creek.

Remarks: This species differs from *B. typa* Kay in smaller size, in more symmetrically elliptical dorsal profile, in pronounced retral swing, and in less rugose central area.

The trivial name is an adjectival form of the Latin verb, corrugo, "to fold or wrinkle"; referring to the corrugated lateral surface.

Genus TETRADELLINA Harris, n. gen.

Genotype: *T. henningsmoeni* Harris, n. sp.

Tiny, subquadrate, straight hinged, equivalved forms characterized by four vertical ridges that are not united ventrally; surface otherwise smooth, punctate, reticulate, papillose, or spinose.

Range: Ordovician.

Remarks: This tiny genus differs from the genus *Tetradella* Ulrich in the fact that the vertical ridges are not united basally.

It differs from the genus *Zygobolboides* Spivey in the possession of four ridges, rather than three.

The generic name is obtained by addition of Latin suffix, ina, "resembling", to the generic stem, tetradell.

TETRADELLINA HENNINGSMOENI Harris, n. sp.

Plate 8, figures 14a-14b

Carapace tiny (averaging 0.5 mm in length), subquadrate in lateral profile, highest and thickest through post-median ridge; dorsal margin straight except for projecting ridge, ventral margin broadly and evenly rounded, sharply rounded at ventral angles, dorsal angles subequal, the post-dorsal angle slightly exceeding 90 degrees, anterior end more gracefully rounded than posterior; hingement contact flush and compressed, entire carapace pinched dorsally; left valve faintly overlaps right about free margins; surface bears four distinct keels; one at either end and parallel to the margins, a third short, upright, antero-median keel lies on the lower part of the carapace, a fourth and longest upright keel lies slightly behind the mid-line and projects backward above the hinge line, anterior keel with maximum curvature, others subparallel, smooth surface depressed among the keels.

Holotype specimen MCZ No. 4643; length: 0.50 mm; height: 0.30 mm; thickness: 0.27 mm, from Bromide horizon, 10 feet below top of Zone 10 of U. S. Highway 77 Simpson section.

Range: Rarely occurring in the Bromide.

Remarks: This species differs from species of the genus *Tetradella* Ulrich in its isolated ridges (not connected basally).

The species is named in honor of Dr. Gunnar Henningsmoen, Paleontological Museum, University of Oslo, Norway, in recognition of his research with Ordovician and Silurian Ostracoda of Norway.

Family *BEECHERELLIDAE* Ulrich, 1894

Genus KRAUSELLA Ulrich, 1894

Genotype: *K. inaequalis* Ulrich, 1894

Krausella Ulrich 1894, Geology Minn., vol. 3, pt. 2, p. 691; Boucek 1936, Neues Jahrb. Mineralogie, Geologie, Paläontologie, Abt. B., Bd. 76, p. 72; Veen 1936, Natuurhistorisch Maandblad, 25e, Jrg. nos. 11-12, p. 46; Kay 1940, Jour. Paleontology, vol. 14, pp. 237, 241, 266-268; Triebel 1941, Senckenbergiana, vol. 23, nos. 4-6, p. 372; Cooper 1942, Jour. Paleontology, vol. 16, p. 775; Shimer and Shrock 1948, Index Foss. North Amer., p. 682; Ellis and Messina 1952, Catalogue Ostracoda, Amer. Museum Nat. Hist., Spec. Publ., vol. 1; Moore, Lalicker, and Fischer 1952, Invert. Foss., pp. 524, 525, text fig. 14-2, 5a-b; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 106.

Additional synonomy in Bassler and Kellett (1934, p. 369).

Carapace attaining a length of 3 mm or more, elongate-ovate in lateral profile; left valve larger than right and overlapping it about entire periphery with exception of posterior end, which is produced into a spine.

Range: Ordovician to Silurian.

Remarks: This genus differs from the genus *Rayella* Teichert in possession of dorsal overlap; in the latter genus the left valve fails to overlap the right valve along the dorsal margin, though projecting slightly above it.

Krausella arcuata Ulrich, 1894

Plate 10, figures 5a-5c

Krausella arcuata Ulrich 1894, Geology Minn., vol. 3, pt. 2, p. 691, pl. 44, figs. 47-53; Coryell 1927, Ostracoda Plates and Text Figures, Columbia Univ., N. Y., vol. 1, p. 87, pl. 44, figs. 47-53; Bassler 1932, Tenn. Geol. Survey, Bull. 38, pp. 65-68; Harris, Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., figs. 46a-b; Kay 1940, Jour. Paleontology, vol. 14, pp. 235, 237, 267, 268; Shimer and Shrock 1948, Index Foss. North Amer., p. 682, pl. 286, figs. 51-55; Ellis and Messina 1952, Catalogue Ostracoda, Amer. Musium Nat. Hist., Spec. Publ., vol. 1; Moore, Lalicker, and Fischer 1952, Invert. Foss., pp. 524, 525, text fig. 14-2, 5a-b.

Additional synonomy in Bassler and Kellett (1934, p. 370).

This large, highly arched, elongate form averaging 2 mm in adult length, displays hingement tightly appressed, not channeled.

Hypotype specimen MCZ No. 4644; length: 1.77 mm; height: 0.85 mm; thickness: 0.72 mm, from Bromide horizon, 6 feet below top of Zone 3 of Rock Crossing Simpson section.

Range: Not uncommonly occurring throughout the Bromide (not in overlying Corbin Ranch).

Remarks: This species is a contemporary of *Rayella calvini* Kay, from which it differs in its appressed, instead of channeled, hingement. Both species are preceded in the Tulip Creek by *R. calvini* Kay subsp. *parva* Harris, n. subsp., characterized by channeled hingement and smaller size.

Genus RAYELLA Teichert, 1939

Genotype: *Basslerites hanseni* Teichert, 1937

Basslerites Teichert (not Howe) 1937, Meddel. om Gronland, Bd. 119, no. 1, p. 5.

Rayella Teichert 1939, Jour. Paleontology, vol. 13, p. 622; Kay 1940, ibid, vol. 14, pp. 237, 241, 267, 268; Agnew 1942, ibid, vol. 16, p. 760; Howe 1955, La. State Univ. Stud., Phys. Sci. ser. no. 1, p. 164.

Carapace attaining a length of 3 mm or more, elongate-ovate in lateral profile, elliptical to subquadrate in transverse section; hingement straight and channeled below straight or slightly convex dorsal umbonation; left valve strongly overlaps right valve along the ventral side and slightly overlaps it anteriorly and posteriorly, dorsally the left valve tends to project slightly above right, right valve possesses acute posterior prolongation or nose beyond margins of the left valve; surface smooth or punctate.

Range: Ordovician.

Remarks: This genus is closely related to the genus *Krausella* Ulrich; differing in that the left valve (though generally projecting beyond) does not overlap right along the dorsal margin.

Rayella calvini Kay, 1940

Plate 10, figures 6a-6c

Krausella arcuata Harris (not Ulrich), Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 15.

Krausella arcuata Harris (not Ulrich) var. *B* Harris, Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., figs. 29a-b.

Rayella calvini Kay 1940, Jour. Paleontology, vol. 14, pp. 237, 268, pl. 34, figs. 32-34.

Carapace elongate-ovate in lateral profile, subquadrate in transverse section, somewhat flattened dorsally and ventrally (especially true of smaller right valve), maximum height and thickness through center, inflated to the extent that thickness approximates the height; dorsal and ventral margins of smaller right valve rather straight and subparallel, dorsal and ventral margins of larger left valve gently convex and projecting beyond corresponding margins of right, ventral projection the more pronounced, terminal noses produced below median line, posterior nose or spine of smaller right valve short and rather bluntly pointed; left valve overlaps right about free margins, generally projecting above dorsal margin of right (occasionally dorsal margins are even); hingement deeply and widely channeled, hingement not exceptionally elongate, and terminating at points approximately equi-distant from either end; surface smooth.

Hypotype specimen MCZ No. 4645; length: 1.62 mm; height: 0.77 mm; thickness: 0.77 mm, from Bromide horizon, in Zone 26 of Oklahoma Highway 99 Simpson section.

Range: Rather commonly occurring throughout the Bromide formation (not in Corbin Ranch).

Remarks: This species is characterized by its subquadrate outline in transverse section, its deeply channeled hingement, and subparallel dorsal and ventral margins. It differs from *Krausella inaequalis* Ulrich in its channeled hingement, in its centralized maximum thickness, and in its subquadrate (rather than subtriangular) sectional profile. This species differs from *Rayella hanseni* (Teichert), from the Wright Bay formation of Greenland in its quadrate (rather than elliptical) sectional profile, and in its smaller size (length 1.79:2.40 and height 0.85:1.20). Furthermore, the posterior nose of the genotype is more produced and upturned than that of the Simpson species. The Bromide form appears slightly higher and thicker than the type species described by Kay from Ion of Iowa and Minnesota, and is possibly more subquadrate in section; it may be varietal.

A smaller subspecies of this form occurs in the underlying Tulip Creek, and a tiny ancestral form, *R. minuta* Harris, n. sp., occurs in upper Oil Creek and lower McLish.

RAYELLA CALVINI Kay subsp. PARVA Harris, n. subsp.

Plate 10, figure 7

This subspecies is smaller than *R. calvini* Kay, averaging 1.4 mm in length. It possesses a subcircular (rather than subquadrate) transverse-sectional profile; dorsal margins of opposite valves appear fairly even above a shallow and less flaring channeled hingement.

Holotype specimen MCZ No. 4646; length: 1.35 mm; height: 0.65 mm; thickness: 0.60 mm, from Tulip Creek horizon, at base of Zone 34 of Oklahoma Highway 99 Simpson section.

Range: Commonly occurring in the Tulip Creek.

Remarks: The subspecific name is obtained from the Latin adjective, parva, "little, small"; referring to the small size of the carapace.

RAYELLA MINUTA Harris, n. sp.

Plate 10, figures 8a-8b

Carapace tiny for the genus (approximating 1 mm in length), elongate-ovate in lateral profile, roundly elliptical to subquadrate in transverse section; dorsal and ventral margins gently convex, those of smaller right valve straighter and subparallel (dorsal edge is slightly thickened and faintly arcuate centrally), ends bluntly rounded, posterior nose of smaller right valve short and neatly pointed, often obliterated; hingement deeply channeled, slightly flaring; surface smooth.

Holotype specimen MCZ No. 4647; length: 1.05 mm; height: 0.45 mm; thickness: 0.47 mm, from McLish shales, 12 feet below top of Zone 47 of West Spring Creek Simpson section.

Range: This species ranges from the upper 100 to 200 feet of the Oil Creek into the lower 200 feet of the McLish. It has been recovered from a Crockett County, Texas, Oil Creek core at a depth of 7,097 feet.

Remarks: This species differs from *R. calvini* Kay and its subspecies, *parva* Harris, n. subsp., in its smaller size. The three forms undoubtedly represent a line of development characterized by a channeled hingeline and rather straight ventral and dorsal margins.

Genus PLATYRHOMBOIDES Harris, n. gen.

Genotype: *P. quadratus* Harris, n. sp.

Equivalved, straight hinged forms, trapezoidal in lateral profile and triangular in transverse section, thickest through peripheral edge of flattened venter; surface smooth, punctate, reticulate, papillose, or spinose.

Range: Ordovician.

Remarks: This form resembles the genus *Beecherella* Ulrich in its flattened base and triangular transverse section, but it differs in the absence of the peripheral carinae and terminal spinose projections.

The generic name is obtained from the Greek words, platys, "flat, broad", rhombos, "rhomb", and suffix, oides, "resembling"; referring to the flattened base and rhomboidal lateral profile, respectively.

PLATYRHOMBOIDES QUADRATUS Harris, n. sp.

Plate 10, figures 4a-4c

Bythocypris ? quadratus Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 3.

Carapace trapezoidal in lateral and lanceolate in dorsal profiles, respectively; thickest through center of basal periphery, anterior slope imperceptibly steeper than posterior, though posterior end is slightly higher, ventral surface flattened, with sharply angled periphery; long hinge line narrowly channeled; valves apparently equal; surface smooth.

Holotype specimen MCZ No. 4648; length: 0.87 mm; height: 0.32 mm; thickness: 0.35 mm, from Bromide horizon, 15 feet below top of Zone 10 of U. S. Highway 77 Simpson section.

Range: Several specimens recovered from upper Bromide zones of U. S. Highway 77 and West Spring Creek Simpson sections.

Remarks: In the flattened venter and trapezoidal lateral profile this species is unlike any other known ostracode. The base is not warped nor flattened by pressure, some half dozen perfectly preserved specimens displaying the characteristic flattened venter.

The trivial name is obtained from the Latin adjective, quadratus, "squared", quadrate"; referring to the subquadrate or trapezoidal lateral profile of the species.

Note: Article 25 of International Code of Zoological Nomenclature decrees as invalid the status of "new species" for a form illustrated, but undescribed, in any publication appearing since December 31, 1930. Accordingly, as suggested by the Rules for such a case, the original synonymic reference to this previously illustrated, though undescribed, species appears here "without date following the trivial name", thus permitting herein official establishment of the new species.

Family *BAIRDIIDAE* Sars, 1887

Genus BYTHOCYPRIS Brady, 1880

Genotype: *B. reniformis* Brady, 1880

Cytherellina Jones and Holl 1869, Ann. Mag. Nat. Hist., ser. 4, vol. 3, p. 215 (Genotype: *Beyrichia siliqua* Jones).

Bythocypris Brady 1880, Challenger Exped., Rept. Ostracoda, p. 45; Jones and Kirkby 1886, Geol. Soc. London, Quart. Jour., no. 42, p. 506; 1887, Geol. Assoc. London, Proc., vol. 9, p. 510; Jones and Sherborn 1889, Pal. Soc. London, Suppl. Monogr. Tert. Entomos., p. 16, Jones 1890, Geol. Soc. London, Quart. Jour., vol. 46, p. 2; Doeglas 1931, Wetenschappelijke van den Mijnbouw in Nederlandsch-Indie, no. 17, p. 34; Geis 1932, Jour. Paleontology, vol. 6, p. 179; van Veen 1934, Natuurhistorisch Maanblad, 23e, Jrg., nos. 7-10, p. 26; Bradfield 1935, Bull. Amer. Paleontology, vol. 22, no. 73, p. 94; Kellett 1935, Jour. Paleontology, vol. 9, p. 136; Kummerow 1939, Preuss. Geol. Landes., Abh., n. f., H. 194, p. 47; Kay 1940, Jour. Paleontology, vol. 14, pp. 241, 268; Cooper 1942, ibid, vol. 16, pp. 770, 772, 774; Scott 1944, Jour. Paleontology, vol. 18, pp. 167-169; Shimer and Shrock 1948, Index Foss. North Amer., p. 683; Hessland 1949, Upsala Univ. Geol. Inst., Bull., vol. 33, pp. 120, 365-367; Moore, Lalicker, and Fischer 1952, Invert.

Foss., pp. 540, 541, text fig. 14-12, 10a-b; Howe 1955, La. State Univ. Stud., Phys. Sci. Ser. no. 1, p. 25.

Bathocypris Vogdes 1890, U. S. Geol. Survey, Bull. 63, p. 154.

Bairdiocypris (subgenus) Kegel 1931, Preuss. Geol. Landes., Jahrb. 52, p. 246 (Genotype: *B. gerolsteinensis* Kegel).

Additional synonomy in Bassler and Kellett (1934, p. 224).

Carapace small, ovate-elongate in lateral profile, ovate-elliptical in transverse section; dorsal margin convex, ventral margin straight, occasionally slightly concave; left valve larger than right and overlapping it in most cases on both dorsal and ventral margins; surface smooth, punctate, granulose, reticulate, or hispid.

Range: Cambrian to Recent.

BYTHOCYPRIS CYLINDRICA (Hall) Ulrich, 1889

Plate 10, figures 11a-11c, 12

Cytherina cylindrica Hall 1852, Nat. Hist. N. Y. (Paleontology), vol. 214, p. 14, pl. 4, figs. 8a-b; Ellis and Messina 1953, Catalogue Ostracoda, Amer. Musium Nat. Hist., vol. 3.

Leperditia (*Isochilina*) *cylindrica* Hall 1871, N. Y. State Musium (Advance Sheets), p. 7, pl. 4, fig. 12; Grabau 1901, Buffalo Soc. Nat. Sci., vol. 7, no. 1, p. 218; Coryell 1927, Ostracoda Plates and Text Figures, Columbia Univ., vol. 1, p. 127, pl. 4, fig. 5.

Leperditia cylindrica (Hall) Miller 1874, Cin. Quart. Jour., vol. 1, pp. 122, 353; Jones 1890, Geol. Soc. London, Quart. Jour., vol. 46, p. 551.

Bythocypris cylindrica (Hall) Ulrich 1889, Geol. and Nat. Hist. Survey, Canada, Contr. Micro-Paleontology, pt. 2, p. 48, pl. 9, fig. 6; Jones 1890, Geol. Soc. London, Quart. Jour., vol. 46, pp. 6, 8; Ellis 1903, N. Y. State Musium, Bull. 66, Misc. 2, p. 540; Coryell 1927, Ostracoda Plates and Text Figures, Columbia Univ., vol. 1, p. 87, pl. 44, figs. 29-35; Harris 1931, Okla. Acad. Sci., Proc., vol. 12, pp. 57, 59, pl. 12, figs. 3a-3b; Kay 1934, Jour. Paleontology, vol. 8, pp. 329, 330; Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 5; ibid, March 5-6, 1937, 4th, 5th pp., fig. 21; Teichert 1937, Meddel. om Gronland, Bd. 119, no. 1, p. 61; Kay 1940, Jour. Paleontology, vol. 14, pp. 237, 268; Dalve 1948, Univ. Cincinnati Musium, Dept. Geology Geography, pp. 4, 8, 12, 15, 17, 23, 26, 31, 33, 37, 42, 46, 52, 54; Shimer and Shrock 1948, Index Foss. North Amer., p. 683, pl. 287, figs. 46-49; Hussey 1950, Mich. Geol. Soc., Annual Field Trip Guidebk., p. 15; Keenan 1951, Jour. Paleontology, vol. 25, p. 567, pl. 78, figs. 4, 8-13; Hussey 1952, Mich. Dept. Conserv., Geol. Survey Div., Publ. 46, Geol. ser. 39, pp. 42, 51.

Primitia minuta (partim) Jones 1890, Geol. Soc. London, Quart. Jour., vol. 46, p. 7, pl. 3, figs. 18-19.

Additional synonomy in Bassler and Kellett (1934, p. 226).

This tiny, smooth, elongate, elliptical form displays a variety of shapes ranging from symmetrically evenly arched dorsal and ventral margins to asymmetrically arched margins and plunging ends. The majority of the Simpson forms average 0.7 mm in length and 0.3 mm in height (one of Ulrich's types from the Galena of Minnesota was identical in these measurements, while another measured 1.30 mm in length and 0.65 in height). Ulrich noted that some specimens of the same species from beds stratigraphically higher (Cincinnatian) may display a length of 2 mm.

Hypotype specimen MCZ No. 4650; length: 0.81 mm; height: 0.34 mm; thickness: 0.28 mm; hypotype specimen MCZ No. 4650A; length: 0.65 mm; height: 0.31 mm, from Bromide horizon, at base of Zone 22 of Oklahoma Highway 99 Simpson section.

Range: Long range in Bromide and Tulip Creek.

BYTHOCYPRIS sp. cf. B. GRANTI Ulrich, 1894

Plate 10, figures 13a-13b

Bythocypris granti Ulrich 1894, Geology Minn., vol. 3, pt. 2, p. 689, pl. 44, figs. 39-42; Bassler 1915, U. S. Nat. Musium, Bull. 92, p. 150; Coryell 1927, Ostracoda Plates and Text Figures, Columbia Univ., N. Y., vol. 1, p. 87, pl. 44, figs. 39-42; Ulrich 1927, Okla. Geol. Survey, Bull. 45, p. 15; Bassler and Kellett 1934, Geol. Soc. Amer., Spec. Pap. no. 1, p. 227; Ellis and Messina 1952, Catalogue Ostracoda, Amer. Musium Nat. Hist., Spec. Publ., vol. 1.

Bythocypris cylindrica (Hall) var. *magnus* Harris, Okla. City Geol., Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., fig. 69.

Ulrich describes the species as an elongate, elliptical, smooth form with valves strongly convex, thickest ventrally, with posterior end slightly the more bluntly rounded.

The Simpson form agrees with the type in size and proportions, though some specimens are thicker posteriorly. Simpson forms display slightly channeled hingeline, a definite left valve overlap, and a more sharply rounded posterior end. Hingement and overlap are constant features, but lateral profile and area of maximum convexity vary slightly (some specimens symmetrically elliptical, with rather sharply rounded ends). Many specimens are distorted, a condition noted among other Ostracoda from McLish shale outcrops on Oklahoma Highway 99.

Hypotype specimen MCZ No. 4651; length: 0.95 mm; height: 0.50 mm; thickness: 0.47 mm, from McLish horizon, in Zone 66 of Oklahoma Highway 99 Simpson section.

Measurements of Ulrich's types from Minnesota: No. 1; length: 1.40 mm; height: 0.68 mm; thickness: 0.70 mm; No. 2; length: 1.17 mm; height: 0.57 mm; thickness: 0.60 mm.

Range: McLish shale Zones 66 to 68 of Oklahoma Highway 99 Simpson section. Ulrich records the species from the Decorah of Minnesota.

Remarks: It is entirely possible that this simple, smooth, conservative bythocyprid is not identical with the Decorah form from Minnesota, minor differences in hingement and profile possibly justifying varietal differentiation.

BYTHOCYPRIS ? SPINOSA Harris, n. sp.

Plate 10, figures 14a-14c

Bythocypris spinosa Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 1; ibid, March 5-6, 1937, 4th, 5th pp., fig. 26.

This smooth, ovate-elongate, sub-cylindrical and bluntly rounded form is characterized by the short and rather fragile backward-projecting spine situated below the median line on the posterior end of the smaller right valve. The dorsal contact of the valves along the straight hingeline is generally slightly channeled. Left valve overlaps the right about entire free margins, with maximum overlap ventral; dorsal margin of smaller right valve generally projects slightly above the opposite margin. The form is questionably bythocyprid because of the lack of true dorsal overlap of left valve.

Holotype specimen MCZ No. 4652; length: 0.92 mm; height: 0.50 mm; thickness: 0.45 mm, from Bromide horizon, in Zone 2 of Rock Crossing Simpson section.

Range: Long range in Bromide.

Remarks: This form may be mistaken for a molt of *Krausella arcuata* Ulrich, with which it occurs. Critical examination, however, reveals that the spine of the new species is a true spine, consistently tiny and fragile throughout an entire growth series. Furthermore, the spine is situated on the rounded nose and does not represent the pinched and sloping produced end of the valve proper, as in the genera, *Krausella* Ulrich and *Rayella* Teichert. The species closely resembles *Bythocypris* (*Rayella*) *brevicornis* (Keenan), from the Maquoketa of Missouri, differing apparently in its shorter spine being located lower on the post-ventral slope. *Primitiella unicornis* Ulrich is flattened, not subcylindrical in shape.

The trivial name is obtained from the Latin adjective, spinosa, "spiny, thorny"; referring to the posterior spine of the small right valve.

Note: Article 25 of International Code of Zoological Nomenclature decrees as invalid the status of "new species" for a form illustrated, but undescribed, in any publication appearing since December 31, 1930. Accordingly, as suggested by the Rules for such a case, the original synonymic reference to this previously illustrated, though undescribed, species appears here "without date following the trivial name", thus permitting herein official establishment of the new species.

Genus PUNCTAPARCHITES Kay, 1934

Genotype: *Cytheropsis rugosus* Jones, 1858

Cytheropsis McCoy, of authors (partim)
Primitia Jones and Holl, of authors (partim)
Cytherella Jones, of authors (partim)
Macronotella Ulrich, of authors (partim)
Punctaparchites Kay 1934, Jour. Paleontology, vol. 8, pp. 328, 331, 332, 343; 1940, ibid, vol. 14, p. 244; Schmidt 1941, Senckenberg. Naturforsch. Ges., Abh., vol. 454, p. 18; Agnew 1942, Jour. Paleontology, vol. 16, p. 760; Henningsmoen 1953, Norsk.

Geol. Tidsskr., Bd. 31, pp. 231, 268; Ellis and Messina 1954, Catalogue Ostracoda, Amer. Musium Nat. Hist., Spec. Publ., vol. 4; Howe 1955, La. State Univ. Stud., Phys. Sci. ser. no. 1, p. 161.

Carapace small (attaining a length of 2 mm), sub-oval in lateral profile, highly arched dorsal margin, ventral margin straight to slightly concave; hingement short, inclined, fairly straight along sloping dorsal edge; valves apparently equal, though on some forms the dorsal margin of the right valve projects faintly above that of the right; surface convex, with numerous distinct pits.

Range: Ordovician.

Remarks: Kay, in his original description of the genus, considered the straighter (to concave) edge the hinge line and the more pointed end the anterior. Such an orientation of the form would allocate it to the family Leperditellidae Ulrich and Bassler. The writer considers the highly arched margin the hinge line and the more broadly rounded end the anterior. Such a conception of the genus would assign it to the bythocyprid family of Bairdiidae Sars. Some bivalved specimens are slightly sheared dorsally, exposing a short, fairly straight, inclined edge along the mid-line of arched dorsum of right valve; this straight edge is considered the hinge line (apparently the right valve of some specimens is normally produced slightly above the hinge line). An illustration of the Recent species, *Cytherites insignipes* Sars, a fresh-water form from Canada, is introduced (Pl. 10, Fig. 17) for purpose of comparing orientation with *Punctaparchites rugosus* (Jones) Kay.

PUNCTAPARCHITES RUGOSUS (Jones) Kay, 1934

Plate 10, figures 15a-15b, 16

Cytheropsis rugosus Jones 1858, Ann. Mag. Nat. Hist., ser. 3, vol. 1, p. 249, pl. 10, fig. 5.

Primitia rugosa (Jones) Jones and Holl 1868, Ann. Mag. Nat. Hist., ser. 4, vol. 2, p. 55.

Cytherella ? rugosa Jones 1891, Geol. Survey Canada Contr. Micro-Paleontology, pt. 3, p. 99; Coryell 1927, Ostracoda Plates and Text Figures, Columbia Univ., vol. 1, p. 81, pl. 43, figs. 21-24.

Bythocypris arcta (Ulrich) Harris 1931, Okla. Acad. Sci., Proc., vol. 12, pp. 58, 59, pl. 13, fig. 8.

Punctaparchites rugosus (Jones) Kay 1934, Jour. Paleontology, vol. 8, pp. 329, 331, 332, pl. 44, figs. 1-4; 1940, ibid, vol. 14, p. 245.

Bythocypris seminalis Harris, Okla. City Geol. Soc., Field Conf. Guidebk., Nov. 21, 1936, 7th p., fig. 17.

Leperditella seminalis Harris, Okla. City Geol. Soc., Field Conf. Guidebk., March 5-6, 1937, 4th, 5th pp., fig. 41.

Macronotella rugosa (Jones) Kay 1940, Jour. Paleontology, vol. 14, pp. 236, 245, pl. 30, figs. 5, 6; Shimer and Shrock 1948, Index Foss. North Amer., p. 665, pl. 280, fig. 41.

Additional synonomy in Bassler and Kellett (1934, p. 280).

The species is highest anteriorly, the posterior nose being lower and more sharply rounded. Smooth, exfoliated specimens occur commonly.

Range: This is a commonly occurring index fossil of the Bromide. It occurs 100 to 150 feet below the top of the formation in a zone of corresponding thickness.

Hypotype specimen MCZ No. 4653; length: 0.85 mm; height: 0.60 mm; eroded hypotype specimen MCZ No. 4653A; length: 0.67 mm; height: 0.47 mm, from Bromide horizon, in Zone 11 of U. S. Highway 77 Simpson section.

Remarks: The species is recorded from the Hull formation of Ontario, the Prosser of Minnesota, Ion and Guttenberg of Iowa, and Leray (Black River) of Pauquette's Rapids, Ottawa River, Canada.

That the writer was confused regarding proper orientation of this form is evidenced by the difference in orientation of the species as sketched as *Bythocypris seminalis* Harris arched hingement) in 1936, and as *Leperditella seminalis* Harris (straight hingement) in 1937, the latter species being conceived by reason of the exfoliated condition of the carapace.

SUMMARY

Herein are described and illustrated 124 species and/or subspecies of Ostracoda belonging to 42 genera, which, in turn, are representative of 11 families. Stratigraphic ranges of the 124 forms are depicted on five separate charts.

Systematic List and Stratigraphic Range of Simpson Ostracoda

Family Leperditiidae Jones	
Genus *Eoleperditia* Swartz	
E. abrupta Harris, n. sp.	Oil Creek
E. fabulites (Conrad) Swartz	McLish to Corbin Ranch
E. inflativentralis Harris, n. sp.	Uppermost Bromide
E. magna Harris, n. sp.	McLish "birdseye"
E. mediumbonata Harris, n. sp.	Joins
E. mediumbonata subsp. *debilis* Harris, n. subsp.	Joins
E. ? obesiporosa Harris, n. sp.	Joins
E. ? perplexa Harris, n. sp.	McLish "birdseye"
E. simplex Harris, n. sp.	McLish "birdseye"
E. spicata Harris, n. sp.	Oil Creek
E. subcarinata Harris, n. sp.	Oil Creek
Family Leperditellidae Ulrich and Bassler	
Genus *Aparchites* Jones	
A. maccoyii (Salter) Jones	Tulip Creek and Bromide
A. millepunctatus (Ulrich)	Tulip Creek and Bromide
Genus *Paraparchites* Ulrich and Bassler	
P. ? circulantis Harris, n. sp.	Bromide
Genus *Hyperchilarina* Harris, n. gen.	
H. angularis Harris, n. sp.	Tulip Creek
H. nodosimarginata Harris, n. sp.	Tulip Creek and Bromide
H. ovata Harris, n. sp.	Tulip Creek
H. symmetrica Harris, n. sp.	McLish shale
Genus *Leperditella* Ulrich	
L. aequilatera (Ulrich)	Corbin Ranch
L. altiforma Harris, n. sp.	Tulip Creek
L. brookingi Harris	Joins
L. bulbosa (Harris)	Oil Creek
L. cooperi Harris	Joins
L. gibba Harris, n. sp.	Oil Creek
L. incisa Harris, n. sp.	Bromide

L. ? *jonesinoides* Harris, n. sp.	Corbin Ranch
L. obesa Harris, n. sp.	Oil Creek
L. porosa Harris, n. sp.	Corbin Ranch
L. rex (Coryell and Schenck)	Corbin Ranch
L. rex (C. & S.) subsp. *minima* Harris, n. subsp.	Bromide
L. ? *subcygnoides* Harris, n. sp.	McLish
L. tumida (Ulrich)	Corbin Ranch
L. valida Harris, n. sp.	Joins
Genus *Kayina* Harris, n. gen.	
K. hybosa Harris, n. sp.	Tulip Creek
K. ? *porosa* Harris, n. sp.	Bromide
Genus *Schmidtella* Ulrich	
S. affinis Ulrich	McLish to Bromide
S. asymmetrica Harris, n. sp.	Tulip Creek-basal Bromide
S. brevis Ulrich	Tulip Creek
S. crassimarginata Ulrich	McLish to Bromide
S. excavata Harris, n. sp.	Tulip Creek
S. excavata subsp. *incisa* Harris, n. subsp.	Bromide
S. minuta Harris, n. sp.	Tulip Creek and Bromide
S. ovalis Harris, n. sp.	Tulip Creek
S. transversa Harris, n. sp.	Tulip Creek and Bromide
Genus *Paraschmidtella* Swartz	
P. multicavata Harris, n. sp.	Oil Creek
P. oviforma Harris, n. sp.	Oil Creek
P. pauciperforata Harris, n. sp.	Oil Creek
P. perforata (Harris) Kay	Oil Creek
P. perforata subsp. *dispersa* Harris, n. subsp.	Joins
P. reticulata Harris, n. sp.	Oil Creek
P. ? *trifoveolata* Harris, n. sp.	Joins
P. umbopuncata Harris, n. sp.	Oil Creek
Genus *Hilseweckella* Harris, n. gen.	
H. rugulosa Harris, n. sp.	Oil Creek
Genus *Cryptophyllus* Levinson	
C. gibbosum Harris, n. sp.	McLish to Bromide
C. magnum (Harris) Levinson	Oil Creek
C. nuculopsis Harris, n. sp.	Tulip Creek
C. simpsoni (Harris) Levinson	Tulip Creek and Bromide
Genus *Macronotella* Ulrich	
M. elegans Harris, n. sp.	Oil Creek

M. mcgeheei Harris, n. sp.	Oil Creek
M. upsoni Harris, n. sp.	Oil Creek
Family Primitiidae Ulrich and Bassler	
Genus *Primitiella* Ulrich and Bassler	
P. constricta Ulrich *varicata* Harris, n. subsp.	Bromide
Genus *Haploprimitia* Ulrich and Bassler	
H. angusta Harris, n. sp.	McLish shales
H. angusta var. *deltata* Harris, n. var.	McLish shales
Genus *Echinoprimitia* Harris, n. gen.	
E. imputata Harris, n. sp.	Bromide
Genus *Eoprimitia* Harris, n. gen.	
E. arcuata Harris, n. sp.	Oil Creek
E. bailyana (Jones and Holl) Harris	Bromide
E. cooperi Harris, n. sp.	Oil Creek
E. moorei Harris, n. sp.	Bromide
E. quadrata Harris, n. sp.	Bromide
E. ? subnodosa Harris, n. sp.	Tulip Creek
Genus *Euprimitia* Ulrich and Bassler	
E. elegans Harris, n. sp.	Bromide
Genus *Halliella* Ulrich	
H. labiosa Ulrich	Bromide
Family Primitiopsidae Swartz	
Genus *Primitiopsis* Jones	
P. bassleri Harris	Bromide
P. elegans Harris, n. sp.	Tulip Creek
P. excavatus Harris, n. sp.	Tulip Creek
P. minutiperforatus Harris, n. sp.	McLish shales
P. minutus Harris, n. sp.	Tulip Creek and Bromide
Family Hollinidae Swartz	
Genus *Eohollina* Harris, n. gen.	
E. depressa (Kay) Harris	Bromide
E. depressa (Kay) *papillata* Harris, n. subsp.	Tulip Creek
Genus *Bellornatia* Kay	
B. mclishi Harris, n. sp.	McLish shales
Genus *Ctenobolbina* Ulrich	
C. abrupta Harris, n. sp.	Corbin Ranch
C. bispinata Harris, n. sp.	Bromide
C. cancellata Harris, n. sp.	Tulip Creek
C. cancellata subsp. *varicata* Harris, n. subsp.	Bromide

C. inflata Harris, n. sp.	Tulip Creek
C. parva Harris, n. sp.	Bromide
C. percarinata Harris, n. sp.	Tulip Creek
C. projecta Harris, n. sp.	McLish shales
Genus *Winchellatia* Kay	
W. cornuta Harris, n. sp.	Tulip Creek
W. longispina Kay	Bromide
Genus *Trubinella* Pribyl	
T. teisi Harris, n. sp.	Bromide
Genus *Acanthobolbina* Harris, n. gen.	
A. loeblichi Harris, n. sp.	Bromide
Genus *Ballardina* Harris, n. gen.	
B. concentrica Harris, n. sp.	Joins and Oil Creek
B. minuta Harris, n. sp.	Joins and Oil Creek
B. simplex Harris, n. sp.	Oil Creek
Genus *Haplobolbina* Harris, n. gen.	
H. arcuata Harris, n. sp.	Oil Creek
Family Beyrichiidae Ulrich	
Genus *Dicranella* Ulrich	
D. fragilis Harris, n. sp.	Bromide
D. macrocarinata Harris	Tulip Creek-basal Bromide
Genus *Eurychilina* Ulrich	
E. cultrata Harris, n. sp.	McLish shales
E. papillata Harris, n. sp.	Bromide
E. simplex Harris, n. sp.	Oil Creek
E. subradiata Ulrich	Bromide
E. ventrosa Ulrich	Tulip Creek and Bromide
Genus *Bromidella* Harris	
B. reticulata Harris	Tulip Creek (rare base Bromide)
B. spiveyi Harris, n. sp.	McLish shales
Genus *Eobromidella* Harris, n. gen.	
E. eurychilinoides Harris, n. sp.	Tulip Creek
Genus *Coelochilina* Ulrich and Bassler	
C. alata Harris, n. sp.	Corbin Ranch
C. alatispinata Harris, n. sp.	Tulip Creek
Family Kloedenellidae Ulrich and Bassler	
Genus *Balticella* Thorslund	
B. deckeri (Harris)	Bromide
B. deckeri subsp. *elongata* Harris, n. subsp.	Tulip Creek

Genus *Glymmatobolbina* Harris, n. gen.	
G. quadrata Harris, n. sp.	Bromide
Family Acronotellidae Swartz	
Genus *Monoceratella* Teichert	
M. brevispinata Harris, n. sp.	Tulip Creek
Family Tetradellidae Swartz	
Genus *Thomasatia* Kay	
T. auricula Harris, n. sp.	Bromide
T. bromidensis Harris, n. sp.	Bromide
T. simplex Harris, n. sp.	Tulip Creek
Genus *Bassleratia* Kay	
B. corrugata Harris, n. sp.	Oil Creek
Genus *Tetradellina* Harris, n. gen.	
T. henningsmoeni Harris, n. sp.	Bromide
Family Beecherellidae Ulrich	
Genus *Krausella* Ulrich	
K. arcuata Ulrich	Bromide
Genus *Rayella* Teichert	
R. calvini Kay	Bromide
R. calvini Kay subsp. *parva* Harris, n. subsp.	Tulip Creek
R. minuta Harris, n. sp.	Oil Creek to McLish
Genus *Platyrhomboides* Harris, n. gen.	
P. quadratus Harris, n. sp.	Bromide
Family Bairdiidae Sars	
Genus *Bythocypris* Brady	
B. cylindrica (Hall)	Tulip Creek and Bromide
B. sp. cf. *B. granti* Ulrich	McLish shales
B. ? spinosa Harris, n. sp.	Bromide
Genus *Punctaparchites* Kay	
P. rugosus (Jones) Kay	Bromide

Ostracoda Species in Simpson Formations

Follows a summarized list of ostracodal species as recovered from outcrop and subsurface samples of the six Simpson formations. One of the striking features regarding the list of 124 species and/or varieties is the fact that the majority of the forms display limited vertical, or stratigraphic, range; most of the species are "index" fossils:

Joins Formation (6 species, 2 subspecies)
Eoleperditia mediumbonata Harris, n. sp.
Eoleperditia mediumbonata subsp. *debilis* Harris, n. subsp.
Eoleperditia ? *obesiporosa* Harris, n. sp.
Leperditella brookingi Harris
Leperditella valida Harris, n. sp.
Leperditella cooperi Harris
Paraschmidtella perforata subsp. *dispersa* Harris, n. subsp.
Paraschmidtella ? *trifoveolata* Harris, n. sp.

Joins and Oil Creek Formations (2 species)
Ballardina concentrica Harris, n. sp.
Ballardina minuta Harris, n. sp.

Oil Creek Formation (23 species)
Eoleperditia abrupta Harris, n. sp.
Eoleperditia spicata Harris, n. sp.
Eoleperditia subcarinata Harris, n. sp.
Leperditella bulbosa (Harris)
Leperditella gibba Harris, n. sp.
Leperditella obesa Harris, n. sp.
Paraschmidtella multicavata Harris, n. sp.
Paraschmidtella oviforma Harris, n. sp.
Paraschmidtella pauciperforata Harris, n. sp.
Paraschmidtella perforata (Harris) Swartz
Paraschmidtella reticulata Harris, n. sp.
Paraschmidtella umbopunctata Harris, n. sp.
Hilseweckella rugulosa Harris, n. sp.
Cryptophyllus magnum (Harris) Levinson
Macronotella elegans Harris, n. sp.
Macronotella mcgheei Harris, n. sp.
Macronotella upsoni Harris, n. sp.
Eoprimitia arcuata Harris, n. sp.
Eoprimitia moorei Harris, n. sp.
Ballardina simplex Harris, n. sp.
Haplobolbina arcuata Harris, n. sp.
Eurychilina simplex Harris, n. sp.
Bassleratia corrugata Harris, n. sp.

Oil Creek and McLish Formations (1 species)
Rayella minuta Harris, n. sp.

McLish "Birdseye" Limestone (5 species)
Eoleperditia fabulites (Conrad) Swartz
Eoleperditia magna Harris, n. sp.
Eoleperditia ? perplexa Harris, n. sp.
Eoleperditia simplex Harris, n. sp.
Leperditella ? subcygnoides Harris, n. sp.
McLish Shales (8 species, 1 variety)
Hyperchilarina symmetrica Harris, n. sp.
Haploprimitia angusta Harris, n. sp.
Haploprimitia angusta var. *deltata* Harris, n. var.
Primitiopsis minutiperforatus Harris, n. sp.
Bellornatia mclishi Harris, n. sp.
Ctenobolbina projecta Harris, n. sp.
Eurychilina cultrata Harris, n. sp.
Bromidella spiveyi Harris, n. sp.
Bythocypris sp. cf. *B. granti* Ulrich
McLish, Tulip Creek, and Bromide Formations (3 species)
Schmidtella affinis Ulrich
Schmidtella crassimarginata Ulrich
Cryptophyllus gibbosum Harris, n. sp.
Tulip Creek Formation (21 species, 3 subspecies)
Hyperchilarina angularis Harris, n. sp.
Hyperchilarina ovata Harris, n. sp.
Leperditella altiforma Harris, n. sp.
Kayina hybosa Harris, n. sp.
Schmidtella asymmetrica Harris, n. sp.
Schmidtella brevis Ulrich
Schmidtella excavata Harris, n. sp.
Schmidtella ovalis Harris, n. sp.
Cryptophyllus nuculopsis Harris, n. sp.
Eoprimitia ? subnodosa Harris, n. sp.
Primitiopsis elegans Harris, n. sp.
Primitiopsis excavatus Harris, n. sp.
Eohollina depressa (Kay) subsp. *papillata* Harris, n. subsp.
Ctenobolbina cancellata Harris, n. sp.
Ctenobolbina inflata Harris, n. sp.
Ctenobolbina percarinata Harris, n. sp.
Winchellatia cornuta Harris, n. sp.

Bromidella reticulata Harris (Apparently in lower Bromide also)
Eobromidella eurychilinoides Harris, n. sp.
Coelochilina alatispinata Harris, n. sp.
Balticella deckeri subsp. *elongata* Harris, n. subsp.
Monoceratella brevispinata Harris, n. sp.
Thomasatia simplex Harris, n. sp.
Rayella calvini Kay subsp. *parva* Harris, n. subsp.

Tulip Creek and Bromide Formations (10 species)
Aparchites maccoyii (Salter) Jones
Aparchites millepunctatus (Ulrich)
Hyperchilarina nodosimarginata Harris, n. sp.
Schmidtella minuta Harris, n. sp.
Schmidtella transversa Harris, n. sp.
Cryptophyllus simpsoni (Harris) Levinson
Primitiopsis minutus Harris, n. sp.
Dicranella macrocarinata Harris (Exceedingly sparse in Bromide)
Eurychilina ventrosa Ulrich
Bythocypris cylindrica (Hall) Ulrich

Bromide Formation (31 species, 4 subspecies)
Eoleperditia fabulites (Conrad) Swartz
Eoleperditia inflativentralis Harris, n. sp.
Paraparchites ? circulantis Harris, n. sp.
Leperditella incisa Harris, n. sp.
Leperditella rex (Coryell and Schenck) subsp. *minima* Harris, n. subsp.
Kayina ? porosa Harris, n. sp.
Schmidtella excavata subsp. *incisa* Harris, n. subsp.
Primitiella constricta Ulrich subsp. *varicata* Harris, n. subsp.
Echinoprimitia imputata Harris, n. sp.
Eoprimitia bailyana (Jones and Holl) Harris
Eoprimitia cooperi Harris, n. sp.
Eoprimitia quadrata Harris, n. sp.
Euprimitia elegans Harris, n. sp.
Halliella labiosa Ulrich
Primitiopsis bassleri Harris
Eohollina depressa (Kay) Harris
Ctenobolbina bispinata Harris, n. sp.

Ctenobolbina cancellata subsp. *varicata* Harris, n. subsp.
Ctenobolbina parva Harris, n. sp.
Winchellatia longispina Kay
Trubinella teisi Harris, n. sp.
Acanthobolbina loeblichi Harris, n. sp.
Dicranella fragilis Harris, n. sp.
Eurychilina papillata Harris, n. sp.
Eurychilina subradiata Ulrich
Balticella deckeri (Harris)
Glymmatobolbina quadrata Harris, n. sp.
Thomasatia auricula Harris, n. sp.
Thomasatia bromidensis Harris, n. sp.
Tetradellina henningsmoeni Harris, n. sp.
Krausella arcuata Ulrich
Rayella calvini Kay
Platyrhomboides quadratus Harris, n. sp.
Bythocypris ? spinosa Harris, n. sp.
Punctaparchites rugosus (Jones) Kay

Corbin Ranch Formation (8 species)

Eoleperditia fabulites (Conrad) Swartz
Leperditella aequilatera (Ulrich)
Leperditella ? jonesinoides Harris, n. sp.
Leperditella porosa Harris, n. sp.
Leperditella rex (Coryell and Schenck)
Leperditella tumida (Ulrich)
Ctenobolbina abrupta Harris, n. sp.
Coelochilina alata Harris, n. sp.

New Ostracoda Genera

Of the 42 genera involved, 13 are newly erected:

Hyperchilarina Harris, n. gen.
Genotype: *Hyperchilarina ovata* Harris, n. sp.

Kayina Harris, n. gen.
Genotype: *Kayina hybosa* Harris, n. sp.

Hilseweckella Harris, n. gen.
Genotype: *Hilseweckella rugulosa* Harris, n. sp.

Echinoprimitia Harris, n. gen.
Genotype: *Echinoprimitia imputata* Harris, n. sp.

Eoprimitia Harris, n. gen.
Genotype: *Primitia bonnemai* Swartz, 1936

Eohollina Harris, n. gen.
Genotype: *Beyrichia irregularis* Spivey, 1939

Acanthobolbina Harris, n. gen.
Genotype: *Acanthobolbina loeblichi* Harris, n. sp.

Ballardina Harris, n. gen.
Genotype: *Ballardina concentrica* Harris, n. sp.

Haplobolbina Harris, n. gen.
Genotype: *Haplobolbina arcuata* Harris, n. sp.

Eobromidella Harris, n. gen.
Genotype: *Eobromidella eurychilinoides* Harris, n. sp.

Glymmatobolbina Harris, n. gen.
Genotype: *Glymmatobolbina quadrata* Harris, n. sp.

Tetradellina Harris, n. gen.
Genotype: *Tetradellina henningsmoeni* Harris, n. sp.

Platyrhomboides Harris, n. gen.
Genotype: *Platyrhomboides quadratus* Harris, n. sp.

Tabulation of Simpson Ostracoda

Of the 126 Ostracoda species and subspecies, 96 are newly erected. Follows a tabulation of Simpson Ostracoda:

Simpson Genera	Established Species	New Species	New Subspecies	Total
Eoleperditia Swartz	1	10	--	11
Aparchites Jones	2	--	--	2
Paraparchites Ulrich & Bassler	--	1	--	1
Hyperchilarina Harris, n. gen.	--	3	1	4
Leperditella Ulrich	6	7	2	15
Kayina Harris, n. gen.	--	2	--	2
Schmidtella Ulrich	3	5	1	9
Paraschmidtella Swartz	1	6	1	8
Hilseweckella Harris, n. gen.	--	1	--	1
Cryptophyllus Levinson	2	2	--	4
Macronotella Ulrich	--	3	--	3
Primitiella Ulrich	--	--	1	1
Haploprimitia Ulrich & Bassler	--	1	1 var.	2
Echinoprimitia Harris, n. gen.	--	1	--	1
Eoprimitia Harris, n. gen.	1	5	--	6
Euprimitia Ulrich & Bassler	--	1	--	1

Simpson Genera	Established Species	New Species	New Subspecies	Total
Halliella Ulrich	1	--	--	1
Primitiopsis Jones	1	4	--	5
Eohollina Harris, n. gen.	1	--	1	2
Bellornatia Kay	--	1	--	1
Ctenobolbina Ulrich	--	7	1	8
Winchellatia Kay	1	1	--	2
Trubinella Pribyl	--	1	--	1
Acanthobolbina Harris, n. gen.	--	1	--	1
Ballardina Harris, n. gen.	--	3	--	3
Haplobolbina Harris, n. gen.	--	1	--	1
Dicranella Ulrich	1	1	--	2
Eurychilina Ulrich	2	3	--	5
Bromidella Harris	1	--	--	1
Eobromidella Harris, n. gen.	--	2	--	2
Coelochilina Ulrich & Bassler	--	2	--	2
Balticella Thorslund	1	--	1	2
Glymmatobolbina Harris, n. gen.	--	1	--	1
Monoceratella Teichert	--	1	--	1
Thomasatia Kay	--	3	--	3
Bassleratia Kay	--	1	--	1
Tetradellina Harris, n. gen.	--	1	--	1
Krausella Ulrich	1	--	--	1
Rayella Teichert	1	1	1	3
Platyrhomboides Harris, n. gen.	--	1	--	1
Bythocypris Brady	2	1	--	3
Punctaparchites Kay	1	--	--	1
Total	30	85	11	126

Previously Described Simpson Ostracoda

Following are listed the 30 previously described Simpson Ostracoda, with formations and localities from whch they have been reported:

Eoleperditia fabulites (Conrad) Swartz, described from Black River (Platteville) of Wisconsin; Black River of Minnesota, Montana, Kentucky, Tennessee, New York, Alabama, Canada, St. Joseph's Island in Lake Huron; Stones River of Tennessee and Appalachian Valley.

Recovered from McLish, topmost massive beds of the Bromide, and the Corbin Ranch. A few similar, if not identical, forms have been recovered also from the Fite and the Tyner of northeastern Oklahoma.

Aparchites maccoyii (Salter) Jones, described from the Caradoc of Ireland; Keisley limestone of Westmoreland, England, Scotland, and North Wales; Drift of North Germany.

Abundant in Bromide and Tulip Creek formations of Oklahoma.

Aparchites millepunctatus (Ulrich), described from Black River (Decorah) of Fountain, Minnesota; Black River (Platteville) of Dixon, Illinois.

Not uncommonly occurring in Bromide and Tulip Creek formations.

Leperditella aequilatera (Ulrich), described from Stones River (Ridley limestone) at bottom of gorge at High Bridge, Kentucky.

A most abundant species in the topmost Corbin Ranch formation. A species, similar, if not identical, occurs in the Fite limestone of northeastern Oklahoma.

Leperditella brookingi Harris, originally described from the Simpson Joins formation, and now ascertained to be limited thereto.

Leperditella bulbosa (Harris), originally described from the Simpson Oil Creek formation, and now ascertained to be limited thereto.

Leperditella cooperi Harris, originally described from the Simpson Joins formation, and now ascertained to be limited thereto.

Leperditella rex (Coryell and Schenck), described from Stones River (Ridley limestone) at bottom of gorge at High Bridge, Kentucky,

Commonly occurring in topmost Corbin Ranch formation of the Simpson.

Leperditella tumida (Ulrich), described from Black River (Lowville) of Ontario, and High Bridge, Kentucky; Black River of Tennessee, Virginia, and Franklin County, Pennsylvania.

An excellent index fossil of topmost Corbin Ranch formation.

Schmidtella affinis Ulrich, described from Ion member of Decorah of Cannon Falls, Minnesota; Ion and Guttenberg (Iowa-Minnesota); Tulip Creek.

Now ascertained ranging from McLish into lower Bromide, though more commonly occurring, in greater abundance, and, accordingly, more indicative in the Tulip Creek.

Schmidtella brevis Ulrich, described from Black River Decorah (Guttenberg) Minneapolis, Minnesota; also in Guttenberg and Ion of Iowa.

Abundant in the Tulip Creek formation of Oklahoma.

Schmidtella crassimarginata Ulrich, described from Black River (Platteville) of Mineral Point, Wisconsin, and Dixon, Illinois; the Chazyan (Valcour) of Valcour Island, New York; Stones River (Lebanon) of Cedar Mountain, Alabama. (The writer questions the occurrence of this species in Chazyan strata).

Recovered from McLish, Tulip Creek, and Bromide formations.

Paraschmidtella perforata (Harris) Kay, described from Simpson Oil Creek of Oklahoma, and now determined to be an index species therein.

Abundant in Oil Creek limestones of Oklahoma and Texas (subsurface).

Cryptophyllus magnum (Harris) Levinson, described from the Simpson Oil Creek of Oklahoma, and now determined to be limited therein.

An excellent index fossil in Oil Creek limestones of Oklahoma and Texas (subsurface).

Cryptophyllus simpsoni (Harris) Levinson, described from the Simpson Tulip Creek and Bromide formations of Oklahoma, and since determined commonly occurring in both.

Eoprimitia bailyana (Jones and Holl) Harris, described from the Caradoc of Ireland, Scotland, and North Wales; Ordovician (Kukruse) of Estonia.

Commonly occurring in the Bromide formation of the Simpson.

Halliella labiosa Ulrich, described from Prosser of Minnesota and Canada (Hull); Guttenberg and Ion of Iowa.

Rather commonly occurring in the Bromide formation of Oklahoma.

Primitiopsis bassleri Harris, originally described from the Simpson Tulip Creek and Bromide formations of Oklahoma; now determined an index species of the Bromide. It also occurs in the upper Woods Hollow formation of the Marathon Mountains. The Tulip Creek form, *P. elegans* Harris, possesses more numerous and finer pores.

Eohollina depressa (Kay) Harris, originally described from the Ion member of the Decorah formation in Minnesota, this species is also recorded from the Ion of Iowa and Wisconsin; Guttenberg of Iowa, Minnesota, and Wisconsin.

Recovered only from the Bromide; a more papillose subspecies is in Tulip Creek.

Winchellatia longispina Kay, commonly occurring in the Guttenberg member of the Decorah formation of Iowa.

Rather commonly occurring in the Bromide of Oklahoma.

Dicranella macrocarinata Harris, described from Simpson Bromide formation; now determined rare in lower Bromide and commonly occurring in the Tulip Creek, where it is associated with *Bromidella reticulata* Harris.

Eurychilina subradiata Ulrich, described from Stones River (Lebanon) of Tennessee; Platteville of Dixon, Illinois; Ion of Minnesota and Iowa; Canajoharie of Canajoharie, New York.

Recovered from the Bromide formation of the Simpson.

Eurychilina ventrosa Ulrich, described from the Ion of Iowa and Minnesota.

Recovered from Bromide and upper Tulip Creek formations of the Simpson.

Bromidella reticulata Harris, described from Simpson Oil Creek and Bromide formations of Oklahoma.

Rarely occurring in basal Bromide and commonly occurring in the Tulip Creek. (The original report of Oil Creek occurrence involves a typographical oversight.)

Balticella deckeri (Harris), described from the Simpson Bromide of Oklahoma, and now determined an index species of the formation.

Krausella arcuata Ulrich, described from the Ion of Iowa and Minnesota; Guttenberg of Iowa; Black River of Wisconsin and Illinois; Black River (Lowville) of High Bridge, Kentucky; Llandovery of England; Simpson Bromide of Oklahoma.

Recovered only from the Bromide formation of the Simpson.

Rayella calvini Kay, reported from the Ion member of the Decorah formation of Iowa and Minnesota.

Commonly occurring throughout the Bromide formation.

Bythocypris cylindrica (Hall), described from strata Trenton to Richmond in age from Cincinnati, Ohio, and vicinity; Indiana, Kentucky, New York, Anticosti, Manitoba; Ion and Guttenberg of Iowa and Minnesota. (Such a simple form might well be expected to range through middle and upper Ordovician).

Recovered from Tulip Creek and Bromide formations of the Simpson group.

Bythocypris sp. cf. *B. granti* Ulrich, described from Black River Decorah (Guttenberg) of St. Paul and Minneapolis, Minnesota.

A form resembling this species occurs in McLish shales of Oklahoma.

Punctaparchites rugosus (Jones) Kay, described from Black River (Leray) of Pauquette's Rapids, Ottawa River, Canada; Hull of Ontario; Guttenberg of Iowa; Ion of Iowa and Minnesota; Simpson Bromide of Oklahoma.

Recovered from Bromide and upper Tulip Creek formations of the Simpson. Also in upper Woods Hollow.

Recapitulation of Previously Described Simpson Ostracoda

Two of the previously described species, *Leperditella brookingi* Harris and *L. cooperi* Harris, have been described from the Simpson Joins formation.

Three of the species, *Leperditella bulbosa* (Harris), *Paraschmidtella perforata* (Harris) Kay, and *Cryptophyllus magnum* (Harris) Levinson, have been described from the Simpson Oil Creek formaiton.

One of the species, *Bythocypris* sp. cf. *B. granti* Ulrich, has been described previously from the Decorah of Minnesota. A form resembling it occurs commonly in McLish shales.

Two of the species, *Schmidtella affinis* Ulrich and *S. crassimarginata* Ulrich previously listed from the Decorah of Iowa and Minnesota; and the Platteville of Wisconsin and Illinois, respectively, range from the McLish, through the Tulip Creek, into the Bromide. (*S. crassimarginata* Ulrich was reported from Chazyan strata of New York and Alabama . . . . . questioned by the writer.)

One of the species, *Schmidtella brevis* Ulrich, described from the Decorah of Iowa and Minnesota, is abundant in the Tulip Creek formation.

Two of the species, *Dicranella macrocarinata* Harris and *Bromidella reticulata* Harris, ordinarily are excellent index fossils of the Tulip Creek, though occasionally ranging into the lower Bromide.

Six of the forms, *Aparchites maccoyii* (Salter) Jones, *A. millepunctatus* (Ulrich), *Cryptophyllus simpsoni* (Harris) Levinson, *Eurychilina ventrosa* Ulrich, *Bythocypris cylindrica* (Hall), and *Punctaparchites rugosus* (Jones) Kay have been reported from the Decorah of Iowa and Minnesota; Platteville of Illinois; Hull and Leray of Canada; Caradoc of Ireland; and Drift of Germany. These species occur in the Tulip Creek and Bromide of Oklahoma.

Nine of the species, *Eoprimitia bailyana* (Jones and Holl) Harris, *Halliella labiosa* Ulrich, *Primitiopsis bassleri* Harris, *Eohollina depressa* (Kay) Harris, *Winchellatia longispina* Kay, *Eurychilina subradiata* Ulrich, *Balticella deckeri* (Harris), *Krausella arcuata* Ulrich, and *Rayella calvini* Kay, previously reported from the Decorah of the upper Mississippi Valley; Platteville of Illinois; Black River of Kentucky; Llandovery of England; and Bromide of Oklahoma, are all index fossils of the Bromide formation.

Four of the species, *Eoleperditia fabulites* (Conrad) Swartz, *Leperditella aequilatera* (Ulrich), *L. rex* (Coryell and Schenck), and *L. tumida* (Ulrich), have been described essentially from the

Black River ? section in the gorge at High Bridge, Kentucky. *L. tumida* (Ulrich) was listed from the Black River ? of Tennessee, Virginia, and Pennsylvania. All of these species are commonly occurring forms in the Corbin Ranch formation, though *Eoleperditia fabulites* (Conrad) Swartz ranges from the McLish into the Corbin Ranch.

Ostracoda Range Charts of Four Type Simpson Sections

The four Ostracoda range charts depict the following information concerning four published type Simpson sections:

(1) Strip log (1″=50′) portraying lithology of each section
(2) Decker's published zones
(3) Thickness of each zone
(4) Outcrop sample horizons lined against the sections
(5) Simpson formational contacts as established by Ostracoda range
(6) Names and range of Ostracoda

Chart No. 1 U. S. HIGHWAY 77 SECTION IN ARBUCKLE MOUNTAINS

Secs. 24 and 25, Twn. 2 S., Rnge. 1 E.

(2.8 mi. N. Springer, Oklahoma)

The chart reflects two eoleperditians in the topmost massive limestone section of the Bromide (Pooleville).

A concentrated zone of some three dozen species is observed in the Bromide, particularly in the middle third.

Twelve to 15 species are observed in a concentrated zone of shales in the upper half of the Tulip Creek, i. e., the section overlying the thick basal sandstone.

Six species are observed in the McLish section, essentially above the basal sandstone. Additional collections in this section would undoubtedly reveal other species of Ostracoda.

Some two dozen species are recorded from the Oil Creek section, particularly from shale breaks in the upper half.

Eight species are recorded from the Joins, five of them limited to the lower part.

(For description of Zones, see OGS Bull. 55, p. 60)

Chart No. 2 WEST SPRING CREEK SECTION IN ARBUCKLE MOUNTAINS

Secs. 7 and 8, Twn. 2 S., Rnge. 1 W.

(3.8 mi. S. E. Pooleville, Oklahoma)

The chart reflects no species having been collected from the topmost massive limestone of the Bromide (Pooleville) section.

Some 30 species are portrayed in the Bromide, essentially in the upper half, and correlative with corresponding zones in the U. S. Highway 77 section some 11 miles to the east.

Some 16 to 18 species are observed in the Tulip Creek, essentially in the shale section above the basal sandstone, and correlative with the corresponding section of U. S. Highway 77 to the east.

Eight species are observed in the McLish section.

Approximately 18 species are discovered in the Oil Creek section, corresponding with those of the U. S. Highway 77 Oil Creek section.

Ten to 12 species are observed in the Joins, essentially in the lower half, and correlative with corresponding species in the U. S. Highway 77 Joins section.

(For description of Zones, see OGS Bull. 55, p. 54)

Chart No. 3 OKLAHOMA HIGHWAY 99 SECTION IN ARBUCKLE MOUNTAINS

Sec. 11, Twn. 1 S., Rnge. 3 E.

(3 mi. S. Fittstown, Oklahoma)

The chart portrays eight Ostracoda in the topmost Corbin Ranch formation, none of which occurs in the overlying Viola, only one (*E. fabulites* (Conrad) Swartz) in the underlying Bromide.

Some 30 species are observed in an abbreviated Bromide section. This zone represents the same concentrated zone in the upper part of the Bromide sections of U. S. Highway 77 and West Spring Creek (Charts 1 and 2). The lower half of the formation, including the basal sandstone, is missing in this section (possibly faulted).

Some three dozen species are depicted in an abbreviated Tulip Creek section, the lower half of the formation as exposed on U. S. Highway 77 and on West Spring Creek apparently missing (probably faulted). The faunal suite here corresponds to that of the Tulip Creek sections to the west, as well with that of the Rock Crossing section in Criner Hills.

Ten to 12 species are commonly occurring in the uppermost shales of the McLish section . . . . . species in the McLish shales not discovered in any other outcrops (of any formation) throughout the mountains, possibly from lack of McLish samples. The 200-foot section of McLish limestone (essentially "birdseye" here will undoubtedly reveal the same eoleperditian species discovered in the "birdseye" McLish toward north end of the Criner Hills.

Neither Oil Creek nor Joins is exposed in this section (faulted), but in outcrops to the south and east typical Oil Creek paraschmidtellids and leperditellids were discovered.

(For description of Zones, see AAPG Bull., vol. 25, p. 662)

Chart No. 4 ROCK CROSSING SECTION IN CRINER HILLS

Sec. 35, Twn. 5 S., Rnge. 1 E.

(On Hickory Creek)

The 4th chart reveals no Corbin Ranch at the top of the Simpson section, the Bromide (with its diagnostic Ostracoda fauna) being in direct disconformable contact with the overlying Viola. The Bromide Ostracoda here corroborate the evidence and conclusion of disconformable contact as indicated in statement and photograph regarding the same by Decker. The aforementioned photograph reveals a layer of bog-iron clay marking an irregular erosional contact of Bromide and overlying Viola at Rock Crossing.

More than two dozen ostracodal species are observed in the thin-bedded shales of the Bromide section, including several forms not discovered elsewhere in the mountains. This section resembles that of Oklahoma Highway 99 in faunal content, as well as in the respect that it is abbreviated and lacks the pronounced basal sandstones as exhibited in the sections on U. S. Highway 77 and on West Spring Creek (Charts 1 and 2).

Some three dozen species in the abbreviated Tulip Creek section correspond to the same Tulip Creek section as exposed on Oklahoma Highway 99, as well as those farther west. The basal Tulip Creek section at Rock Crossing is not exposed.

(For description of Zones, see AAPG Bull., vol. 25, p. 666)

General Ostracoda Range Chart

The General Range Chart presents a summary of ostracodal ranges through various Simpson exposures and samples as follows:

(1) Systematic list of the 126 species and subspecies of Ostracoda recovered from Simpson outcrops and subsurface samples

(2) Summary of ostracodal ranges through respective zones of the four type Simpson sections as portrayed on Charts 1 to 4

(3) Summary of ostracodal species recovered from four other Simpson localities in the Arbuckle Mountains (see top center of General Chart for legend explaining localities 1, 2, 3, and 4)

(4) Summary of occurrence of certain species in miscellaneous Simpson exposures and subsurface horizons

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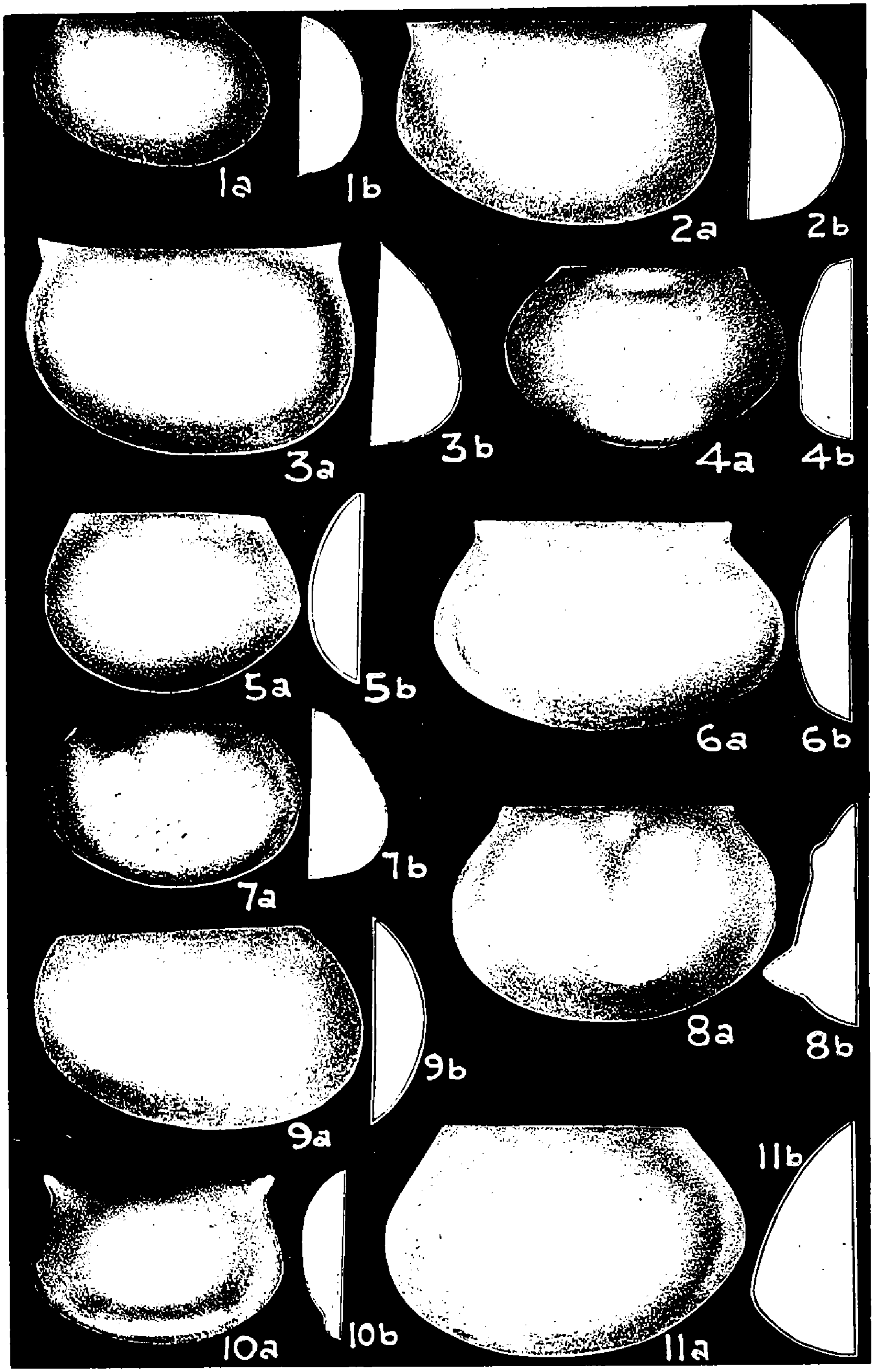
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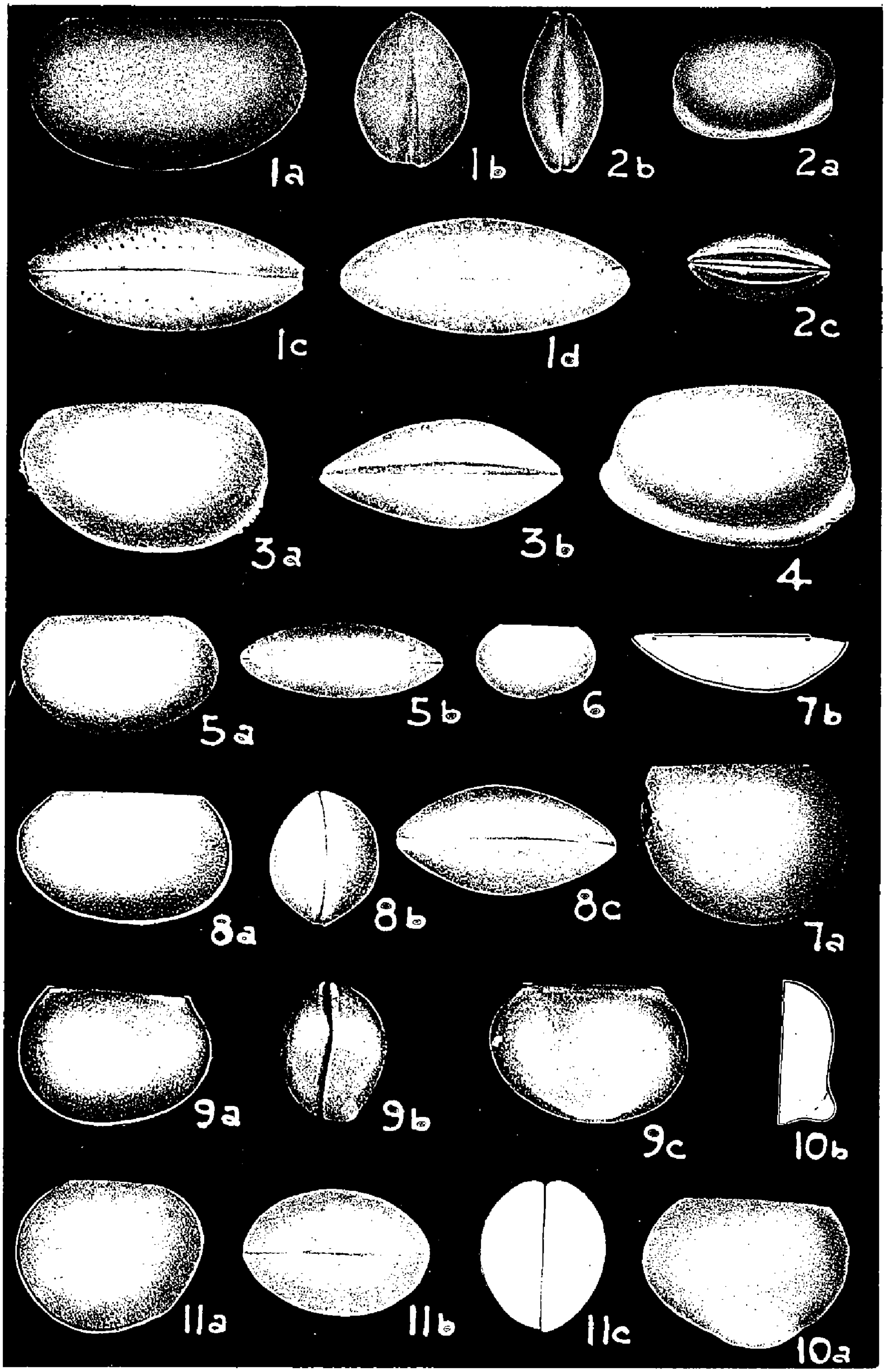
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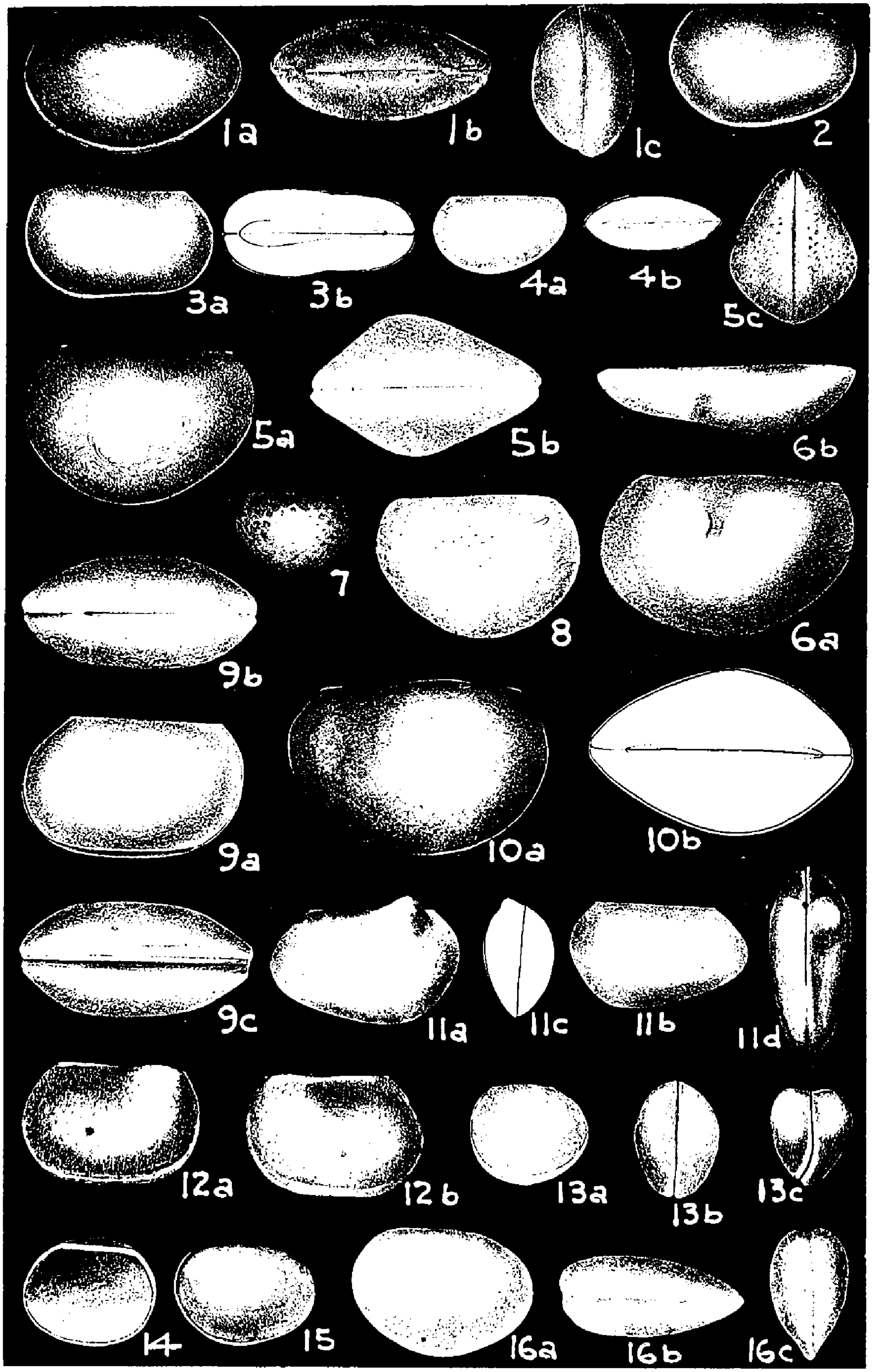
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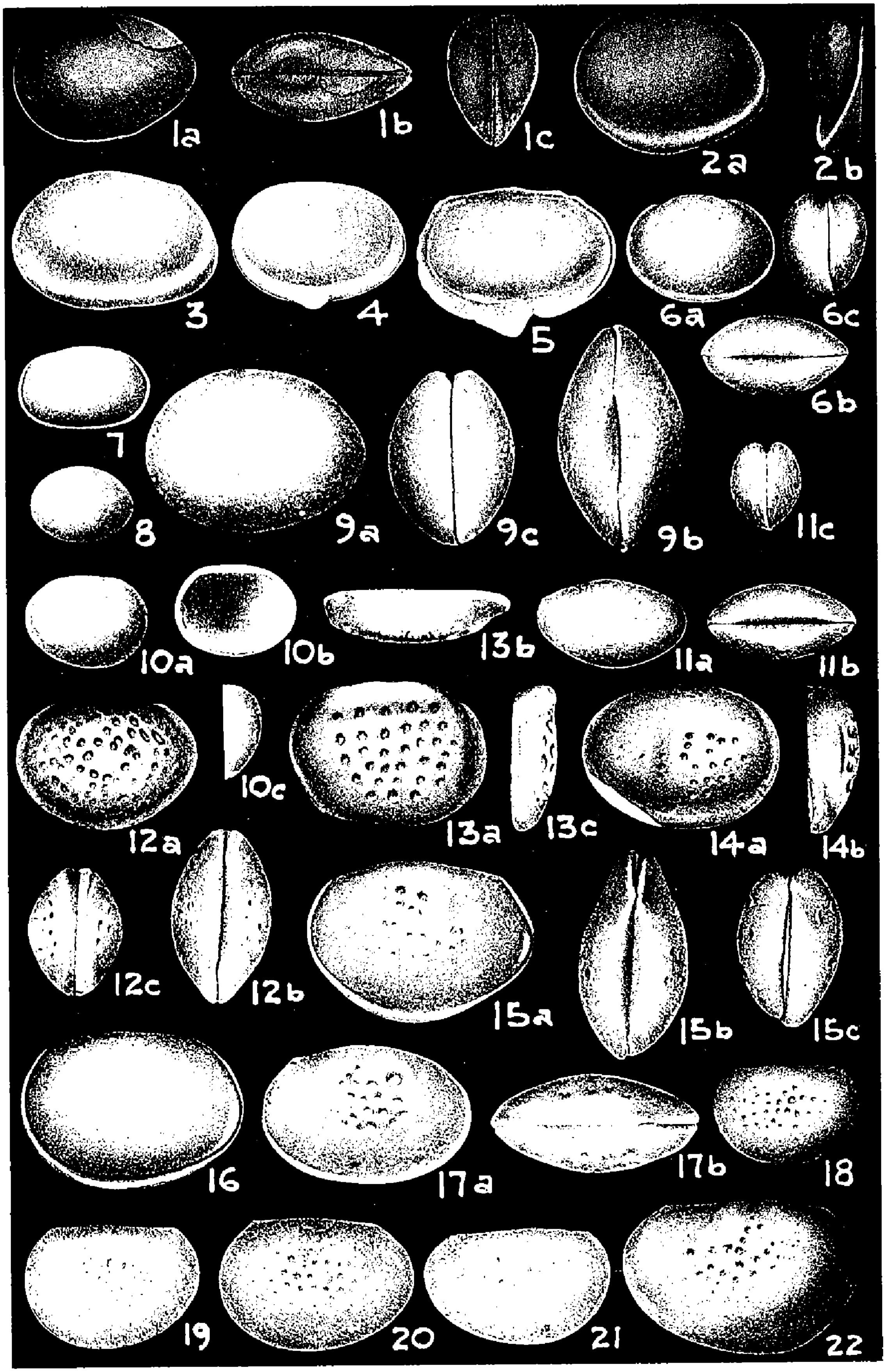
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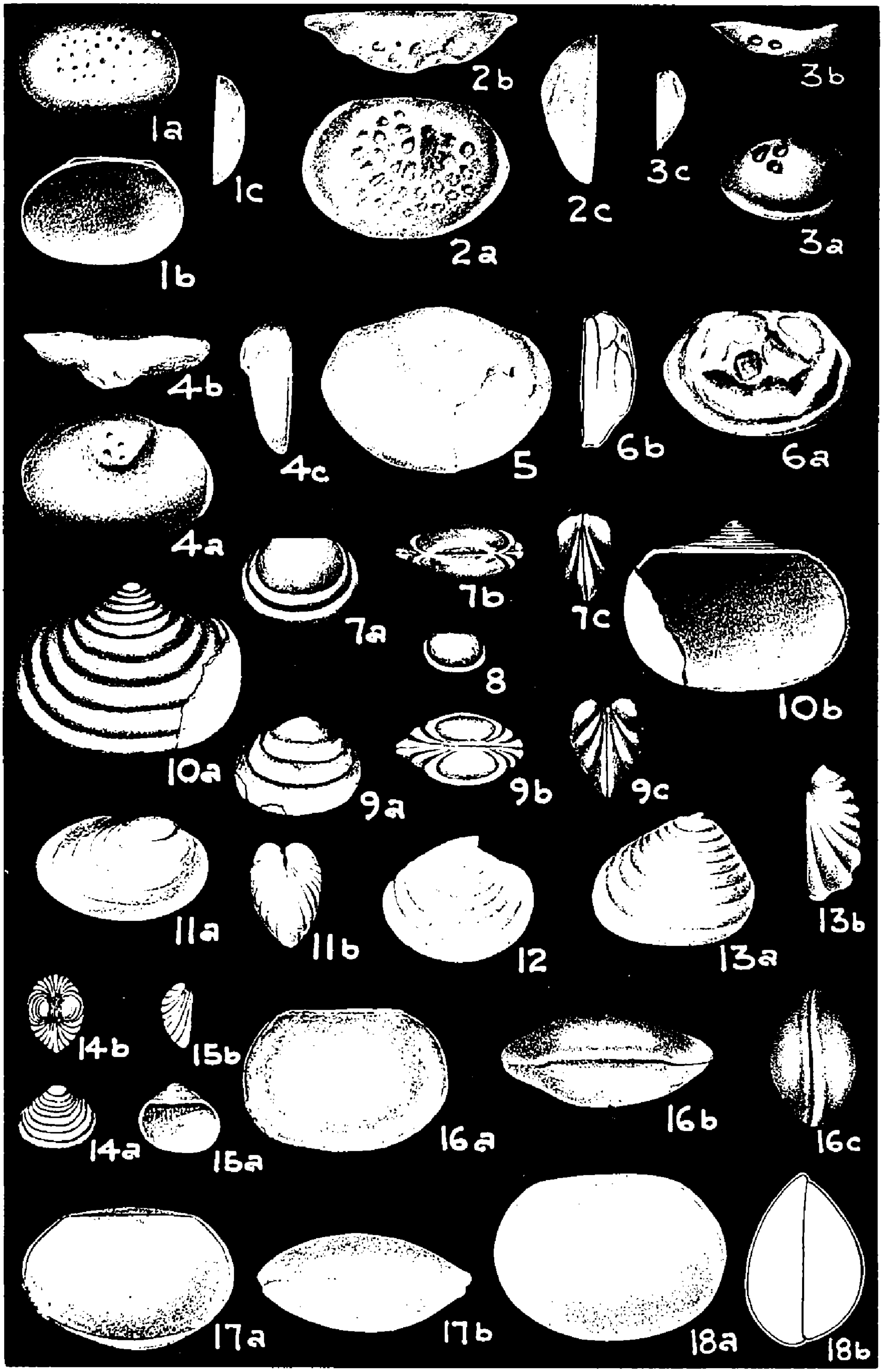
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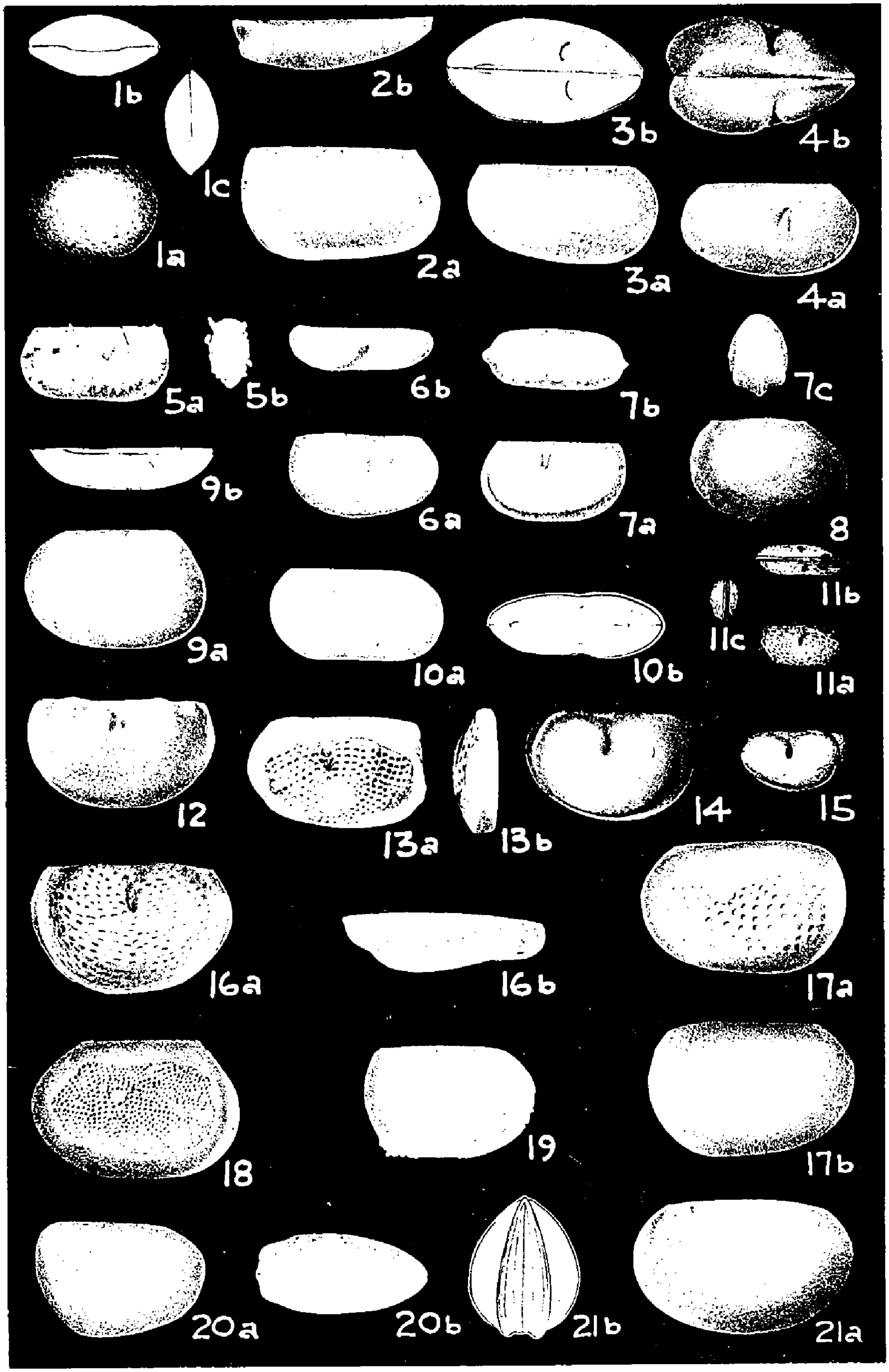
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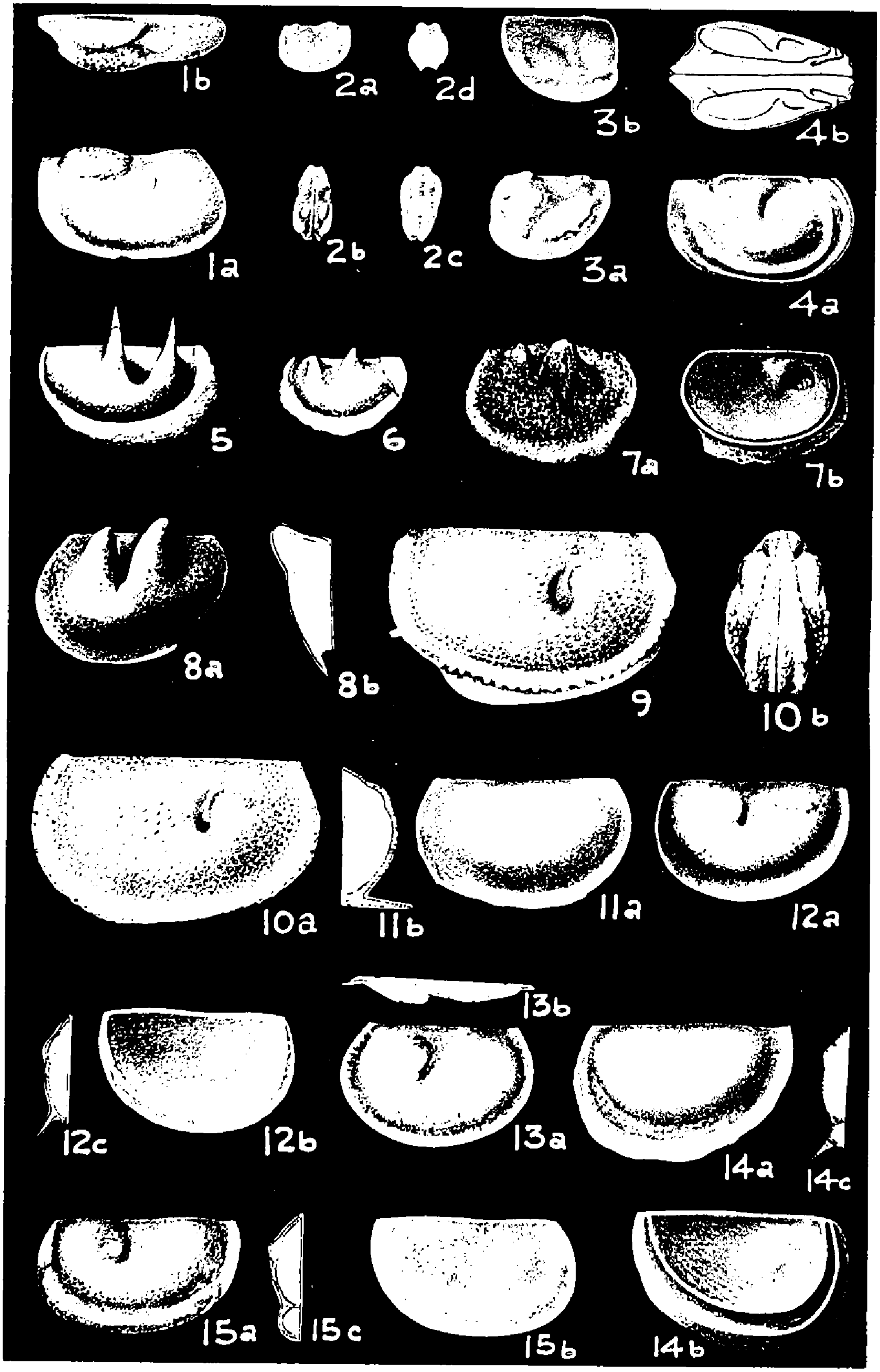
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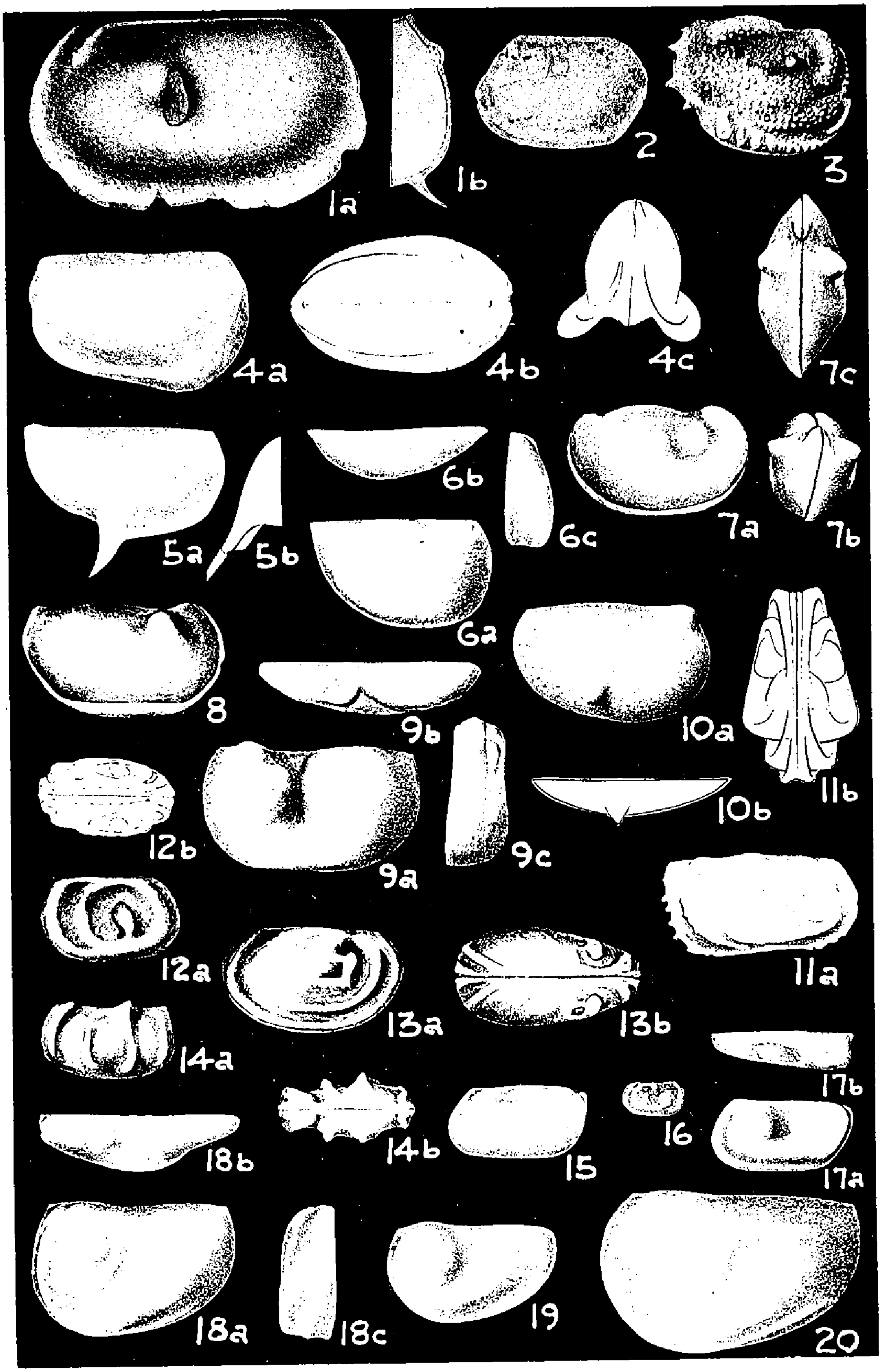
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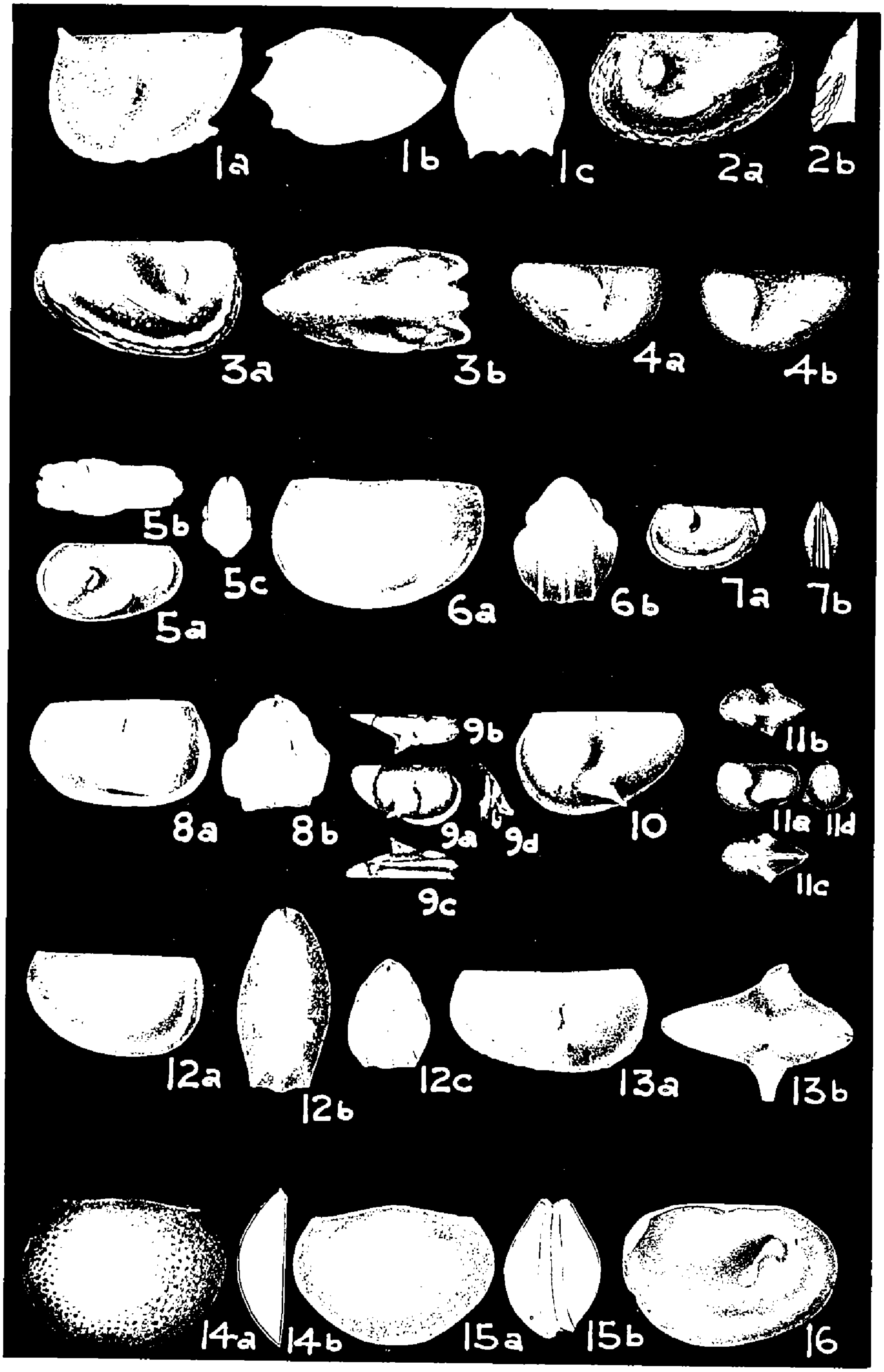
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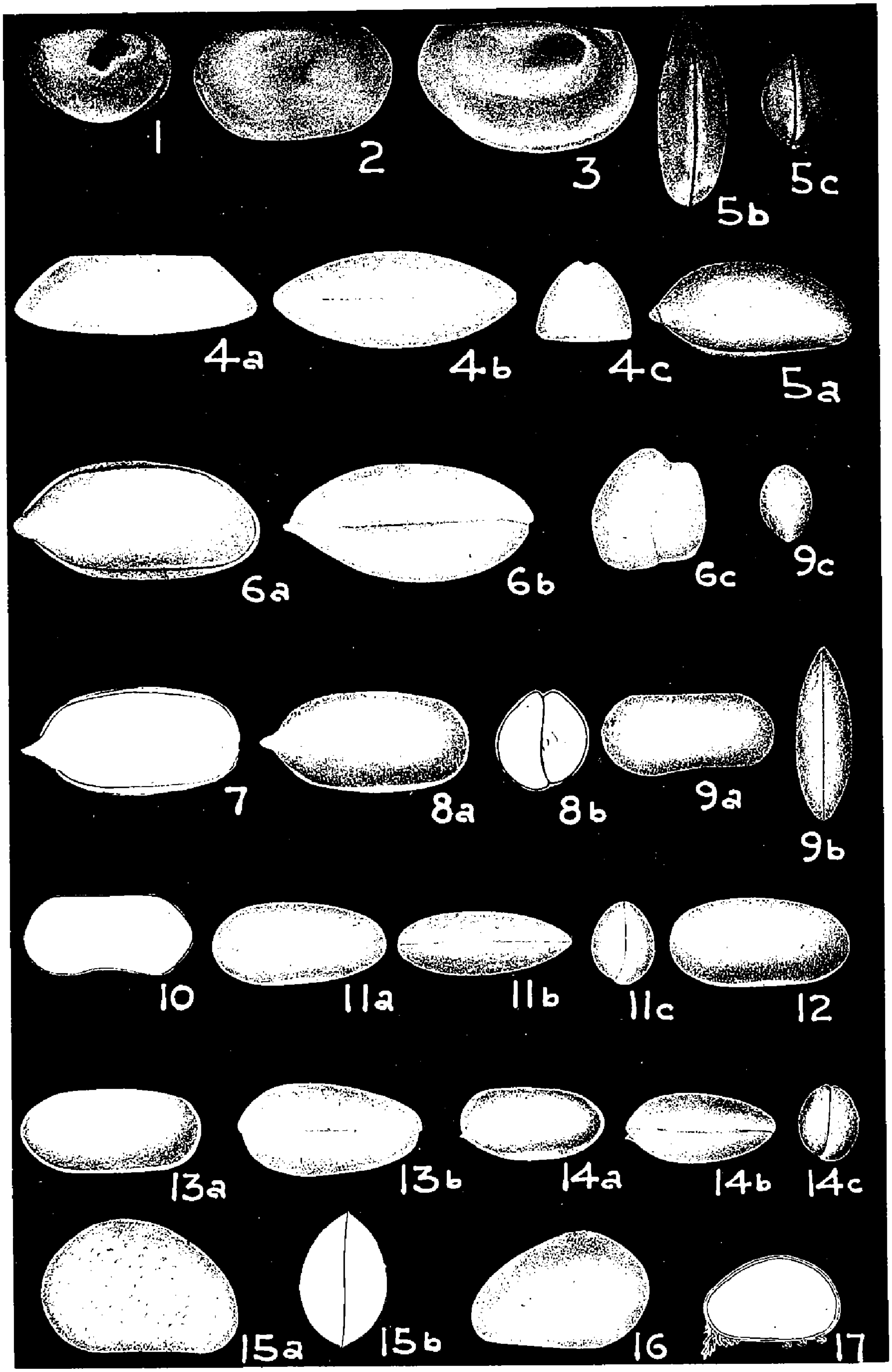
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