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A Preliminary Study of the Ostracoda of the Big Snowy Group, Mississippian, of Montana.

John C. Rabbitt

Rabbitt J.C.

A PRELIMINARY STUDY OF THE OSTRACODA OF THE BIG SNOWY GROUP, MISSISSIPPIAN, OF MONTANA

By

John C. Rabbitt

A Thesis
Submitted to the Department of Geology
in Partial Fulfillment of the
Requirements for the Degree of
Bachelor of Science in Geological Engineering

MONTANA SCHOOL OF MINES
BUTTE, MONTANA
May, 1935

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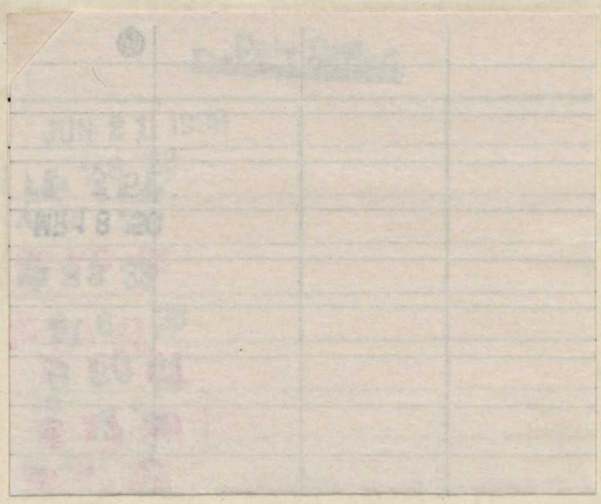

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INTRODUCTION

The Problem

In the summer of 1934, Dr. Harold W. Scott, of the Department of Geology, Montana School of Mines, assisted by Mr. George Powe, a graduate student in the same department, engaged in extensive field work in central and south-central Montana. Their object was to study the outcrops of the Quadrant formation with the view of determining, definitely, the age of that formation. To arrive at any conclusions a study of the Quadrant fauna became necessary, so careful sampling was done in the field.

Mr. Powe has started a study of the megascopic fossils of the Big Snowy group. Mr. Zeihen, of the Senior class, has worked on the sponge spicules from the quartzites of the Quadrant formation. This paper embraces preliminary work done on the ostracods from the Big Snowy Group, Mississippian in age.

Previous Work

Since the days of James Hall, noted American paleontologist, ostracods of North America have been diligently studied. A list of the early workers would include such familiar names

as T. R. Jones, John M. Clarke, W. Kirkby, Frederick McCoy and E. O. Ulrich, and among the later and present-day students are R. S. Bassler, H. N. Coryell, David M. Delo, H. L. Geis, Percy Raymond and Betty Kellett. All have made known their researches thru numerous reports so that the literature dealing with the Ostracoda is very extensive. Tertiary, Cretaceous and Paleozoic forms have been reported and described from countless localities in the East, the South, the Middle West and the Gulf Coast Region. The West has been neglected almost completely, as only a few forms have been reported in Wyoming, Colorado and Utah. To the writers knowledge no Paleozoic fossil ostracods from Montana have ever been described.

It would be impractical to include a complete bibliography of North American Ostracoda in this paper. For such a list the reader is referred to "Bibliographic Index of Paleozoic Ostracoda" by R. S. Bassler and Betty Kellet, G. S. A. Special Paper Number 1, 1934. A selected list of those references which were of help in preparing this paper will be found on page 28.

Acknowledgments

The author wishes to express his appreciation of the many valuable suggestions made by Dr. E. S. Perry, head of the Department of Geology, Montana School of Mines. Especially he wishes to thank Dr. Harold W. Scott, under whose direction the work went forward, for his untiring interest and

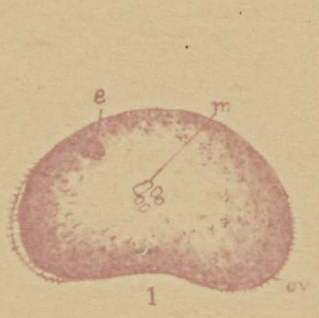
inspiring leadership. To Miss Margery Bedinger, Librarian, thanks are due for the many facilities which she made available in the necessary survey of the literature. Mrs. A. J. Lochrie of Butte made the drawings for the plates and Miss Lois Thirloway typed the manuscript.

GENERAL DESCRIPTION OF THE OSTRACODA

Anatomical Features

The Ostracoda are minute crustaceans having the entire body inclosed in a chitinous or slightly calcareous carapace, articulated along the dorsal edge to form a bivalved shell. The body, indistinctly divided into cephalic and thoracic segments, is equipped with seven pairs of appendages, divided into a pair of antennules, a pair of antennae, a pair of mandibles, two pairs of maxillae and two pairs of slender legs. All of these are adapted for creeping and swimming. The abdomen is rudimentary; there may be a single or bifurcated spinous plate at its extremity.

There is usually present a small median eye, or there may be two large lateral eyes. The position of the lateral eyes is sometimes indicated by an "eye spot" on the valves of well-preserved fossil specimens. The digestive system and reproductive organs are usually well developed, but there is not a distinct heart. Respiration is effected thru respiratory plates fastened to the mouth parts, which when in motion, keep a stream of fresh water circulating between the valves. The sexes are distinct, altho in a few species reproduction is accomplished by parthogenesis.



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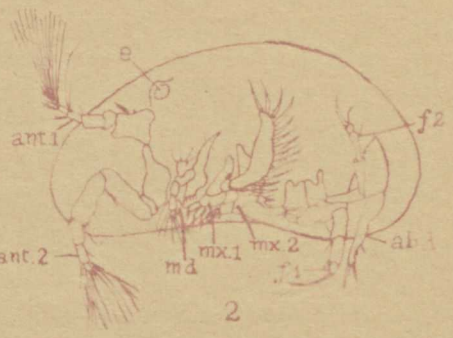

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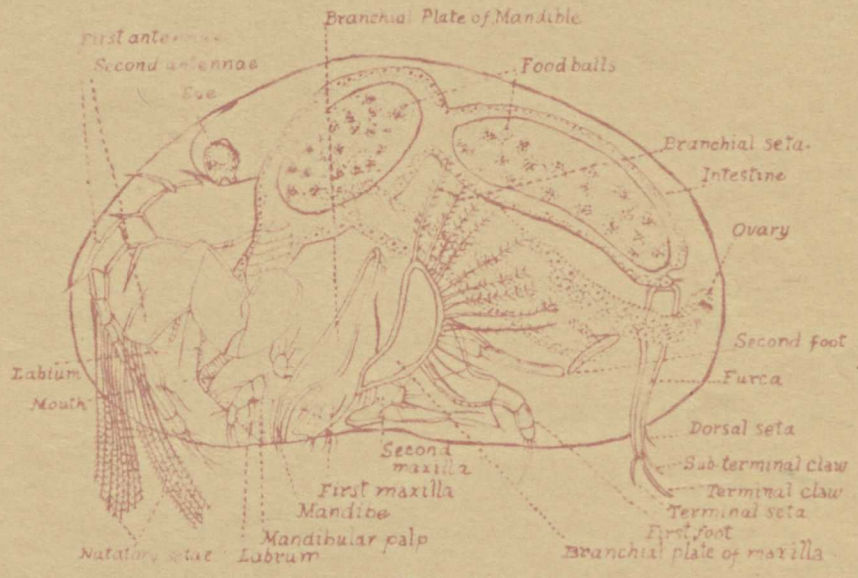


3

ANATOMY OF THE OSTRACODA
(From Bassler and Kellett)

1. Left side of the translucent shell of a recent species of Cypris, magnified, showing eye spot (e), the position of the ovary (ov), and adductor muscle scars (m).

2. Sketch showing anatomy of the same species: Median eye (e), abdomen (abd), antennule (ant. 1), antenna (ant. 2), thoracic feet (f1, f.2), maxillaw (mx. 1, mx. 2), mandible (md), (1, 2 after Gerstaker).

3. Detailed anatomy of the recent species Cypris virens Jurine (after Vavra). Ends of the adductor muscles are seen in the middle of the figure.

The Ostracoda, like all members of the Crustacea, are scavengers and feed principally on the remains of small animals and decaying vegetable matter.

Shell Characteristics

The shell ranges in length from 0.5 to 4 millimetres altho in some doubtful Paleozoic forms the length is as much as 25 millimetres. The two valves are of equal size or commonly unequal with the right or left valve overlapping at the ventral border only or at both the ventral and dorsal border or all around. The outer surface of the valves is commonly smooth or it may be pitted, granulose, striate, reticulose or hirsute.

Some fossil forms, particularly those of the Paleozoic, exhibit valves which are lobed or sulcate, or nodose, and the variations in the member, position and size of these ornamentations constitute important bases for specific and generic identification. Students of living Ostracoda base their identifications on the anatomical characteristics of the different forms; the paleontologist must depend entirely on the exterior of the shells for his determinations. It is necessary to recognize in this respect that the value of the surface ornamentations is in relation to their persistence and not to their variation.

The outline of the carapace is commonly ovate or reniform. In some cases one end or both may be pointed. The hinge line may be straight or arcuate, and is usually simple, altho in some Recent genera hinge teeth and sockets are present.

It is sometimes possible to distinguish between the sexes in fossil forms by use of the fact that in the female a brood pouch is occasionly present to a marked degree. It is exhibited by a greater obesity in the post-ventral half of the shell; in its greatest degree it consists of a semi-ovate or subglobular pouch which covers most of the ventral half of the shell.

The shell material, originally chitinous or slightly calcareous, is nearly always replaced to the point where it may consist entirely of calcite, pyrite or dolomite. The forms studied by the writer are nearly all calcareous, a few pyritized specimens having been found.

Orientation Of The Valves

The question as to which end of the carapace is anterior has presented the greatest difficulty to students of fossil Ostracoda. Jones and other authors regarded the blunter end as the posterior. Bassler agrees with Jones but is inclined to think that there are too many exceptions to that general rule, and that other criteria must be sought. Intensive study has resulted in the following four criteria of Bassler:

1. Relative width, position, and direction of the median sulcus. It is considered to be wider than either the posterior or anterior sulcus, to lie nearly always behind the mid-length of the valves and when prolonged ventrally to curve more or less backward.

2. Correlation and identification of the median and posterior lobes both of which lie behind the median sulcus and are usually separated by the posterior sulcus.
3. The outline of the valves which in straight-hinged forms is more or less oblique and widest behind with a backward swing from the hinge.
4. The location of the brood pouch which manifestly should belong to the posterior half of the carapace.

In several recent articles Bonnema insists that Jones, Ulrich, Bassler, Kummerow and others have confused the anterior and posterior ends in their descriptions of many genera. He arrives at this conclusion from the comparison of Paleozoic and living species. However, his work is not complete, and for the present the criteria cited will have to suffice.

Habitat And Distribution

The Ostracoda are world-wide in distribution. The majority are marine altho a few genera are found in fresh water. They are essentially bottom dwellers, where they creep and swim in and out of the aquatic vegetation. They are found alike in cold and warm water and exhibit a ready adaptability to all kinds of environment.

Value As Index Fossils

Fossil Ostracoda are found in all kinds of rock ranging from unconsolidated sandstones to dense limestone. They are the most common in shaly lenses in limestones. Because they

exhibit such a great variety of shell form, because of their great abundance and wide geographical distribution, they are of value as index fossils in stratigraphy. They are particularly of value, because of small size, in determining the age of beds encountered in drilling deep wells.

STRATIGRAPHY

General Description of The Big Snowy Group

The Big Snowy Group, delineated by Dr. H. W. Scott during the summer 1934, comprises those beds which commonly occur throughout central and south-central Montana, above the Mississippian Madison formation and below the Missippian Amsden formation. The beds are, in order above the Madison, the Kibbey, the Otter and the Heath, the term Heath having been proposed by Dr. Scott. A typical section of the Big Snowy Group is as follows:

(Section on the north flank of the
Big Snowy Mountains, in sec. 6, T. 12 N., R. 20E.)
(Measured by H. W. Scott)

Amsden Formation

Heath Formation:	Feet
Black, calcareous shale, fish scales. . . .	20
Limestone	4
Black, calcareous shale, <u>Chonetes</u> <u>Productus</u>, <u>Composita</u> and others	5
Black impure limestone.	1

	Feet
Black fossiliferous shale	4
Calcareous shale.	1
Black petroliferous shale, fish scales. . .	29
Brown sandstone	12
Black carbonaceous shale.	29
Cross-bedded sandstone, plant fragments . .	16
Black shale	68
Black shale partly covered.	43
Massive sandstone	27
Covered	54
Conglomeratic sandstone	7
Dark shale, partly covered.	10
Gray limestone.	12
Carbonaceous shale, petroliferous fossils, Pugnax, Conodont zone	65
TOTAL	381
Otter Formation:	
Limestone	3
Vivid green shale	48
Gray limestone.	4
Gray-green shale.	63
Gray limestone.	12
Gray shale with intercalated limestone. . .	204
TOTAL	334
Kibbey Formation:	
Red shaly sandstone, partly covered	70
Madison Formation	

These beds were formerly included in the Quadrant formation of Weed and were thus thought to be of Pennsylvanian age. It is now certain, however, that they are definite formations in themselves and are Mississippian in age.

Ostracod Zones

Ostracods are found in the Big Snowy Group in more or less definite zones as follows:

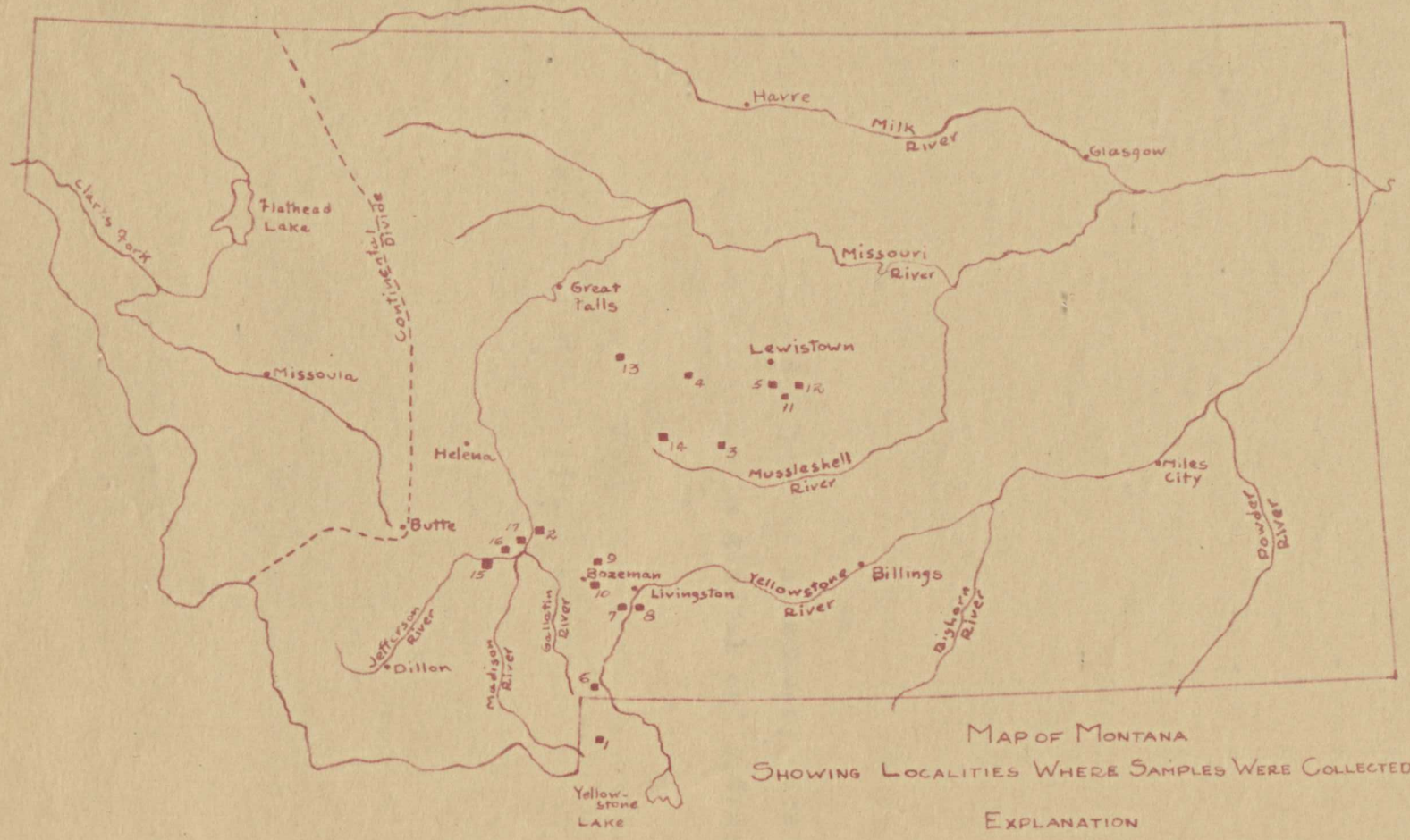
Otter	Heath
Basal calcareous shales	Limestone near top
Immediately below green zone	
Limestones near top	

They are also found in the lower and upper Amsden limestone which overlies the Heath formation in many places. Undoubtedly, future work with the Ostracoda will result in more exact definition of faunal zones which will prove of value in correlating the beds in which they are found with those of other sections.

PROCEDURE

Collection of Samples

In the field, samples were taken vertically and horizontally along the various outcrops in different sections of central and south-central Montana (See Plate 2). At important localities the samples were taken about every half-foot vertically; in other sections they were taken every few feet. Where the presence of micro-fossils was suspected, a greater amount



MAP OF MONTANA

SHOWING LOCALITIES WHERE SAMPLES WERE COLLECTED

EXPLANATION

1. QUADRANT MOUNTAIN
2. LOMBARD
3. JUDITH GAP
4. UTICA
5. BIG SNOWY MOUNTAINS
6. CINNABAR MOUNTAIN
7. YELLOWSTONE CANYON
8. YELLOWSTONE CANYON
9. ROCKY CANYON
10. ROCKY CANYON
11. SAHARA
12. DURFEE CREEK
13. KIBBEY
14. MUSSELSHELL CANYON
15. JEFFERSON CANYON
16. THREE FORKS
17. EUSTIS

of material was collected than in those zones which were not favorable. Great care was used in numbering and segregating the samples so that no confusion would result as to the location from which the rocks were secured. In addition, a note book was kept in which were entered the sample numbers and the essential descriptions of the various horizons. As a tribute to the care which Dr. Scott and Mr. Powe exercised in these important respects, it can be said that in the laboratory no trouble was met with in identifying the samples.

Laboratory Procedure

All of the samples (some 200 in number) were examined by the writer for micro-fossils in general and ostracods in particular.

The usual method of liberating micro-fossils from the inclosing rock consists in dissolving about 1 cubic inch of the material in a 1 to 2 per cent hydrochloric acid solution. The calcareous substance is slowly dissolved, leaving the fossil, if siliceous, behind. Ostracods are nearly always calcareous so that this method could not be used, altho it was tried in testing the degree of calcification of the organisms. In any case, this method is not satisfactory for shaly material.

For shales, and shaly limestones, it is usual to boil a part of the sample in a 10% solution of potassium hydroxide. The action of this reagent on the shale is partly mechanical and partly chemical, so that the rock is disintegrated and a muddy mass is formed. The mud is repeatedly decanted off

with water until the solution is clear. The micro-fossils will be found in the heavier material at the bottom. They can then be recovered by carefully transferring the pulp on to a paper, drying, and examining the fragments under a microscope. This method is satisfactory as to results, but it requires too much time. This becomes a serious disadvantage when a large number of samples have to be examined. Also, hard limestone is not amenable to this treatment.

A third method, and the one adopted by the writer after trying the preceding two, consists in crushing the rock into very small fragments, and the subsequent recovery of the fossils by washing, drying, and screening. The method in detail is as follows:

A quantity of the material is crushed to a fine consistency on an anvil and the resulting more or less powdered rock is placed in a beaker and washed repeatedly. The fine material (that which remains suspended in the water) is decanted off. The product is then spread thinly on an ordinary pie plate and dried on a hot plate, after which it is screened thru a 20-mesh screen. The fragments retained on the screen are discarded, the ostracods being found in the material which goes thru. Further concentration can be attained by screening thru 40- and 60-mesh, but these screens were not available.

The screened product is spread thinly and evenly on a frosted glass plate 4 inches square on which parallel lines have been drawn, enough space having been left between them

to just cover the field of the microscope when the lowest magnification is used. In this way, all of the material can be examined without fail by running the microscopic field up one line and down the other. A Leitz binocular microscope is used, with magnifications X17, X28 and X40, the X17 magnification being used for this preliminary examination.

As the fossils are found they are picked out of the field by means of a moistened, fine-tipped brush and transferred to a card to which they are cemented with gum tragaconth, a water soluble resin. If later the fossil must be moved a drop of water will easily loosen the cement.

The cards, known as micro-cells, are 3 inches long and 1 inch wide. They are made by pasting a strip of black-surfaced bristol board to a white piece of the same material, a $\frac{1}{2}$-inch hole having been punched in the latter. The fossils are placed in the recess surrounded by the circumference of the punched hole and are thus protected from injury. If a white background is desired, a white card is used for the base. These micro-cells are filed away in special drawers. Later, in the classifying procedure, the fossils are segregated according to genera and species, the X28 and X40 magnifications being used.

The whole operation consumes about 20 minutes, so that the crushing method can be regarded as a rapid one. The ostracods break away rather cleanly; if it is desirable to further clean them, they can be scraped with a steel needle.

No trouble was experienced with this method except in the case of very brittle limestones. In such rocks the fracture is often thru the ostracod and not around it. By using an hydraulic jack and applying a slow, even pressure, rather than a shock, this difficulty might be overcome.

It was found to be impossible to adequately photograph the fossils so as to secure relief and sharpness of focus simultaneously on all parts of the shell. One is only secured at the expense of the other. Rather than include photographs of indifferent merit in the report, it was thot best to present drawings, which have been made as accurate as possible.

In all, about 2000 ostracods have been extracted from the rocks. In some zones they were found to be exceedingly abundant; in other horizons they were very scarce. They are rarely found in black or green shales or hard, brittle limestones; they are the most numerous in shaly limestone or shaly lenses interbedded in the massive limestone. Table 1 shows the locality and formation in which the ostracods were found.

CLASSIFICATION

Criteria For Classification

As stated elswhere in this report, fossil Ostracoda are classified generically and specifically according to the external shell characteristics. The following criteria are quoted from Bassler and Kellett:

T A B L E 1

SHOWING LOCALITIES IN WHICH OSTRACODS WERE FOUND

LOCALITY	FORMATION	LITHOLOGY	OCCURRENCE	IDENTIFIED GENERA
Judith Gap	Basal Otter Middle Otter	ls & sh cal. sh	Common Abundant	Bairdia Macrocypris Pontocypris Bythocypris
Utica-Judith River	Basal Otter	ls & sh	Very abundant	
	Upper Otter	ls	Common	
	Top of Otter	sh	Rare	
	Heath	ls & sh	Very rare	
	Lower Amsden	ss	Rare	
Northern Big Snowy Mountains	Upper Heath	cal. sh	Rare	
	Top of Heath	ls	Common	
	Basal Amsden	ls & sh	Common	
	Upper Amsden	ls	Very rare	
Big Snowy Mountains	Basal Otter	ls	Common	
Lombard	Basal Otter	sh	Common	Bairdia Sansabella Paracythere Jonesina
	Top of Otter	ls	Rare	
Jefferson Canyon	Lower Amsden	ls	Rare	
Livingston	Top of Amsden	ls	Very rare	
2 miles East of Big Snowys	Basal Heath	ls & sh	Common	

"1. Difference in size, outline, convexity of valves and location of greatest thickness. Such distinctions vary greatly in value, being used in discriminating varieties, species, genera, and families, the values depending on relative persistence of occurrence.

2. Nature of hinge. It is essential to observe whether the hinge is straight, the two valves fitting evenly, or whether articulation is by overlap of the more or less rounded dorsal edge of one or the other.

3. Modification of the hinge. Modifications, such as internal denticles or external interlocking processes, are important and should be carefully noted.

4. Overlap of edges. In the study of entire carapaces, it should be observed whether the valves are unequal or equal, and when unequal, which valve overlaps the other, and whether the overlap is mainly or wholly confined to the dorsal edge (which is rather rare), to the ventral side (a more common occurrence), or takes in the entire circumference, one valve being set into the other. Such modifications are usually considered of generic and family importance.

5. Surface characters of valves. It should be observed whether the valves are simple, smoothly convex, or develop terminal spines or a border at the contact edge or a false border which overhangs the contact edges. The false border may be simple or developed

into a broad, radially lined frill. This frill may be a simple flat plate or may be convexly bowed to form a marginal chamber beneath it, or it may be modified in various other ways.

6. Lobation of valves. Good generic characters are found in the lobation of the valve. In the simplest forms there is a small subcentral depression or pit (probably always indicating the attachment of the adductor muscles) which may be prolonged slit-like as a sulcus to the dorsal edge or extended toward the ventral margin. In other forms there is a node on each side of the pit, which may be modified into long lobes. The lobe posterior to the median sulcus is designated the median lobe. This may be defined on its posterior side by another sulcus, thus separating a posterior lobe. Anterior to the median sulcus is the anterior lobe, which is often divided by another sulcus. These three lobes are present in one form or another in practically all the Beyrichiacea, and variations in their development always afford good specific characters, and often distinguish genera. Any or all of these lobes may be prolonged dorsally into spines. The confluence of the lobes, their immersion in the general surface by an increase in convexity of the valves, and their breaking up into smaller nodes or ridges are all points to be noted and are of varying

importance. Excellent examples of these features occur in the Kloedenellidae and Beyrichiidae.

7. Surface ornamentation. As a rule, reticulation and other forms of surface ornament of the valves are not of generic importance but are always useful in specific determinations. Crestlike ribs traversing the surface irrespective of the lobes, or crowning them as in Steusloffia, Mastigobolbina and Strepula, are commonly regarded as of higher value.

8. Sex characters. The presence or absence of a separate pouchlike swelling, regarded as a brood chamber for the development and protection of the larvae in many of the Beyrichiacea, is considered as a generic character."

In this report no attempt has been made to make specific determinations, as the writer feels that he has not as yet had enough experience with the fossil forms to differentiate the species. Only a few of the 2000 or more individuals have been identified as to genus. Family descriptions have been taken from Bassler and Kellett, op. cit.; generic descriptions have been taken from various sources amoung the works listed under "References."

SYSTEMATIC DESCRIPTION OF FAMILIES AND GENERA

Phylum ARTHROPODA

Class CRUSTACEA

Order OSTRACODA Latreille

Superfamily CYPRIDACEA

Family BAIRDIIDAE Brady and Norman 1892

Minute, mostly reniform or elongate-ovate, corneo-calcareous shells with thin more or less unequal valves, one overlapping the other either ventrally or dorsally, or both.

Bairdia

Genus Bairdia McCoy

Genotype Bairdia curta McCoy 1844

Synopsis Carb. Foss. of Ireland, 1844, p. 164

Shell subtriangular or rhomboidal having the greatest height near the middle; inequivalved, narrowly rounded anteriorly and more or less acuminate posteriorly; dorsal margin usually strongly convex; hinge line straight, short; left valve overlaps the right dorsally and along the ventral median third; surface smooth.

Bairdia sp. A

Plate 3 Figures 1-A, 1-B, 1-C

This species answers to the description of Bairdia rather closely. The posterior end is sharply acuminate; the left valve overlaps the right dorsally and ventrally, the ventral overlap being confined to the central portion of the ventral

margin. Length: 1.125 mm. Height: 0.54 mm.

Locality: Judith Gap, Otter formation.

Bairdia sp. B

Plate 3 Figures 2-A, 2-B, 2-C

This species is undoubtedly a Bairdia but it is not as elongate as most members of that genus. There is some doubt in the writer's mind as to which valve overlaps. If the left valve overlaps the right, than the slightly acuminate end is the anterior, a condition which is contrary to the accepted orientation of the genus. In all other respects it agrees closely with the description cited. The overlap on the dorsal margin is strong, that on the ventral margin is weak. Length: 0.90 mm. Height: 0.45 mm.

Locality: Lombard, Otter formation.

Bairdia sp. C

Plate 3 Figures 3-A, 3-B, 3-C

The outline of the carapace sub-ovate; greatest height near the middle; dorsal overlap strong and confined to central portion of dorsal margin; ventral overlap weak and confined to posterior half. Hinge-line arcuate, surface smooth. Length: 1.44mm. Height: 0.72 mm.

Locality: Judith Gap, Otter formation.

Genus Macrocypris Brady 1867

Genotype Macrocypris minna Baird

Carapace small, elongate; right valve the larger, overlapping the left dorsally and ventrally; dorsal margin arched, ventral margin straight; posterior acuminate; surface smooth.

Macrocypris sp.

Plate 3 Figures 4-A, 4-B, 4-C

This species agrees in all respects with the description cited, except that the anterior end is acuminate and not the posterior. The dorsal overlap is scarcely evident, but runs the entire length of the dorsal margin. The ventral overlap is barely perceptible. Length: 1.125 mm. Height: 0.63 mm.

Locality: Judith Gap, Otter formation.

Genus Pontocypris M. Sars 1865

Genotype Pontocypris serrulata Sars

Outline of carapace smooth, reniform, ovate or elliptical, left valve the larger, overlapping the right dorsally and ventrally; dorsal margin convex, ventral margin somewhat straighter; shell delicate; hinge simple, straight. Posterior sometimes acuminate.

Pontocypris sp.

Plate 3 Figures 5-A, 5-B, 5-C

The overlap in this species is difficult to find, causing some doubt as to the orientation. For that reason its identification as Pontocypris is doubtful; however, in outline, smoothness of surface, and simplicity of hinge line, it agrees rather closely with the description cited. Length: 0.90 mm. Height: 0.45 mm.

Locality: Judith Gap, Otter formation.

Genus Bythocypris Brady 1880

Genotype Bythocypris reniformis Brady 1880

Carapace small, reniform; dorsal margin arched, ventral margin straighter; left valve the larger, overlapping the right dorsally and ventrally; surface smooth.

Bythocypris sp.

Plate 4 Figures 1-A, 1-B, 1-C

Carapace small, reniform; dorsal margin slightly arched ventral margin straighter; left valve overlaps the right strongly in the dorsal region, ventral overlap somewhat weaker; hinge-line straight; surface smooth. Length: 0.90 mm. Height: 0.54 mm.

Locality: Judith Gap, Otter formation.

Superfamily LEPERDITIIDA Jones

Family LEPEDITELLIDAE Ulrich and Bassler 1906

Simple, unsulcated; straight hinge line and thickened, often channeled, free edges, the edge of one valve sometimes slightly overlapping the other ventrally. Dorsal region often protruding over the hinge line.

Genus Paraparchites Ulrich & Bassler

Genotype Paraparchites humerous Bassler

Carapace small, leperditoid to subovate; hinge line straight, short, usually depressed; dorsal margin of left valve projecting above hinge line; right valve the larger, overlapping the left all around, edge of right valve grooved to receive the beveled edge of the left; surface smooth.

Paraparchites sp.

Plate 4 Figures 2-A, 2-B, 2-C

Carapace small, subovate; right valve overlaps the left all around; hinge-line straight, surface smooth. Length: 0.675 mm. Height: 0.45 mm.

Locality: Lombard, Otter formation.

Genus Sansabella Roundy

Genotype Sansabella amplectans Roundy

Carapace small, left valve overlapping the right along the ends and ventral margin; hinge line straight, equal in both valves, and slightly depressed below the dorsal margins giving a channeled appearance.

Sansabella sp.

Plate 4 Figures 3-A, 3-B, 3-C

Carapace small, subelliptical; left valve overlaps the right ventrally; hinge-line straight, depressed; surface punctate. Length: 0.90 mm. Height: 0.45 mm.

Locality: Lombard, Otter formation.

Superfamily BEYRICHIACEA

Family KIRKBYIDAE Ulrich and Bassler

Valves straight hinged, joined together by a ridge or teeth in the left fitting into corresponding sockets on the right, essentially equal but with edge of right valve fitting into the slightly rabbeted edge of the left, the left valve thus slightly overlapping the right, surface reticulate with several nodes and a subventral pit or muscle spot.

Genus Paracythere Ulrich and Bassler

Genotype Paracythere granopunctata Ulrich and Bassler

Carapace sub quadrate, left valve slightly overlapping the right; granose surface, broad pit on median dorsal half of shell.

Paracythere sp.

Plate 4 Figures 4-A, 4-B, 4-C

Carapace small, subquadrate; left valve overlaps the right ventrally and around both ends; broad pit on median dorsal half of shell (The figure does not show this pit very well). Length: 0.675 mm. Height: 0.495 mm.

Locality: Lombard, Otter formation.

Family KLOEDENELLIDAE Ulrich and Bassler

Straight-hinged; right valve overlapping the left around the free edges and provided with a small process in the post-dorsal angle that fits into a corresponding depression in the opposite valve; valves shallowly unisulcate to deeply quadrilobate with practically complete transition from the one extreme to the other.

Genus Jonesina Ulrich and Bassler

Genotype Jonesina (Berychia) fastigiata (Jones and Kirkby)

Characterized by a straight and obscurely denticulate hinge-line, unequal valves, the left being the larger and a primitian sulcus somewhat behind the middle.

Jonesina sp.

Plate 4 Figures 5-A, 5-B, 5-C

Carapace small, subquadrate; left valve overlaps the right ventrally and around both ends; hinge-line straight somewhat denticulate; a long narrow sulcus near the dorsal posterior end, a crescent-shaped narrow sulcus near the dorsal anterior end on the left valve; a curved, narrow sulcus near the dorsal posterior end, and a small pit on median dorsal half of right valve. Length: 0.68 mm. Height: 0.45 mm.

Locality: Lombard, Otter formation.

CONCLUSIONS

The results attained from this preliminary study of the Ostracoda of the Big Snowy Group can be summarized as follows:

1. The Ostracoda are abundant in the Big Snowy Group, particularly in certain zones of the Otter and Heath formations.
2. The forms partially identified by the writer are certainly of Carboniferous age; they are all probably Mississippian.
3. Complete identification of those forms already secured from the rocks will almost certainly result in the establishment of new species, and perhaps of new genera.
4. The known presence of such abundant micro-fauna in the Big Snowy Group will provide a needed impetus to

intensive micropaleontological research in Montana. Such studies will help to illuminate many obscure points in Montana stratigraphy.

The personal benefit to the author of the valuable experience attained by studying the Ostracoda needs no comment.

GLOSSARY

Acuminate---pointed

Adductor muscles---muscles used in operating the valves

Antennae---feelers, articulated appendages

Antennules---small antennae

Arcuate---curved like a bow

Articulated---hinged, jointed

Bifurcated---forked

Branchial---Resembling gills

Carapace---the shell-covering

Cephalic---pertaining to the cephalon, or head

Chitinous---composed of chitin, a horny organic substance

Denticles---tooth-like processes

Denticulate---provided with denticles

Dorsal---the back, the upper side

Furca---fork or branch

Granulose, granose---granular

Hirsute---hairy

Labium---a lip or lip-like part. Lower lip

Labrum---a lip or lip-like part. Upper lip

Leperditiod---scaly

Lobe, (lobed, lobation)---a round projection

(Cont.)

Mandibles---biting or chewing appendages

Maxillae---accessory mandibles

Natatory---pertaining to, adapted for, swimming

Node, (nodose)---a knob

Ovate---oval-shaped

Parthogenesis---reproduction without fecundation by the male element

Rabbeted---recessed

Reticulate, reticulose---netted, net-like

Striate---striped, streaked, furrowed

Seta---a bristle

Sulcus, (sulcate)---a groove or furrow

Thoracic---pertaining to the thorax

Ventral---the bottom, the lower side

EXPLANATION OF PLATE III

Figure 1. *Bairdia* sp A, x31. A, Right valve; B, Left valve; C, Dorsal view.

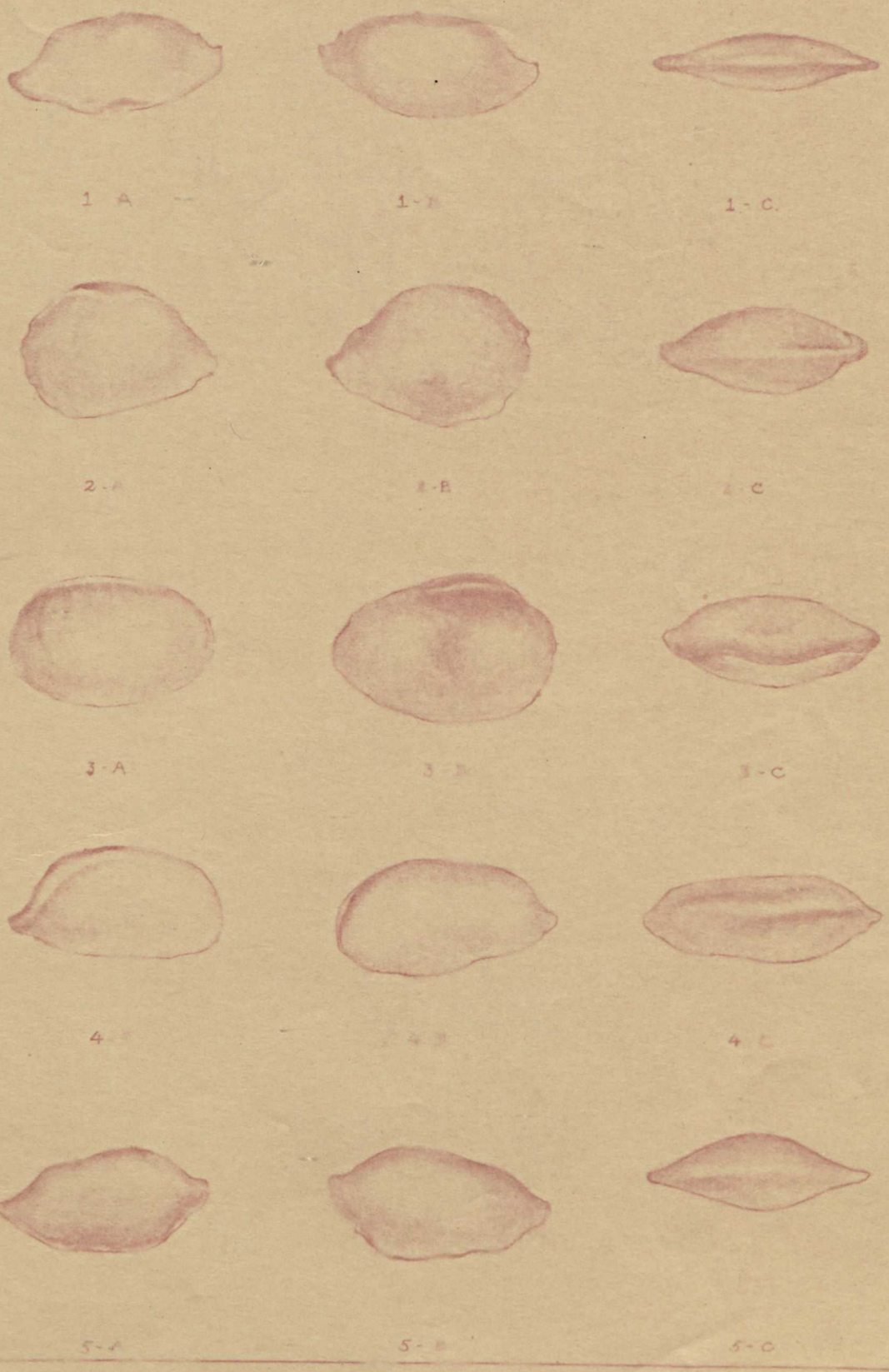
2. *Bairdia* sp B, x34. A, Right valve (?); B, Left valve (?); C, Dorsal view.

3. *Bairdia* sp C, x22. A, Right valve; B, Left valve; C, Dorsal view.

4. *Macrocypris* sp, x20. A, Left valve; B, Right valve; C, Dorsal view.

5. *Pontocypris* sp, x37. A, Right valve; B, Left valve; C, Dorsal view.

PLATE 3



EXPLANATION OF PLATE IV

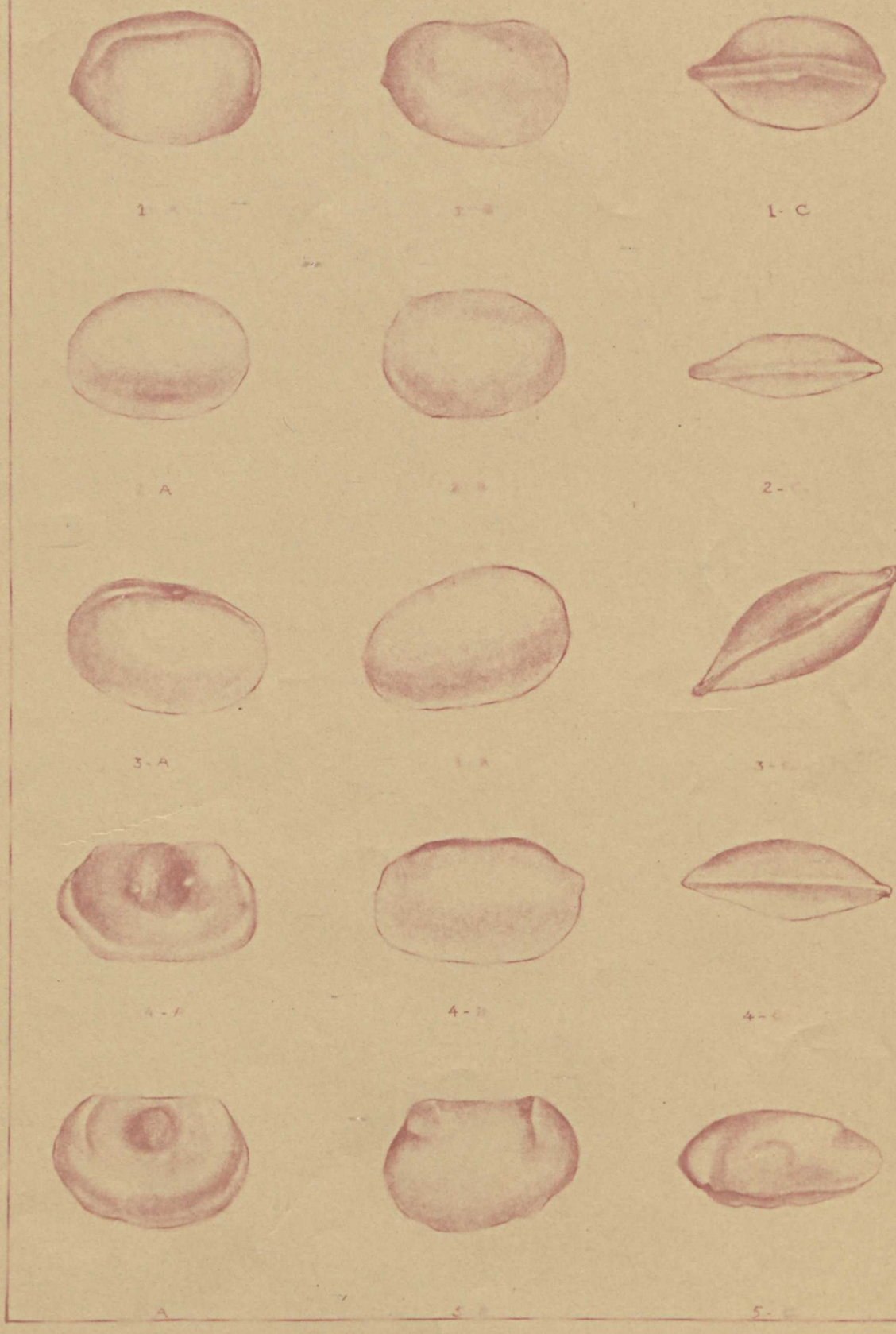
Figure 1. Bythocypris sp, x34. A, Right valve; B, Left valve; C, Dorsal view.

2. Paraparchites sp, x44. A, Right valve; B, Left valve; C, Dorsal view.

3. Sansabella sp, x37. A, Right valve; B, Left valve; C, Dorsal view.

4. Paracythere sp, x47. A, Right valve; B, Left valve; C, Dorsal view.

5. Jonesina sp, x47. A, Right valve; B, Left valve; C, One-quarter dorsal view.


1-C
1 A
3-A
4-
4-
A

REFERENCES

Alexander, Charles Ivan, Ostracoda of the Cretaceous of North Texas: Univ. of Texas Bull., No. 2907. February, 1929.

Delo, David M., Some Upper Carboniferous Ostracoda from the Shale Basin of Western Texas: Jour. of Paleontology, Vol. 4, No. 2. June 1930.

Furtos, Norma C., The Ostracoda of Ohio: Ohio Biological Survey, Bull. 29 (Vol. V, No. 6). February, 1933.

Geis, H. L., Some ostracodes from the Salem limestone, Mississippian, of Indiana; Jour. of Paleontology, Vol. 6, No. 2. June, 1932.

Grabau, A. W., and Shimer, H. W., North American index fossils: Vol. 2. 1910.

Holland, Wilbur C., The ostracods of the Neneveh limestone of Pennsylvania and West Virginia: Annals of the Carnegie Museum, Vol. XXII, Nos. 3-4 March, 1934.

Israelsky, Merle C., Upper Cretaceous Ostracoda of Arkansas: Arkansas Geol. Survey, Bull. 2. 1929.

Kellett, Betty, The ostracode genus Hollinella, expansion of the genus and description of some Carboniferous species: Jour. of Paleontology, Vol. 3, No. 2. 1929.

(Cont.)

Kummerow, E., Orientation of the carapaces of Paleozoic Ostracoda: Jour. of Paleontology, Vol. 5, No. 2. 1931.

Raymond, Percy E., The Brachiopoda and Ostracoda of the Chazy: Annals of the Carnegie Museum, Vol. VII, No. 2. June, 1911.

Roth, Robert, A revision of the ostracod genus Kirkbya and subgenus Amphissites: Publications of the Wagner Free Institute of Science, Vol. 1. 1929.

Upson, M. E., The Ostracoda of the Big Blue Series in Nebraska: Neb. Geol. Survey, Bull. 8, Second Series. June, 1933.