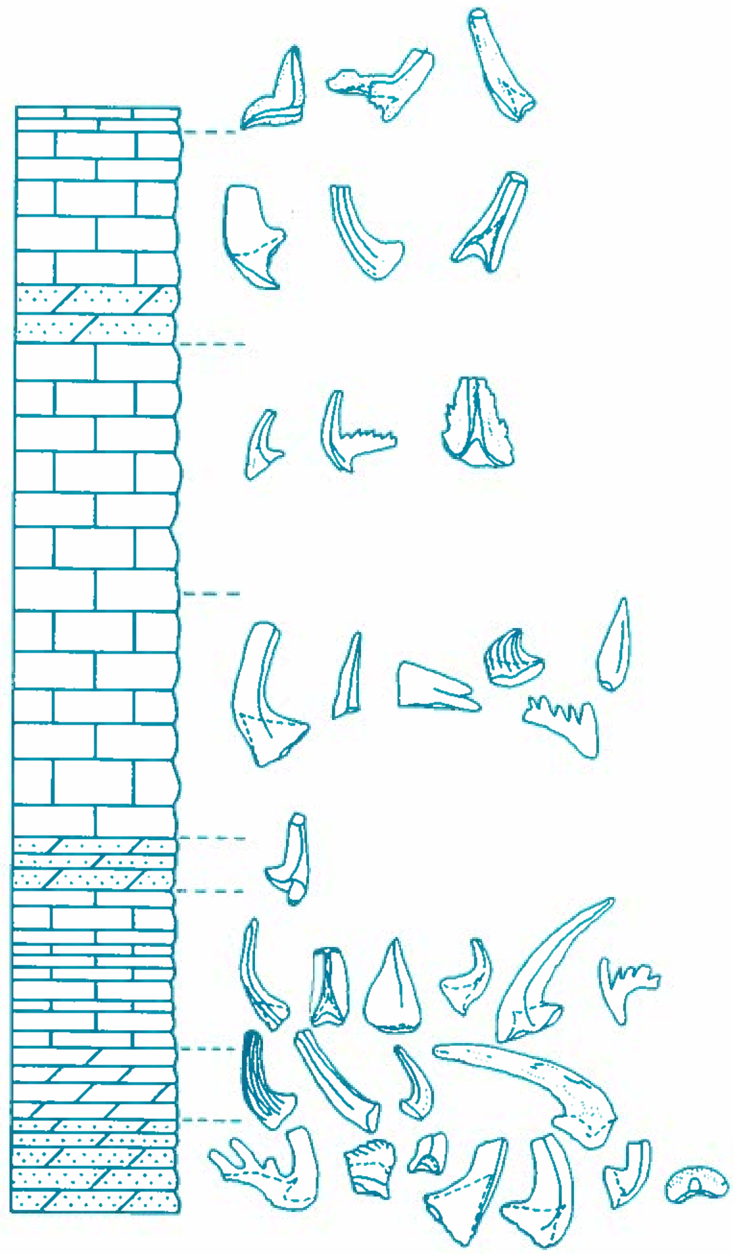
Conodonts from El Paso Group (Lower Ordovician) of westernmost Texas and southern New Mexico

by JOHN E. REPETSKI



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by John E. Repetski

Prepared in cooperation with the United States Geological Survey

COVER SKETCH—SKETCHES OF SOME OF THE BIOSTRATIGRAPHICALLY IMPORTANT CONODONTS FOUND IN THE EL PASO GROUP, shown in the intervals in which they first appear at the type section.

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Abstract

Samples were taken at 20-ft (6-m) intervals through a 1,345-ft (410-m) section of the El Paso Group (Lower Ordovician) in the southern Franklin Mountains of westernmost Texas and southern New Mexico as part of a detailed study of the conodonts of that unit. The succession is predominantly dolostone in the lower part and limestone in the upper part of the section. All of the 1-kg samples processed yielded conodonts. More than 16,500 conodont elements were recovered, and preservation of the conodonts ranges from poor to good. Altogether, 145 species are described and/or discussed taxonomically. The conodonts are distributed among 30 genera, of which *Cristodus* is new. Of the 145 species, 41 are discussed in terms of multielement taxonomy, and 104 are discussed in form taxonomy. New species named herein include: *Clavohamulus lemonei, Cristodus loxoides, Drepanodus pseudoconcavus* s. f. , *Histiodella donnae, Juanognathus hayesi, Oistodus? lecheguillensis, Protopanderodus leei, Reutterodus borealis, Scolopodus abruptus* s.f., *Scolopodus acontiodiformis, S. acontiodiformis angularis, S. bolites, S. filosus xyron, S. kelpi, S. parabruptus, S. carlae,* and *S. floweri.* The conodonts range in age from early (but not earliest) to late Canadian. North American conodont Fauna C is represented in the lowermost beds of the El Paso Group in west Texas. Diagnostic conodonts of Fauna D appear between 180 ft (55 m) and 300 ft (91.5 m) above the base of the section. Elements of Fauna E appear abruptly at 839 ft (255.7 m). Fauna 1 is represented in the uppermost El Paso; diagnostic elements of this fauna appear between 1,140 ft (347.5 m) and 1,300 ft (396.2 m) above the section base. Correlation by means of conodonts is discussed, and the El Paso faunal sequence is compared with faunas from Lower Ordovician conodont-bearing successions in the United States and abroad.

Introduction

Conodonts of Early Ordovician age are as yet quite poorly known , especially considering the relatively widespread occurrence of rocks of that age. Lindström (1971) and Ethington and Clark (1971) have summarized the knowledge of Early Ordovician conodonts of Europe and North America. Contributing to the paucity of definitive studies of Early Ordovician conodonts, at least in North America, is the widespread occurrence through this interval of dolostones that are difficult to disaggregate. Sections that yield to acidizing techniques and that are partly to nearly continuous through the Lower Ordovician do exist, and several of these sections are presently the objects of intense conodont study.

In North America, important sequences of this age being studied are those of the Great Basin; the Arbuckle Group of southern Oklahoma; the Canadian Rocky Mountains; the northern and central Appalachians; the Canadian Arctic; and the El Paso Group of western Texas, New Mexico, and Arizona.

Objectives

The primary purpose of this paper is to report, describe, and illustrate the conodont fauna recovered from the type section of the El Paso Group. Secondly, the conodonts of the El Paso Group are compared and correlated, where possible, with conodont faunas recovered from Lower Ordovician sequences elsewhere. Most of this comparison is done within taxonomies. Biostratigraphic and taxonomic work is continuing on the conodonts from the El Paso Group and related strata from sections in the Florida and Caballo Mountains, New Mexico, and from other sections in New Mexico and southeastern Arizona, as well as on the fauna recovered for this study.

Procedures

Samples of 2-3 kg were taken at approximately 20-ft (6.1-m) stratigraphic intervals along a section measured across the El Paso Group in the southern Franklin Mountains in westernmost Texas in May 1973 (Fig. 1). The thickness was measured across strike using Brunton compass and Jacob's staff. The measured section (Fig. 2) is just south of the section described by Cloud and Barnes (1948). I measured 1,345 ft (410 m) of El Paso along the traverse. This thickness is greater than the approximate 1,000 ft (305 m) given by Richardson (1909) and less than the 1,590 ft (485 m) measured by Cloud and Barnes (1948). Kottlowski (1963, p. 16) stated that " in the southern Franklin Mountains, the El Paso Limestone is 1,355 or 1,590 feet thick (Cloud and

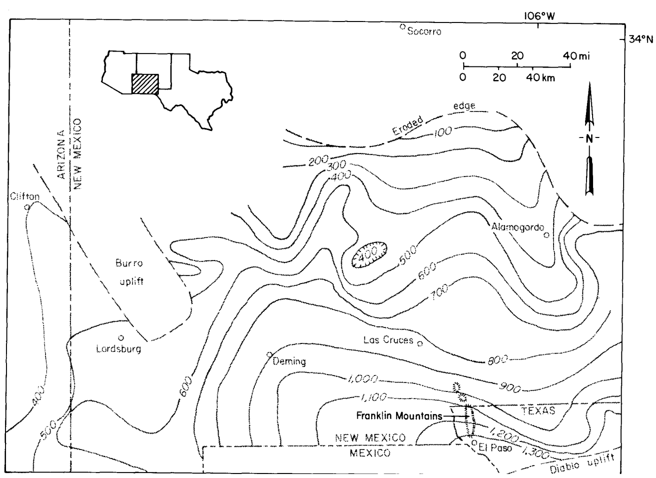

FIGURE 1—ISOPACH MAP (THICKNESSES IN FEET) OF EL PASO GROUP (FROM KOTTLOWSKI, 1963).

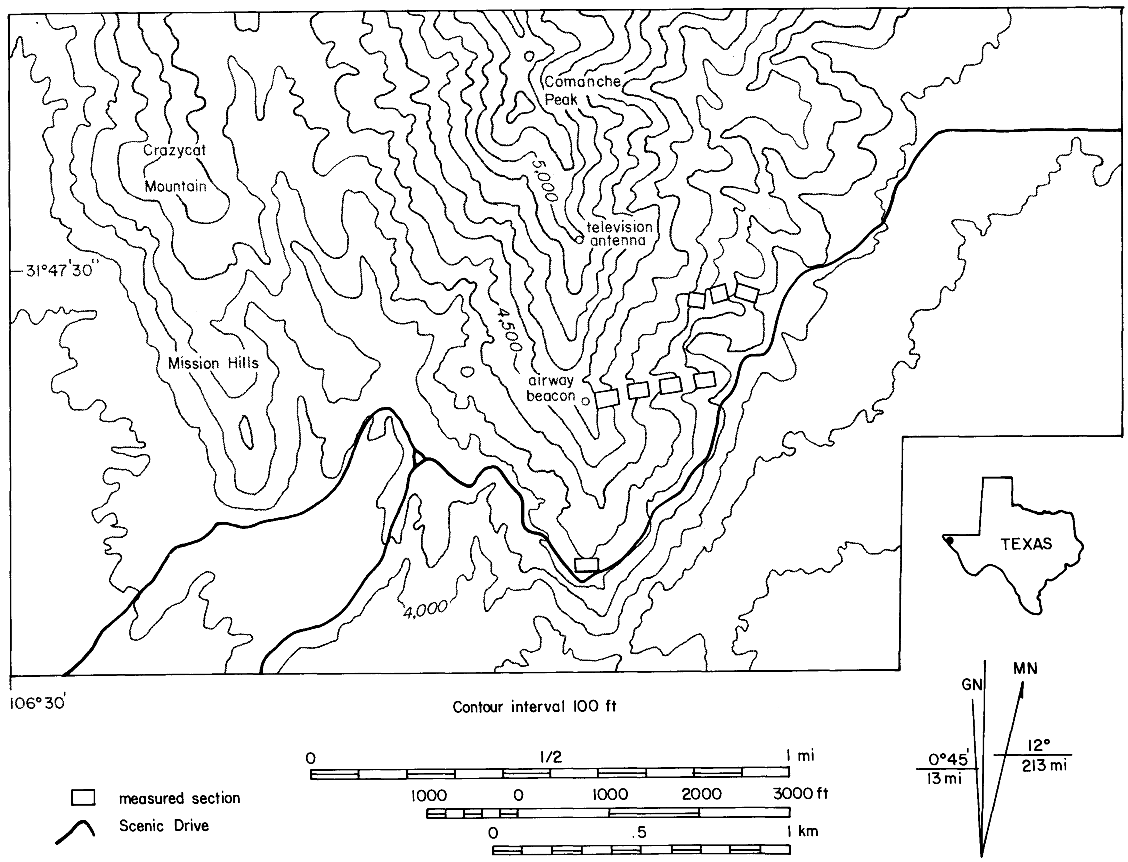

FIGURE 2—MAP OF SOUTHERN END OF FRANKLIN MOUNTAINS SHOWING LOCATION OF SAMPLED SECTION. (Enlarged from USGS 7 1/2-min-series topographic map, El Paso quadrangle, 1955, photorevised 1973).

Barnes, 1948)." This is an ambiguous statement in itself; however, when considered with Kottlowski's (1963, p. 15) isopach map of the El Paso (Fig. 1), it suggests that my 1,345 ft (410 m) is close to the actual thickness. Discrepancies in measured thicknesses could be the results of measuring errors, undetected faults across sections, or actual differences in thickness (for example, measuring across or between bioherms present in the middle and upper parts of the unit). Each of my sample localities was marked by nailing an aluminum strip into the sampled bed or beds. Each aluminum strip is embossed with the section code SD (Scenic Drive) and the footage above the base of the section.

One kilogram of each sample was processed, using standard techniques (Collinson, 1963). A 140-mesh screen was used to wet-sieve the acidized residues. All samples produced conodonts, although abundance and quality of preservation vary widely. In only one sample (SD/460) were the conodonts preserved too poorly for identification . The taxa and their abundances and ranges are presented in table 1 (appendix).

The conodont color-alteration index (CAI of Epstein and others, 1977) of the Scenic Drive section conodonts is 3-3$^{1}/_{2}$, indicating that these rocks have been heated to 120-150°C.

Figured specimens

The conodonts illustrated here were photographed on scanning electron microscopes at the U.S . National Museum of Natural History. All the figured specimens are deposited in the conodont collections of the Department of Geology, University of Missouri, Columbia, Missouri. Catalogue numbers are preceded by the letters UMC.

Comments on taxonomy

Multielement taxonomy is applied wherever possible to the conodonts of this collection. For multielement taxa involving elements that have distinct, nontransitional morphologies, each form is identified in table 1 (in back pocket) as to its occurrence and abundance. Elements that could not be placed in multielement apparatuses are identified as form species by the designation s. f. *(sensu formo)* after the name.

The El Paso Group contains many elements that, in the form sense, resemble forms described originally from the Baltic area (Pander, 1856; Lindström, 1955). In many instances the proposed multielement apparatuses involving those elements (Lindström, 1971; van Wamel, 1974) cannot be recognized in the El Paso fauna at hand because of missing elements and dissimilar element ranges. Indeed, differences of opinion exist among paleontologists working on the Baltic faunas as to the elemental components of several multielement apparatuses (see, for example, Lindström, 1971 and van Wamel, 1974). In his report on Arenigian conodonts from central Nevada, Ethington (1972) expressed difficulties similar to those encountered herein, in attempting to recognize multielement apparatuses proposed previously for elements of the Baltic region. This problem may be caused by the occurrence of homeomorphic elements of different species in the two regions. At this preliminary stage in our understanding of North American Early Ordovician conodonts, a conservative taxonomic approach is warranted.

Previous work

The El Paso Formation was named by Richardson (1904), who later (1909) restricted the El Paso to include only Lower Ordovician rocks. The unit was raised to group status by Kelley and Silver (1952), who distinguished lower (Sierrite) and upper (Bat Cave) lithic units in the Caballo Mountains, south-central New Mexico. Cloud and Barnes (1948) divided the El Paso of the type area into units A, B, and C, in ascending order; they correlated the El Paso with other sequences of Canadian age, most notably the Ellenburger Group of the Llano uplift of central Texas. Flower (1964) gave geographic names to units defined previously as faunal zones. Flower's terms (summarized in Flower, 1969) are probably the most widely used at present. Lucia (1969) established lithic formational units and correlated these units with Flower's faunal zones. Recently, Hayes and Cone (1975) presented a new formational subdivision of the El Paso Group based on lithic units they recognized in many sections in New Mexico and Texas. Fig. 3 shows the position of key measurements in the Scenic Drive section relative to the formational units of Flower (1969), LeMone (1969), and Hayes and Cone (1975).

The El Paso Group is composed chiefly of carbonate, limestone being dominant in the upper part and dolostone in the lower part. Quartz sand is abundant at a few horizons. Fig. 1 shows the distribution and thickness of the unit. For comprehensive treatments of El Paso lithology and/or stratigraphy, see Cloud and Barnes (1948), Kottlowski and others (1956), Kottlowski (1963), Flower (1969), Lucia (1969), LeMone (1969), and Hayes and Cone (1975).

Ethington and Clark (1964) described conodonts from the El Paso Group of the southern Franklin Mountains. These conodonts were recovered from Cloud and Barnes's unit B_1, which is in the lower middle part of the succession. The material from that study was used here for comparative purposes.

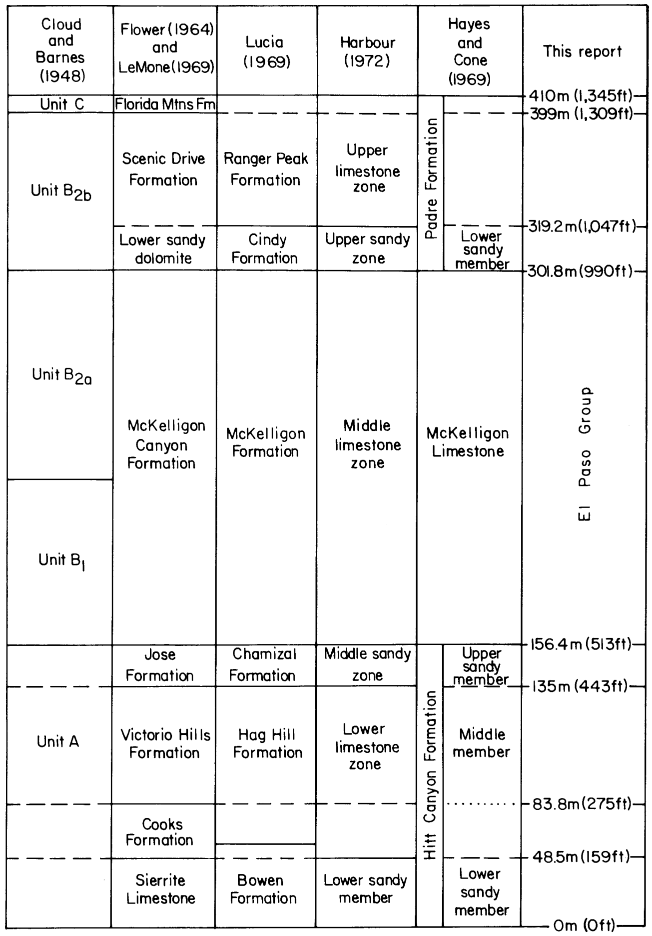

FIGURE 3—CHART SHOWING SUBDIVISIONS USED BY VARIOUS WORKERS FOR THE EL PASO GROUP IN WESTERNMOST TEXAS (modified from Hayes and Cone, 1975). As the subdivision terminology is not stabilized at present and as a conodont zonation is not being proposed herein, I have treated the sequence as El Paso Group undifferentiated as based on one sampled section. Measurements (in feet and meters above the base of the section) have been included, allowing comparison of the conodont sequence with the various lithic units.

ACKNOWLEDGMENTS—Many individuals and institutions contributed to make the completion of this project possible. R. L. Ethington of the University of Missouri (Columbia) suggested the project, and he and Godfrey S. Nowlan, Geological Survey of Canada, critically reviewed this manuscript. Ethington also made available his extensive collections for comparative study. J. H. Stitt and D. E. Metter, University of Missouri (Columbia), read an earlier draft of this paper. I profited from many discussions with colleagues and fellow students T. R. McHargue, C. Wilson Potter, and especially D. J. Kennedy. David LeMone, Michael Urbach, and Donald Vorhees, University of Texas (El Paso), helped familiarize me with the Scenic Drive section; Vorhees also assisted with part of the sampling. Rousseau H. Flower contributed his vast knowledge of the El Paso Group and Canadian stratigraphy in many discussions and helped me collect from two additional sections of the El Paso Group on a trip funded by the New Mexico Bureau of Mines and Mineral Resources. Facilities and funding for this project were supplied by the Geology Department of the University of Missouri (Columbia), a National Science Foundation Graduate Traineeship, an M. G. Mehl Paleontology Award, and an E. J. Palmer Award. Additional funding for supplies was provided by National Science Foundation grant GP-4786. The preparation of this manuscript for publication was supported by the U.S. Geological Survey. Susan Braden, Smithsonian Institution, aided with the SEM (scanning electron microscope) photography and H. E. Mochizuki, R. H. McKinney, and E. Stromberg, U.S. Geological Survey, helped in preparing the plates and illustrations. Donna Repetski assisted with sampling, data compilation, drafting, and photography. She also typed the manuscript.

Ethington made available for study the type material of Branson and Mehl (1933) from the Jefferson City and Plattin Formations. The State University of Iowa loaned the type material from the Prairie du Chien Group (Furnish, 1938), and Morris Peterson of Brigham Young University loaned specimens from the El Paso Group described by Ethington and Clark (1964).

Faunal evaluation

The conodonts recovered in this study range in age from early (but not earliest) to late Canadian. A summary of Early Ordovician conodonts from North America was given by Ethington and Clark (1971), who presented a sequence of five conodont faunas through the Canadian. The presence of *Loxodus bransoni* Furnish, *Acanthodus lineatus* (Furnish), *Paltodus bassleri* Furnish, *Acodus oneotensis* Furnish, *Acodus triangularis* (= *Oistodus? triangularis* Furnish), and *Drepanoistodus suberectus* (Branson and Mehl) in the basal bed of the Scenic Drive section indicates that Ethington and Clark's Fauna C is the lowest fauna present in the El Paso Group at this locality. The initial appearance of elements of Fauna D is sporadic. Disregarding the generalized element *Drepanodus parallelus* Branson and Mehl (= *D. subarcuatus* Furnish), which is present in the lowest samples, the distinctive elements *Scolopodus rex* Lindström s.f. (= *S. cornutiformis* of some authors), *S. quadraplicatus* Branson and Mehl s.f., and *Macerodus dianae* Fohraeus and Nowlan (= *Paltodus* sp. C of Ethington and Clark, 1971) make their appearance, respectively, at 180 ft (55 m), 180 ft (55 m), and 300 ft (91 m) above the base of the El Paso Group. *Oistodus* cf. *0. parallelus* Pander s.f. and *0. forceps* Lindström s.f. first appear at 300 ft (91 m) and 320 ft (97 m).

Diagnostic elements of Fauna E appear abruptly in sample SD/839, 839 ft (256 m) above the base of the section. These taxa include *Oepikodus communis* (Ethington and Clark) and *Juanognathus variabilis* Serpagli (= *Paltodus* sp. D of Ethington and Clark, 1971).

Fauna 1 of Sweet and others (1971), a fauna that apparently spans the Lower-Middle Ordovician boundary, is represented in the uppermost part of the El Paso Group. Elements of Fauna 1 and their levels of first occurrence are as follows: New Genus A (of Sweet and others, 1971) at 1,300 ft (396 m); *"? Spathognathodus* sp." (= New Genus B of Sweet and others, 1971) at 1,140 ft (347 m); *Oistodus* cf. *0. lanceolatus* Pander (= *0.* sp. A of Sweet and others, 1971) at 1,220 ft (372 m); and *Protopanderodus asymmetricus* Barnes and Poplawski s.f. (= *Paltodus* sp. A of Sweet and others, 1971) at 1,140 ft (347 m).

Correlation

Correlation of units bearing conodonts of the faunal associations discussed by Ethington and Clark (1971) and by Sweet and others (1971) with the El Paso Group will be treated here only in the most general manner. Those two papers include comprehensive discussions of the rock units that contain the various faunal associations. The occurrence of the studied taxa in other areas is detailed in the systematic taxonomy section of this report.

The lower 100 to 160 feet (30 to 49 m) of the Scenic Drive section has a fauna similar to rock units containing Fauna C (Ethington and Clark, 1971). Other units containing similar faunas are: the lower part of the Dumugol Beds of the Choson Group of Korea (Lee, 1970, 1975a); the A_{II} subdivision of the Estonian sequence studied by Viira (1974); the upper part of the Ninmaroo Formation (= *Cordylodus rotundatus-C. angulatus* and *Chosonodina herfurthi-Acodus* assemblage zones) of western Queensland, Australia (Druce and Jones, 1971); the upper part of the Pander Greensand of the Bonaparte Gulf basin and probably the Claravale sequence in the Daly River basin, northwestern Australia (Jones, 1971); the upper Shirgesht Formation (assemblage zone 7 and possibly 6) in the Derenjal Mountains of northern Iran (Müller, 1973); the lower part of the Chun'sk Stage sequence of southeastern Siberia (Abaimova, 1971, 1972, 1975); and the older of the two faunas from the Summit Limestone, Nelson, New Zealand (Cooper and Druce, 1975).

Samples from about 180 ft (55 m) to 821 ft (250 m) above the base contain Fauna D of Ethington and Clark (see Ethington and Clark, 1971, p. 73-77, 79, for discussion of units with Fauna D). Units containing Fauna D that have been reported since 1970 include: part of the Emanuel Formation of Western Australia, constituting the range of *Acodus deltatus deltatus* and *dylodus gracilis* (McTavish, 1973); two samples from the Mystic Conglomerate of southern Quebec, Canada (Barnes and Poplawski, 1973) that contain *Paracordylodus gracilis;* part or all of the Arenigian part of the Choson Group of Korea (Lee, 1970); the lower part *(pre-Oepikodus communis)* of Ethington's (1972) section 1 of the Ninemile Formation of central Nevada; the St. George Formation of Newfoundland (Uyeno and Barnes, 1970); the Oxford Formation in southeast Ontario and northern New York, as used by Bond and Greggs (1973); the upper part of the Nepean Formation and the lower part of the March Formation near Ottawa, Ontario (Brand and Rust, 1977); and possibly the lower part of the San Juan Limestone of Argentina (Serpagli, 1974), although some of the forms found there *(Reutterodus, Protopanderodus leonardii)* do not appear in the El Paso Group until much higher in the section.

Conodonts characteristic of Fauna E appear at 839 ft (256 m) above the base of the section, and some range to the top of the section. Besides the units cited by Ethington and Clark (1971), other units containing elements of Fauna E include: the upper part of the Ninemile Formation in central Nevada (Ethington, 1972); the uppermost Emanuel Formation and the Gap Creek Formation of Western Australia (McTavish, 1973); the West Spring Creek Formation (Potter, 1975) and possibly at least the uppermost 6 inches of the Kindblade Formation of southern Oklahoma (on the basis of the presence of one prioniodiform element of *Oepikodus communis* in a reconnaissance sample in D. J. Kennedy's undescribed collections); a part of the San Juan Limestone of Argentina (Serpagli, 1974); and the upper part of the Chun'sk Stage sequence of southeastern Siberia (Abaimova, 1972, 1975).

Elements of Fauna 1 of Sweet and others (1971) first appear at 1,140 ft (347 m) above the base and range to the top of the section. Units other than those mentioned by Sweet and others (1971) that contain the diagnostic conodonts of Fauna 1 include: the Mystic Conglomerate of Quebec (Barnes and Poplawski, 1973), although the Mystic samples, except for the two samples containing *Paracordylodus gracilis,* are dominated by unquestioned Middle Ordovician conodonts; the upper part of the West Spring Creek Formation of southern Oklahoma (Potter, 1975); and part of the San Juan Limestone of Argentina (Serpagli, 1974).

Exact correlatives of Serpagli's (1974) local assemblage zones cannot be recognized in the El Paso Group of the southern Franklin Mountains. Elements of his local assemblage zone A *(Reutterodus andinus? , Protopanderodus leonardii)* appear only in the upper part of the Scenic Drive section, at 1,180 ft (360 m) and 800 ft (244 m). However, *Paracordylodus gracilis,* found only in local assemblage zone A in the San Juan Limestone of Argentina, occurs at a low level in the El Paso Group (320-440 ft or 97-134 m) at Scenic Drive. Elements of local assemblage zones B, C, and D (Serpagli, 1974) occur in El Paso strata containing Faunas D and E of Ethington and Clark (1971) and Fauna 1 of Sweet and others (1971).

Flower (1969) indicated the approximate correlations in the El Paso sequence of the lettered trilobite zones established by Ross (1951) and Hintze (1953) for Lower Ordovician strata in Utah and Nevada. Flower (1969, fig. 2) concluded that the El Paso Group in westernmost Texas ranges from trilobite zone B or C at the base to zone J at the top. This correlation is supported by cornparison of the conodonts of the El Paso Group with those recovered from the Lower Ordovician rocks of western Utah (R. L. Ethington, personal communication, 1975, 1976).

Systematic paleontology

GENUS *ACANTHODUS* Furnish, 1938
TYPE SPECIES: *Acanthodus uncinatus* Furnish, 1938

Acanthodus lineatus (Furnish) s.f.
P1. 1, figs. 1, 3

Drepanodus lineatus Furnish, 1938, p. 328, p1. 41, figs. 33, 34; text fig. 1H.
Acanthodus sp. A., Hass, *in* Sando, 1958, p. 841-842, p1. 2, fig. 20.
Acanthodus cf. *uncinatus* Furnish. Lindström, 1964, p. 137, text fig. 47f.
Acodus n. sp. Ethington and Clark, 1965, p. 187, p1. 2., figs. 3, 4.
Distacodus n. sp. Ethington and Clark, 1965, p. 190, p1. 2, figs. 1, 2.
Acanthodus lineatus (Furnish). Ethington and Clark, 1971, p. 73, p1. 1, fig. 4; Abaimova, 1972, text fig. 1(18); Abaimova, 1975, p. 29-30, pl. 1, figs. 1-5; text fig. 6(1, 2); Repetski and Ethington, 1977, p. 95-96, p1. 1, fig. 7.
Acanthodus costatus Druce and Jones, 1971, p. 54-55, p1. 5, figs. la-5c; text fig. 19a; Müller, 1973, p. 26, p1. 8, figs. 8-12.
?*Acanthodus costatus* Jones, 1971, p. 42-43, p1. 1, figs. 4a, b.

DISCUSSION-As was suggested by Ethington and Clark (1965), *Acanthodus lineatus* s.f. is involved in a symmetry-transition series with three end-member morphologies. See Furnish (1938, p. 328) for a description of the strongly recurved form with a flared base and Ethington and Clark (1965, p. 187, *Acodus* n. sp.; p. 190, *Distacodus* n. sp.) for a description of the tall, less strongly recurved elements having one or two lateral costae. Inspection of a large collection of well-preserved elements from the Manitou Formation (R. L. Ethington, undescribed collections) clarifies that these three forms have posterior denticulation on the distal part of the cusp. Therefore, as suggested by Druce and Jones (1971, p. *55), Acanthodus costatus* s.f. becomes a junior synonym of *A. lineatus* s.f.

OCCURRENCE-This distinctive form species has been reported from the Blue Earth beds of Minnesota as used by Furnish (1938), the Dry Creek Shale of Montana (Lindström, 1964), the Stonehenge and Rockdale Run Formations of Pennsylvania (Sando, 1958), the Columbia Ice Fields section of Alberta (Ethington and Clark, 1965), northern Iran (Müller, 1973), Queensland (Druce and Jones, 1971) and northwestern Australia (Jones, 1971), Siberia (Abaimova, 1972, 1975), and the Collier Shale of Arkansas (Repetski and Ethington, 1977). It is one of the most abundant elements in the lower El Paso Group at Scenic Drive. In the Scenic Drive section, *A. lineatus* s.f. was found in samples SD/0-120, 160, 240, and 260.

NUMBER OF SPECIMENS-403.

REPOSITORY-UMC 1058-9, 10.

Acanthodus uncinatus Furnish s.f.
P1. 1. fig. 4

Acanthodus uncinatus Furnish, 1938, p. 337, p1. 42, fig. 30, text fig. 2B; Druce and Jones, 1971, p. 55-56, p1. 6, figs. 9a-12c; text fig. 19b.
non Acanthodus cf. *uncinatus* Furnish. Lindström, 1964, p. 137, text fig. 47f [= *Acanthodus lineatus* s.f.].

DISCUSSION-Only one specimen has enough of the distal part of the cusp preserved to show the serration on the posterior margin. Some of the specimens from the lower El Paso Group here assigned to the drepanodiform element of *Drepanoistodus suberectus* subsp. A may actually belong in *Acanthodus uncinatus* s.f.

OCCURRENCE-A. *uncinatus* s.f. has been reported from the Blue Earth beds and the Oneota Dolomite of Minnesota (Furnish, 1938) and from Queensland, Australia (Druce and Jones, 1971). One identifiable specimen was recovered in sample SD/80.

NUMBER OF SPECIMENS-One.

REPOSITORY -UMC 1060-1.

Acanthodus sp. s.f.
Pl. 1, fig. 2

DISCUSSION-Several samples contain fragments of the serrated distal ends of *Acanthodus* cusps. Because this is the only genus from the Lower Ordovician presently known to possess this distinctive feature, recording the occurrence of these samples (Moskalenko, 1972, 1973, reported Middle and Late Ordovician conodonts with distal cusp serration) is of value. *Acanthodus* sp. s.f. is reported only in those samples in which the basal part of either *A. lineatus* or *A. uncinatus* has not been recognized.

OCCURRENCE-SD/280, 320, 340.

NUMBER OF SPECIMENS-4.

REPOSITORY-UMC 1063-3.

GENUS *ACODUS* Pander, 1856
TYPE SPECIES: *Acodus erectus* Pander, 1856

Acodus delicatus Branson and Mehl
Pl. 1, figs. 5-9

ACODIFORM element:

Acodus delicatus Branson and Mehl, 1933, p. 56, p1. 4, fig. 10.

CORDYLODIFORM element:

Cordylodus simplex Branson and Mehl, 1933, p. 64, p1. 4, fig. 11.
Drepanodus tenuis Moskalenko, 1967, p. 107-108, p1. 23, figs. 5-11; text fig. 9; Moskalenko, 1973, p1. 15, fig. 8.
?*Drepanodus* cf. *verutus* Hadding. Moskalenko, 1967, p. 108-109, p1. 22, fig. 13; text fig. 10.

PALTODIFORM element:

Paltodus distortus Branson and Mehl, 1933, p. 62, p1. 4, fig. 12.
Distacodus baikiticus Moskalenko, 1967, p. 104-105, p1. 22, figs. 810; text fig. 6; Moskalenko, 1973, p1. 15, fig. 5.

OISTODIFORM element:

Oistodus expansus Branson and Mehl, 1933, p. 60, p1. 4, fig. 4.
Acodus sibiricus Moskalenko, 1967, p. 102-103, p1. 22, figs. 5-7; Moskalenko, 1973, p1. 15, fig. 4.

The trichonodelliform element has a thinly sheathed base which is expanded laterally and posteriorly. The cusp is deflected orally above the base to a proclined to suberect position. The unit is convex anteriorly, strongly so in the cusp region and only gently convex basally. Each side bears a prominent, sharp, posterolaterally directed costa that becomes wider basally and that may extend beyond the basal margin. The posterior edge of the unit is keeled along the entire length. Posterolateral faces of the unit are flat or nearly so. The basal margin is thin between costae and the basal cavity is deep and

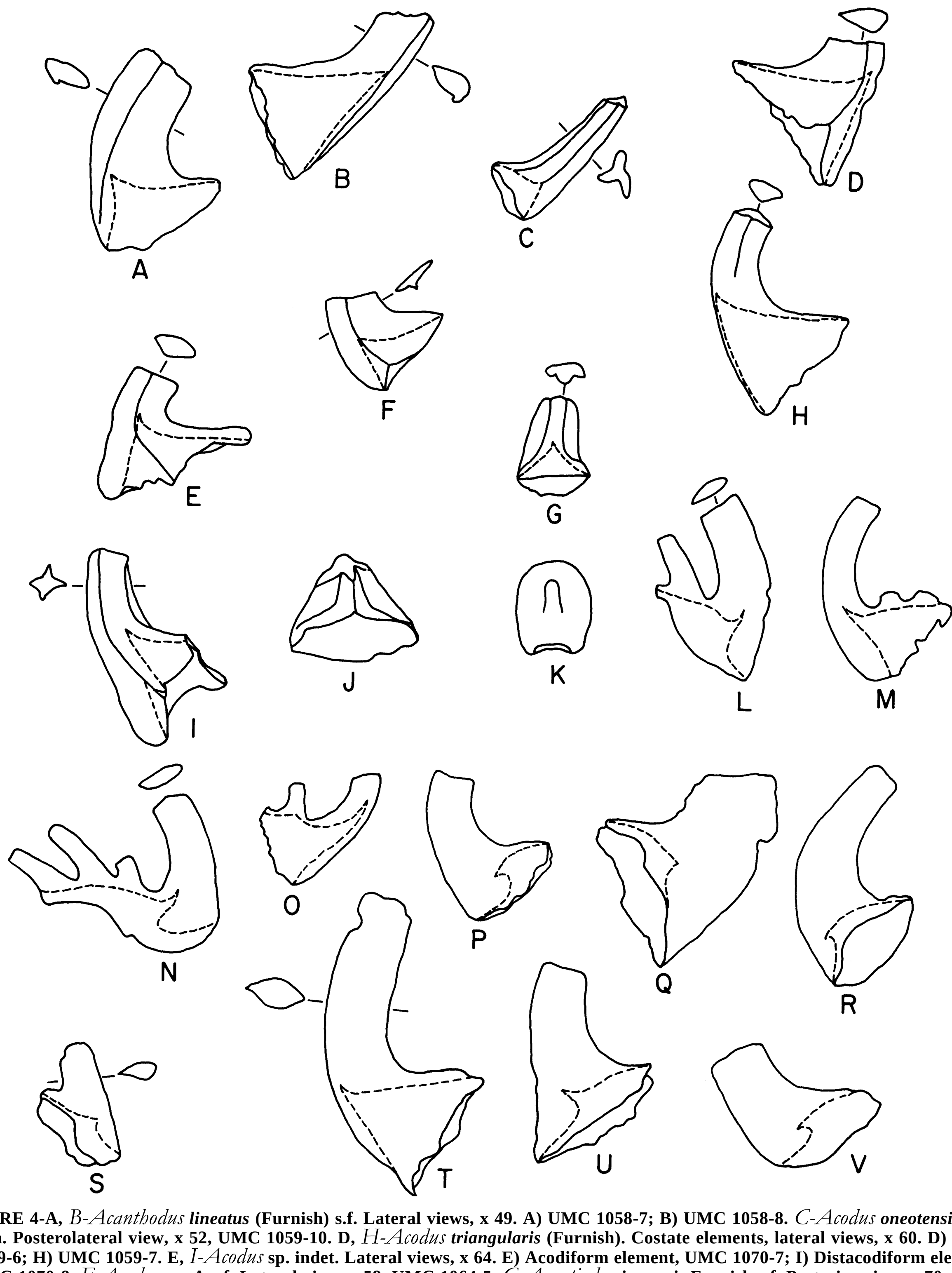

FIGURE 4-A, *B-Acanthodus* ***lineatus*** **(Furnish) s.f. Lateral views, x 49. A) UMC 1058-7; B) UMC 1058-8.** *C-Acodus* ***oneotensis*** **Furnish. Posterolateral view, x 52, UMC 1059-10. D,** *H-Acodus* ***triangularis*** **(Furnish). Costate elements, lateral views, x 60. D) UMC 1059-6; H) UMC 1059-7. E,** *I-Acodus* **sp. indet. Lateral views, x 64. E) Acodiform element, UMC 1070-7; I) Distacodiform element, UMC 1070-8.** *F-Acodus* **sp. A s.f. Lateral view, x 58. UMC 1064-5.** *G-Acontiodus* ***iowensis*** **Furnish s.f. Posterior view, x 70. UMC 1059-14.** *J-Acontiodus* ***aff. A. propinquus*** **Furnish s.f. Posterior view, x 61. UMC 1062-6.** *K-Clavohamulus* **n. sp. A s.f. Posterior view, x 56. UMC 1063-11.** *L-Cordylodus* ***angulatus*** **Pander s.f. Inner lateral view, x 59. UMC 1058-4.** *M-Cordylodus* ***intermedius*** **Furnish s.f. Outer lateral view, x 60. UMC 1058-12.** *N-Cordylodus* ***rotundatus*** **Pander s.f. Outer lateral view, x 59. UMC 1058-6. 0-*****Cordylodus lindstromi*** **Druce and Jones s.f. Inner lateral view, x 60. UMC 1060-4.** *P-Drepanodus* ***aff. D. amoenus*** **Lindstrom s.f. Lateral view, x 65. UMC 1064-15.** *Q-Drepanodus* **cf.** ***D. arcuatus*** **Lindstrom s.f. Inner lateral view, x 42. UMC 1061-19.** *R-Drepan-****odus concavus*** **(Branson and Mehl) s.f. Inner lateral view, x 56. UMC 1060-12.** *S-Drepanodus?* ***gracilis*** **(Branson and Mehl) s.f. Inner lateral view, x 66. UMC 1064-20.** *T-Drepanodus* **cf.** ***D. conulatus*** **Lindstrom s.f. Lateral view, x 56. UMC 1068-15.** *U-Drepanodus* **cf.** ***D. planus*** **Lindstrom s.f. Lateral view, x 67. UMC 1070-11.** *V-Drepanodus* ***proteus*** **Lindstrom s.f. Lateral view, x 64. UMC 1065-2.**

pyramidal, with the apex near the anterior margin. The basal cross section of the cavity approximates an equilateral triangle.

DISCUSSION-All the elements except the trichonodelliform element have been described previously (Branson and Mehl, 1933; Moskalenko, 1967). Moore (1970) recovered and described the trichonodelliform element (as *Acontiodus jeffersonensis)* from the Jefferson City Dolomite.

Paltodus comptus s.f. may be a paltodiform element of *A. delicatus* with five costae (Serpagli, 1974, p. 75, however, thought *P. comptus* might be related to *Walliserodus australis* Serpagli), and *Oistodus vulgaris* s.f. may be a variant on the acodiform element or it may be the acodiform element of a subspecies of this apparatus.

OCCURRENCE -A . *delicatus* is present in the Jefferson City Dolomite of Missouri (Branson and Mehl, 1933; Moore, 1970), in rocks of the Chun'sk Stage in Siberia (Moskalenko, 1967), and in the upper West Spring Creek Formation of Oklahoma (Potter, 1975). El Paso specimens were recovered in samples SD/821-1220 and 1279-1334.

NUMBER OF SPECIMENS -Acodiform elements-23; cordylodiform elements-33; paltodiform elements-17; trichonodelliform elements-41; oistodiform elements-41.

REPOSITORY-UMC 1069-9 through 13.

Acodus deltatus deltatus (Lindströms)
Pl. 2, figs. 1-6

Acodus deltatus Lindström, 1955, p. 544, p1. 3, fig. 30; Viira, 1974, p. 41, p1. 2, fig. 28; text fig. 16.
Acodus deltatus deltatus (Lindström). McTavish, 1973, p. 39-40, p1. 1, figs. 1-9, 12-14; text fig. 3 p-t [synonymy].
Prioniodus deltatus (Lindström). Van Wamel, 1974, p. 85-87, p1. 8, figs. 1-9 [synonymy].
Distacodus rhombicus Lindstrom. Viira, 1974, p. 64, p1. 3, figs. 12-15.
Drepanodus latus Lindström. Viira, 1974, p. 66.
?Acodus deltatus Lindström. Lee, 1975a, p. 80, p1. 1, fig. 2; text fig. 3-B; Cooper and Druce, 1975, p. 569, 570, figs. 10-12; Abaimova, 1975, p. 42-43, p1. 1, figs. 17, 18.

DISCUSSION -I have followed McTavish (1973) in distinguishing adenticulate multielement species of the Prioniodontacea from the denticulate species of that family. Van Wamel (1974), however, preferred to place this species in the genus *Prioniodus,* as he suggested that *Acodus deltatus deltatus (*= van Wamel's *Prioniodus deltatus)* evolved into *Prioniodus navis* by the development of denticulation on the processes.

The delicate thin-walled elements of this species include oistodiform, cordylodiform, acodiform, gothodiform (= *Acodus deltatus altior* s.f.), oepikodiform (= oepikodiform and tetraprioniodiform of McTavish, 1973), and trichonodelliform elements.

This species has been reported from the Summit Limestone at Mount Patriarch, northern Nelson, New Zealand, by Cooper and Druce (1975), but the preservation of the figured specimens is such that a firm comparison is precluded. The broken specimen from the Dumugol Formation of South Korea figured by Lee (1975a) may be an acodiform element of *A. deltatus deltatus.*

OCCURRENCE-Acodus *deltatus deltatus* has been recovered from the Baltic area (Lindström, 1955; Viira, 1974; van Wamel, 1974), from western North America (Ethington and Clark, 1965; ?Mound, 1968; Ethington and Clark, 1971; Ethington, 1972), and possibly from Asia (Lee, 1975a; Abaimova, 1975) and New Zealand (Cooper and Druce, 1975). The Scenic Drive specimens are in samples SD/621-861.

NUMBER OF SPECIMENS -Oistodiform elements-269; cordylodiform elements-53; acodiform elements-101; gothodiform elements-54; oepikodiform elements-66; trichonodelliform elements-23.

REPOSITORY-UMC 1066-13 through 18.

Acodus oneotensis Furnish s.f.
P1. 2, figs. 7, 8

Acodus oneotensis Furnish, 1938, p. 325, p1. 42, figs. 26-29, text fig. 1N; Ethington and Clark, 1971, p. 72, p1. 1, figs. 3, 6, 8; Jones, 1971, in part, p. 44, pl. 1, fig. 5 *[non* pl. 1, figs. 6, 7; pl. 8, fig. 1, = new genus and species A]; Repetski and Ethington, 1977, p. 95.
non Acodus oneotensis Furnish? Willer, 1964, p. 95-96, p1. 13, figs. 1, 8.
non Acodus oneotensis Furnish. Ethington and Clark, 1964, p. 686, 687, [= *Scolopodus* aff. *S. parabruptus];* Müller, 1973, p. 26-27, p1. 7, figs. 1, 3-8 [= new genus and species A].
?Acodus oneotensis Furnish. Druce and Jones, 1971, p. 56-57, p1. 12, figs. 3a-7c; text fig. 20 [= new genus and species A?].
cf. *Acodus oneotensis* Furnish. Lee, 1975a, p. 80, 82, p1. 1, fig. 1, text fig. 3-A.

The elements are suberect cones having an elliptical to circular basal cross section, a rather deep basal cavity, and three or four prominent costae. In side view, the basal (aboral) margin is straight. The cusp is recurved only slightly, so that the distal end is usually deflected less than 30 degrees from an axis drawn perpendicular to the basal plane. The basal cavity is tilted only slightly (direction of tilt is here defined as anterior whereas direction of curvature of the cusp is posterior). The cavity height is approximately one-third the height of the entire element. Costae are nearly always arranged asymmetrically. Three major costae arise immediately above the basal margin and usually are arranged with inner anterolateral , inner posterolateral , and outer posterolateral orientations. Other costae arise between these major ones, usually slightly above the basal margin. An accessory costa on the outer anterolateral face, if present, may rival the development of the three primary costae above the level of the basal cavity. This fourth costa is the anterior costa in the rare elements having symmetrical cusp cross sections. The area between costae is convex outward in cross sections taken from the basal margin to the height of the apex of the basal cavity; cross sections above the level of the tip of the cavity consist only of costae and V-shaped grooves between costae, except for some tricostate elements that may maintain their convex-outward outer lateral face.

DISCUSSION-A. *oneotensis* s.f. probably is related to *Scolopodus sulcatus* s.f. and *S. sexplicatus* s.f. as identified in this collection, but neither abundance nor quality of preservation of elements allows a strong case for this relationship. Furnish (1938, p. 325) and Ethington and Clark (1971, p. 72) noted the wide range of variation in *A. oneotensis* s.f. Sweet and Bergström (1972, p. 32) suggested that *Acodus oneotensis* s.f. is part of a multielement apparatus also containing *Oistodus? triangularis* s.f. and *Paltodus bassleri* s.f. These forms do occur together in the El Paso, but they are rather poorly preserved. I have maintained the form sense here, pending evaluation of larger collections of well-preserved material.

OCCURRENCE-The geographic distribution of *Acodus oneotensis* s.f. has been discussed by Ethington and Clark (1971). In addition, this species has been recovered from the Collier Shale of Arkansas (Repetski and Ethington, 1977). The specimen from the Dumugol Formation of South Korea figured by Lee (1975a) is broken but may be an element of *A. oneotensis* s.f. In the Scenic Drive section, this species occurs in samples SD/0-100, and 180.

NUMBER OF SPECIMENS -63.

REPOSITORY—UMC 1059-9, 10.

Acodus? russoi Serpagli
P1. 3, figs. 1-5

Acodus? russoi Serpagli, 1974, p. 35-37, p1. 8, figs. 1-5; p1. 20, figs. 7, 8; text fig. 5 [synonymy].

DISCUSSION—Serpagli (1974) suggested that an acodiform element should be present in the apparatus. However, the belodiform element may actually occupy the position of the acodiform element. Serpagli has described the individual elements of *A.? russoi* adequately.

Although few specimens of *A.? russoi* are present in either this or Serpagli's collection, there is good reason to believe that these elements may have been part of a common apparatus. The elements have a common stratigraphic range, and they are very similar in size and quality of preservation. The elements have the same general morphology of basal cavity, posterior process, and cusp.

OCCURRENCE-This species is present in Argentina (Serpagli, 1974). Elements that probably belong to *A.? russoi* have been reported from Sweden, as *Scolopodus* n. sp. and *Oistodus* n. sp. (Lindstrom, 1955), and from Newfoundland, as *Oepikodus* n. sp. A (Barnes and Tuke, 1970). Specimens were found in samples SD/560 and 600-660 in the El Paso Group.

NUMBER OF SPECIMENS —Belodiform elements-5; tetraprioniodiform elements-7; trichonodelliform elements-7; oepikodiform elements-3; oistodiform elements-23.

REPOSITORY-UMC 1065-18 through 20, 1066-1, 2.

Acodus triangularis (Furnish)
Pl. 2, figs. 9-12

COSTATE element:

Oistodus? triangularis Furnish, 1938, p. 330-331, p1. 42, fig. 22; text fig. 1P; Ethington and Clark, 1971, p. 72, p1. 1, figs. 18, 22, 23. *"Oistodus" triangularis* Furnish. Repetski and Ethington, 1977, p. 95.

OISTODIFORM element:

Oistodus sp. Ethington and Clark, 1971, p. 69, p1. 1, fig. 2.

In costate elements the basal cavity is tall and approximates an equilateral triangle. In side view the anterior margin of the basal cavity is straight to slightly convex outward near the tip; the posterior margin is also nearly straight but slightly concave outward near the tip. This configuration of cavity profile results from a slight posterior deflection of the cavity tip. The basal cavity is about one-third the total height of the element. The base of the elements is broad in lateral view and thinly sheathed except for costate edges. The basal margin is fairly straight. The cusp ranges from slightly proclined to slightly reclined when the oral margin ("posterior process" of McTavish, 1973) is oriented horizontally. All elements possess a moderately sharp posterior keel. Bicostate elements have a sharp anterior keel also; usually this latter keel is deflected anterolaterally, giving the element inner and outer lateral faces. The inner side of bicostate and tricostate (prioniodiform) elements is nearly flat except for a longitudinal concavity immediately posterior to the deflected anterior or anterolateral costa. The outer face is convex outward and the element is widest about two-thirds of the way toward the anterior margin. Tricostate elements have an outer lateral costa at this widest part. Inner lateral deflection is more extreme on tricostate elements than on bicostate ones; rarely, the elements approximate trichonodelliform symmetry. Tetracostate elements have an additional costa on the inner lateral face giving the element a distacodiform appearance and a diamond-shaped (symmetrical or asymmetrical) cross section. Costate elements may have additional subsidiary costae between the main costae; these subsidiary costae are most pronounced in the region of greatest curvature.

Examination of hundreds of costate elements of *Acodus triangularis* from the Manitou Formation (R. L. Ethington, undescribed collections) has resulted in the conclusion that there seems to be a considerable amount of variation within each of the bi-, tri-, and tetracostate forms. These forms are identified simply as costate elements.

The oistodiform element figured by Ethington and Clark (1971, p1. 1, fig. 2) as *Oistodus* sp. may be assigned properly to *Acodus triangularis* (Furnish). This form has an arched posterior process that is longer than the keellike part of the base anterior to a prominent rounded carina. This carina extends the length of the inner side of the lanceolate cusp and is expressed on the inner side of the base as a prominent flare whose axis extends aboroposteriorly. The outer face of the cusp is broadly convex outward. This oistodiform element superficially resembles *0. lanceolatus* Pander s.f., as mentioned by Ethington and Clark (1971, p. 69).

DISCUSSION-Sweet and Bergström (1972, p. 32, and text fig. 1L) state that the form species *Acodus oneotensis, Oistodus? triangularis,* and *Paltodus bassleri* are congeneric. I think that these forms, although commonly found together, are sufficiently different in basal morphology and in ornamentation to warrant keeping them separate at this time. Further, I think that the form *0.? triangularis* s.f. is part of the multielement skeleton here named *Acodus triangularis.*

OCCURRENCE—*Acodus triangularis* is present in. the Blue Earth beds of Minnesota (Furnish, 1938), in the Manitou Formation of Colorado (Ethington and Clark, 1971), and in the Collier Shale of Arkansas (Repetski and Ethington, 1977). It occurs in samples SD/0-100, 140, and 180-240 of the Scenic Drive section of the El Paso Group.

NUMBER OF SPECIMENS—Costate elements-131, oistodiform elements-72.

REPOSITORY—UMC 1059-4 through 7.

Acodus sp. A s.f.
P1. 3, fig. 6

cf. *Acodus* sp. A, Ethington and Clark, 1971, p. 76, p1. 2, fig. 17.

DISCUSSION-A few acodiform elements cannot be assigned to any multielement apparatus at this time These elements somewhat resemble *A. deltatus* s.f. *sensu* Lindström (1955); however, the El Paso Grour specimens have a shorter anterior process than that illustrated by Lindström (1955; p1. 3, fig. 30). *Acodus* sp. A *sensu* Ethington and Clark (1971) seems to be close tc the El Paso form.

OCCURRENCE-Samples SD/320 and 400.

NUMBER OF SPECIMENS-4.

REPOSITORY-UMC 1064-5.

Acodus sp. indet.
P1. 3, figs. 7, 8

A few rare acodiform and distacodiform elements could not be identified with any known species and are too rare and poorly preserved for a diagnosis here. The acodiform element has a drawn-out posterior costa and a cusp which is recurved more strongly than that of *Acodus deltatus deltatus.*

OCCURRENCE-Sample SD/920.

NUMBER OF SPECIMENS-Acodiform elements-3; distacodiform elements-2.

REPOSITORY-UMC 1070-7, 8.

GENUS *ACONTIODUS* Pander, 1856
TYPE SPECIES: *Acontiodus lotus* Pander, 1856

Acontiodus iowensis Furnish s.f.
P1.4, figs. 1, 3

Acontiodus iowensis Furnish, 1938, p. 325-326, p1. 42, figs. 16, 17; text fig. 1L.

non Acontiodus iowensis Furnish. Ethington and Clark, 1964, p. 687, p1. 113, fig. 3.

?Scolopodus iowensis (Furnish). Druce and Jones, 1971, in part, p. 93, p1. 16, figs. 1-5, 7 *[non* fig. 6 = *Acontiodus propinquus* s.f.]; text fig. 30d, e; Jones, 1971, in part, p. 64, p1. 6, fig. 3 *[non* fig. 4 = *Acontiodus propinquus];* p1. 9, fig. 5.

?Scolopodus transitans Druce and Jones, 1971, p. 95-96, p1. 15, figs. 10-15; text fig. 30g, h; Jones, 1971, p. 68, p1. 6, figs. 8-11; p1. 9, fig. 6.

Acontiodus staufferi Furnish. Greggs and Bond, 1971, p1. 1, figs. 1, 2. *? Scolopodus aff. S. iowensis* (Furnish). Cooper and Druce, 1975, p. 578, fig. 31.

DISCUSSION-The El Paso specimens of *A. iowensis* have been compared directly with the illustrated syntype.

Scolopodus iowensis (Furnish) s.f. of Druce and Jones (1971) and Jones (1971) has a base that, when viewed from the posterior, appears to be expanded more than that of Furnish's (1938) illustrated specimen.

Scolopodus transitans Druce and Jones seems, from the published illustrations, to be conspecific with *A. iowensis* s. f.

OCCURRENCE-Acontiodus *iowensis* s.f. occurs in the Oneota Dolomite in Iowa and Minnesota (Furnish, 1938) , in the upper part of the March Formation of southeastern Ontario (Greggs and Bond, 1971), possibly in Australia (Druce and Jones, 1971; Jones, 1971) and in New Zealand (Cooper and Druce, 1975). The El Paso specimens occur in samples SD/20-80.

NUMBER OF SPECIMENS-11.

REPOSITORY-UMC 1059-14, 15.

Acontiodus propinquus Furnish s.f.
P1.2, fig. 13

Acontiodus propinquus Furnish, 1938, p. 326, p1. 42, figs. 13-15; text fig. 1M; Ethington and Clark, 1971, p. 72, p1. 1, fig. 5; Abaimova, 1975, p. 49, 50, p1. 2, figs. 6, 7; Repetski and Ethington, 1977, p. 95, p1. 1, fig. 8.

?Acontiodus cf. *propinquus* Furnish. Miller, 1964, p. 96, p1. 12, fig. 8.

?Scolopodus iowensis (Furnish). Druce and Jones, 1971, in part, p. 93, p1. 16, fig. 6 only *[non* p1. 16, figs. 1-5, 7, = *?Acontiodus iowensis];* Jones, 1971, in part, p. 64, p1. 6, fig. 4 *[non* p1. 6, fig. 3; p1. 9, fig. 5 = *?Acontiodus iowensis].*

?Scolopodus sp. cf. *S. iowensis* (Furnish). Jones, 1971, p. 65, p1. 6, fig. 5.

Acontiodus iowaensis Furnish. Lee, 1975a, p. 82, 83, p1. 1, figs. 8, 12; text fig. 3-G.

non Acontiodus sp. cf. *A. propinquus* Furnish. Lee, 1975b, p. 170, p1. 1, fig. 5; text fig. 3-F.

REMARKS-Acontiodus iowaensis [sic] of Lee (1975a) appears to be *A. propinquus* s.f. As Lee mentioned (1975a, p. 82), the Dumugol Formation specimens have a "laterally more expanded basal sheath" than does *A. iowensis* s.f. The specimen figured as *Acontiodus* sp. cf. *A. propinquus* by Lee (1975b) does not taper as rapidly, nor does it appear to have as deep a posterior groove as does *A. propinquus* Furnish s.f.

OCCURRENCE-This form species is present in the Blue Earth beds of Minnesota and possibly in the Oneota Dolomite in Iowa (Furnish, 1938), in the Manitou Formation of Colorado (Ethington and Clark, 1971), the Collier Shale of Arkansas and Oklahoma (Repetski and Ethington, 1977), the Dumugol Formation of Korea (Lee, 1975a), and the southeast part of the Siberian Platform (Abaimova, 1975). Possible occurrences are in South Korea (Müller, 1964) and in Australia (Druce and Jones, 1971; Jones, 1971). El Paso Group specimens are in samples SD/20, 60-120, 502.

NUMBER OF SPECIMENS-24.

REPOSITORY UMC 1060-2

Acontiodus aff. A. propinquus Furnish s.f.
Pl. 4, fig. 2

?Acodina euryptera Abaimova, 1971, p. 75, 76, p1. 10, figs. 2, 3; Abaimova, 1972, text fig. 1(19); Abaimova, 1975, p. 33-34, pl. 1, figs. 7-9; text fig. 6(7, 8).

The element is compressed anteroposteriorly and the base is greatly expanded aborally. The basal margin is subtriangular, the posterolateral edges are straight, and the anterior face is broadly convex outward. The basal cavity is moderately shallow and expansive. A prominent sharp costa runs above the apex formed at the posterior of the basal margin. On each side of this costa is a deep sharp groove separating the posterior costa from the lateral costae. Lateral costae are thin, sharp, and keellike; these costae point slightly posteriorly. The anterior of the element is broadly convex on the base and a median carina runs longitudinally on the cusp. At the base, this anterior carina widens, becomes less prominent, and grades into the anterior face of the base.

This specimen may be conspecific with the specimens named *Acodina euryptera* Abaimova (1971) that occur in the Lower Ordovician (Chun'sk Stage) of the Lena River basin of the southeast Siberian platform. Direct comparison of specimens is necessary before a firm identification can be made.

DISCUSSION-This element most closely resembles *Acontiodus propinquus* s.f., although the two are different in detail. The basal margin of *A. propinquus* s.f. is nearly circular rather than subtriangular, and the anterior face of *A. propinquus* s.f. is noncostate.

OCCURRENCE-This new form was found only in sample SD/240.

NUMBER OF SPECIMENS-1.

REPOSITORY-UMC 1062-6.

Acontiodus staufferi Furnish s.f.
Pl. 4. figs. 4. 5

Acontiodus staufferi Furnish, 1938, p. 326, pl. 42, figs. 11-12; text fig. 1K; Ethington and Clark, 1971, p. 72, pl. 1, fig. 14.

?Acontiodus staufferi Furnish. Ethington and Clark, 1964, p. 687688, pl. 113, figs. 4, 9; Abaimova, 1975, p. 51-52, pl. 2, figs. 8-10; text figs. 6(14, 17).

non Acontiodus staufferi Furnish. Ethington and Clark, 1965, pl. 2, fig. 14; Greggs and Bond, 1971, p. 1,463, pl. 1, figs. 1, 2.

non Scolopodus staufferi (Furnish). Druce and Jones, 1971, p. 94-95, pl. 18, figs. 8-9; Jones, 1971, p. 67, pl. 6, fig. 7.

DISCUSSION-Both El Paso Group elements figured as *A. staufferi* by Ethington and Clark (1964) are broken on the posterior part of the base, the configuration of which is critical for identification.

The figured specimens of *Scolopodus staufferi* of Druce and Jones (1971) and of Jones (1971) are not as wide laterally as the type specimens; these Australian specimens probably are similar to a variation of *Scolopodus quadraplicatus* s.f., which also occurs in the El Paso. This form has an anterior costa wider than the combined width of the two posterolateral costae. This configuration gives the form a superficial resemblance to *A. staufferi* s.f.

The form illustrated as *A. staufferi* s.f. by Ethington and Clark (1965) is not a representative of that form species. It is not wide enough laterally, nor does it have an elliptical basal cross section or a grooved posterior costa.

As each of the figured syntypes of *A. staufferi* s.f. possesses a longitudinal groove along its posterior costa, Druce and Jones (1971) appear to be justified in erecting a separate form species for specimens lacking this groove.

Specimens figured by Greggs and Bond (1971) lack grooved posterior keels and herein are placed in *A. iowensis* s.f. The specimens of *A. staufferi* figured by Abaimova (1975) have the cusp cross section of that taxon, but the basal regions are more drawn-out posteriorly than are those of the holotype.

OCCURRENCE-A. *staufferi s.f.* occurs in the Shakopee Dolomite in Wisconsin (Furnish, 1938), in the Manitou Formation of Colorado (Ethington and Clark, 1971), and in the El Paso Group in samples SD/60, 480-520, 1,180.

NUMBER OF SPECIMENS-23.

REPOSITORY-UMC 1059-16, 17.

GENUS *CLAVOHAMULUS* Furnish, 1938
TYPE SPECIES: *Clavohamulus densus* Furnish, 1938

Furnish (1938) based this genus on one form species, *C. densus.* Miller (1969) identified three new form species and redefined the genus. I have recovered two additional new species of *Clavohamulus* in the El Paso Group. One of these, *C. lemonei* n. sp., has a basal cavity that is quite enlarged and elongate. This requires modification of Miller's redefinition to include elements whose basal cavity may be large. The two new form species described below are bilaterally symmetrical and both possess the distinctive ornamentation of rows of tiny nodes on the anterior surface.

Clavohamulus densus Furnish s.f.
P1. 4, fig. 6

Clavohamulus densus Furnish, 1938, p. 327, pl. 42, figs. 18-21; Ethington and Clark, 1971, p. 72, pl. 1, fig. 13.

DISCUSSION-Although the El Paso specimens agree well with Furnish's (1938) type material, a few differences exist. In posterior view the lateral "wings" of the anterior bulbous process are depressed slightly below the level of the aboral margin under the cusp. According to Furnish (1938, p. 327), the cusp of *C. densus* may be bladelike or small and cylindrical. All the specimens recovered in my collection possess very small, cylindrical, peglike cusps. Most specimens have broken cusps.

The basal cavity is tiny and is located aborally at the junction of the cusp and the anteroposteriorly flattened anterior process. On some specimens the basal cavity continues laterally as a shallow, inverted attachment surface under the anterior bulbous process and posteriorly under the cusp but not reaching the distal part of either. On these specimens, the attachment surface forms a T shape when viewed aborally.

OCCURRENCE-Clavohamulus densus s.f. has been reported previously only from the Oneota Dolomite (Furnish, 1938), the upper part of the House Limestone of western Utah, and the Manitou Formation of Colorado (Ethington and Clark, 1971). The El Paso Group specimens are in samples SD/60-100.

NUMBER OF SPECIMENS-14.

REPOSITORY -UMC 1060-3 .

Clavohamulus lemonei n. sp.
Pl. 5. fig. 1

These specimens are moccasin-shaped elements having the anterior bulb drawn out aborally. The aboral extension is at least as long as the oral extension. In side view the basal margin forms an inverted L shape with the short leg horizontal; the long leg of the L is nearly vertical and is at least five times the length of the short leg. In posterior view, the upper part of the basal margin is horizontal or slightly convex downward. The lower posterior part of this basal margin forms a deep U shape, so that when observing the element in this orientation one can observe much of the interior part of the basal cavity. The rim of the basal margin is thick and smooth surfaced.

Anteroposteriorly, the unit is thickest across the posterior extension. The element is widest (laterally) approximately at the level of the apex of the basal cavity; above this level, the unit tapers (with convex-outward margins) to a sharply rounded oral (upper) apex; below the level of greatest width, the unit tapers (with relatively straight margins) to a bluntly rounded aboral (lower) termination.

The flattened anterior process is gently reclined above the basal cavity. A tiny cusp is located on the posterior part at the apex of this anterior process; the cusp arises approximately halfway between the upper part of the basal margin and the top of the element and probably extends to nearly the height of the unit (all specimens in the collection have at least the apical part of the cusp broken).

The anterior face of the anterior process is a broad surface, gently sloping toward a median groove running lengthwise along the face. The typical *Clavohamulus* surface ornamentation can be seen only on the edges and on the upper part of the anterior face of the element.

DISCUSSION-This form species is unlike any described form of *Clavohamulus*. The tiny cusp is attached to an enlarged anterior process; overall features of this anterior process and of the basal region, however, allow confident placement of this form in *Clavohamulus*.

DERIVATION OF NAME-After Dr. D. V. LeMone, who has contributed to El Paso Group stratigraphy.

OCCURRENCE-C. *lemonei* appears to be the youngest Ordovician representative of the genus known to date. It is present in samples SD/560, 760, and 1,000.

NUMBER OF SPECIMENS-6.

REPOSITORY-UMC 1065-17 (holotype).

Clavohamulus n. sp. A
P1. 4, figs. 7, 8

This element is an erect, slightly anteroposteriorly flattened bulb, smoothly rounded anteriorly, with a tiny peglike cusp arising from a slight longitudinal depression on the posterior face of the bulb. The cusp does not reach the height of the bulb. The basal cross section is subcircular. Viewed aborally, the basal cavity has its apex near the anterior margin of the element; it then shallows posteriorly so that the shape of the cavity is asymmetrical and the cavity cross section may appear to be triangular. The surface of the bulb is ornamented with tiny nodes, except the rim around the base, which is smooth.

DISCUSSION-This species of *Clavohamulus* does not have the lateral development of the anterior bulblike process as does *C. densus* s.f. One specimen of *C.* n. sp. A is reclined markedly relative to the basal margin but otherwise is similar to the remainder of the specimens.

This form appears to be transitional in morphology between C. *densus* and *C. lemonei* n. sp.

OCCURRENCE-Samples SD/300, 320, and 420.

NUMBER OF SPECIMENS-15.

REPOSITORY-UMC 1063-10, 11.

GENUS *CORD YLODUS* Pander, 1856
TYPE SPECIES: *Cordvlodus angulatus* Pander. 1856

Cordylodus is treated here in the form sense. Bergström and Sweet (1966) suggested that *C. angulatus* and *C. rotundatus* are elements of one multielement species. Since 1966, reports have brought to light several other penecontemporaneous form species (Druce and Jones, 1971; Jones, 1971; Willer, 1973). The collection at hand is inadequate both in numbers of specimens and in quality of preservation to permit the establishment of relationships among the various forms. Work is presently underway (J. F. Miller, personal communication, 1975) on collections containing well-preserved abundant cordylodans that may clarify these relationships.

Cordylodus angulatus Pander s.f.
Pl. 4, fig. 9

Cordylodus angulatus Pander, 1856, p. 33, pl. 2, figs. 29-31, 34, ? figs. 26-28, pl. 3, fig. 10; Lindström, 1955, p. 551-552, pl. 5, fig. 9; text fig. 3G *[non* text fig. 3E, = *C. lindstromi];* Ethington and Clark, 1965, p. 189, pl. 1, fig. 7; Druce and Jones, 1971, p. 66-67, pl. 3, figs. 4a-7b; text fig. 23a, b; Jones, 1971, p. 45-46, pl. 8, figs. 3a-c; Willer, 1973, p. 27, 29, pl. 11, figs. 1-7; text fig. 2G; 3a-c; Barnes, 1974, p. 226, pl. 1, fig. 3; Cooper and Druce, 1975, p. 572573, figs. 14, 16; Repetski and Ethington, 1977, p. 95-96, pl. 1, fig. 3.

?Cordylodus angulatus Pander. Lindström, 1964, p. 147, fig. 50h; Pantoja-Alor and Robison, 1967, p. 1,034; Ethington and Clark, 1971, pl. 1, figs. 15-16, 20; Viira, 1974, p. 63, pl. 1, figs. 1-3, 8, 11-13.

?Belodus sp. A, Hass, *in* Sando, 1958, p. 840, pl. 2, fig. 23.

?Cyrtoniodus ? sp., Hass, *in* Sando, 1958, p. 840, pl. 2, fig. 26.

? Cordylodus sp., Ethington and Clark, 1964, pl. 688.

non Cordylodus angulatus Pander. Van Wamel, 1974, p. 58-59, pl. 1, figs. 5-7 [fig. 5 = *C. proavus* Willer; figs. 6, 7 = *C. intermedius* Furnish].

The main cusp is erect to slightly proclined at its juncture with the posterior bar. The distal part of the cusp is recurved. The cusp and denticles on the posterior bar are ellipsoidal to lanceolate in cross section; the anterior edge of the main cusp is normally located on the inner anterolateral edge, forming a very shallow groove just posterior to the edge. The line of denticles on the posterior bar is usually tilted outward from the plane of curvature of the main denticle. The basal cavity has a Phrygian cap shape and the cavity tip does not extend very far into the main denticle, if at all. The posterior denticles and that part of the main cusp above the level of the posterior bar consist of white matter.

DISCUSSION-Druce and Jones (1971), Jones (1971), and Müller (1973) have taken a conservative taxonomic approach toward *Cordylodus.* They have recognized several new form species that can be distinguished by basal cavity shape and position. Using this approach, *C. angulatus* can be recognized by the Phrygian cap shape of its basal cavity; *C. rotundatus* also has this distinctive cavity shape, but it has a rounded, rather than angular, antero/aboral juncture. *Cordylodus angulatus* appears to be gradational in its variations with *C. intermedius* Furnish.

The queried entries in the synonymy refer to occurrences that were cited and not figured, or that, though figured, do not show the shape of the basal cavity.

None of the specimens of *C. angulatus* illustrated by van Wamel (1974, pl. 1, figs. 5-7) show the Phrygian cap shape for the basal cavity. Van Wamel's fig. 5 has the cavity profile of C. *proavus* Müller s.f. and his figs. 6 and 7 have cavity profiles like that of *C. intermedius* Furnish s.f.

OCCURRENCE-C. *angulatus* is found in strata of the Pakerort Stage of the Baltic region (Lindström, 1971; Viira, 1974), the top of the Jinduckin Formation of the Daly River basin of northwest Australia (Jones, 1971), the upper part of the Ninmaroo Formation of western Queensland, Australia (Druce and Jones, 1971), the Shirgesht Formation of northern Iran (Müller, 1973), and the older of two faunas from the Summit Limestone at Mount Patriarch, New Zealand (Cooper and Druce, 1975). In North America this form is present in the Nochixtlan region of Oaxaca, Mexico (Pantoja-Alor and Robison, 1967), the Stonehenge Limestone of Pennsylvania (Hass, *in* Sando, 1958), the Columbia Ice Fields section of Alberta (Ethington and Clark, 1965), the House Limestone of western Utah (Ethington and Clark, 1971), the Manitou Formation of central Colorado (Ethington and Clark, 1971), the Copes Bay Formation on Devon Island in the Canadian Arctic (Barnes, 1974), the Collier Shale in the Ouachita Mountains of Arkansas and Oklahoma (Repetski and Ethington, 1977), and the El Paso Formation of southeast Arizona (Ethington and Clark, 1964). In the Franklin Mountains, *C. angulatus* is present in samples SD/0, 20, 40, 60, and 100. It is abundant only in sample SD/60.

NUMBER OF SPECIMENS-29.

REPOSITORY-UMC 1058-4.

Cordylodus intermedius Furnish s.f.
Pl. 5, fig. 2

Cordylodus intermedius Furnish, 1938, p. 338, pl. 42, fig. 31, text fig. 2C; Druce and Jones, 1971, p. 68, pl. 3, figs. la-3b; text fig. 23f, g; Jones, 1971, p. 46, pl. 2, figs. 2a-3c; Müller, 1973, p. 30, pl. 10, figs. 1-3; text figs. 2C; 4a, b.

Cordylodus angulatus Pander. Van Wamel, 1974, in part, p. 58, 59, pl. 1, figs. 6-7 only [fig. 5 = C. *proavus* Muller] .

?Cordylodus cf. *intermedius* Furnish. Abaimova, 1975, p1. 10, fig. 10.

DISCUSSION-The El Paso Group specimens of *Cordylodus intermedius* conform closely to the description given by Furnish (1938), although some variation exists in the shape of the basal cavity. In some specimens, the tip of the cavity points into the main denticle. In this respect, the cavity of these specimens resembles that of *C. proavus;* however, the cavity of *C. intermedius* does not extend nearly so far into the main denticle as does that of *C. proavus.* In other specimens the cavity tip points toward the anterior margin of the element. In yet other specimens, the shape of the cavity is transitional between the other two profiles and the Phrygian cap shape of *C. angulatus* s.f. Indeed, Druce and Jones (1971) hypothesized that *C. intermedius* is the transitional form between *C. proavus* and *C. angulatus.*

Some of the queried entries in the synonymy of *Cordylodus angulatus* might prove to be *C. intermedius* ii the shape of the basal cavity were known.

The shape of the basal cavity on two of the specimens illustrated by van Wamel (1974, pl. 1, figs. 6-7) conforms to that of *C. intermedius* s.f. The specimen of *C.* cf. *intermedius* figured by Abaimova (1975) may be that form or it may be *C. angulatus* s.f.

OCCURRENCE-C. *intermedius* has been reported from the Blue Earth beds in Minnesota (Furnish, 1938), from the lower part of the Pander Greensand of northwestern Australia (Jones, 1971), from western Queensland (Druce and Jones, 1971), and from Iran (Müller, 1973). It is common in collections from the Manitou Formation of Colorado (Ethington, unpublished data), as pointed out to me by J. F. Miller (personal communication, 1975). This form is relatively rare in the El Paso Group in the southern Franklin Mountains of west Texas, being found only in samples SD/0, 20, 40, and 60.

NUMBER OF SPECIMENS-19.

REPOSITORY-UMC 1058-12.

Cordylodus lindstromi Druce and Jones s.f.
P1. 5, figs. 4, 5

Cordylodus lindstromi Druce and Jones, 1971, p. 68-69, pl. 1, figs. 7a-9b; pl. 2, fig. 8a-c; text fig. 23h; Jones, 1971, p. 47, pl. 2, figs. 4a-c; Müller, 1973, p. 32, p1. 9, figs. 10-11, text figs. 2D; 6a, b.

Cordylodus angulatus Pander. Lindström, 1955, in part, p. 551-552, text fig. 3E.

?Cordylodus oklahomensis Müller. Miller, 1969, in part p. 423-424, pl. 65, figs. 52-53 only [figs. 46-51 = *C. oklahomensis* Müller].

Elements in the El Paso collection are similar to *C. intermedius* in having a cusp and posterior denticles with a round to elliptical cross section and a basal cavity extending slightly into the main denticle. The basal cavity has a secondary apex extending slightly into the denticle immediately posterior to the main cusp.

DISCUSSION-The secondary apex of the basal cavity distinguishes this form species of *Cordylodus* from all others. In most other aspects the specimens resemble *C. intermedius,* except that the cavity tip of *C. lindstromi* does not point toward the anterior margin as in some forms of *C. intermedius,* and the cavity of C. *lindstromi* extends slightly further into the main denticle. Because of breakage, none of the Scenic Drive specimens has more than one accessory denticle behind the main cusp; thus, the identification of more than one secondary apex of the basal cavity is precluded.

Miller (1973) pointed out that specimens identified on the basis of basal cavity morphology as *C. lindstromi* in his Iranian material resemble *C. prion, C. angulatus,* and *C. proavus* in general morphology, and suggested that the presence of secondary cavity apices could possibly be within the range of variation of those form species. However, he found *C. lindstromi* only in one sample, in which it must be noted that only two of the other three forms were present as very rare constituents, whereas *C. lindstromi* was abundant. If *C. lindstromi* is a collection of variants of these other three, then an explanation is required to account for the development of secondary apices on these elements only in this sample.

Miller (1969) also noticed the uncommon occurrence of secondary apices on the basal cavities of specimens otherwise assignable to *Cordylodus oklahomensis* in material from the Notch Peak Formation of Utah. Because of the occurrence of secondary apices on elements otherwise being referrable to at least five different form species, perhaps Müller (1973, p. 32) was correct in suggesting that the presence of one or more extra cavity apices holds no taxonomic significance. This problem needs further investigation.

OCCURRENCE-This form has been reported from the Baltic region (Lindström, 1955), western Queensland (Druce and Jones, 1971), northwest Australia (Jones, 1971), northern Iran (Mailer, 1973), and possibly from western Utah (Miller, 1969). At the Scenic Drive section, *C. lindstromi* is present only in samples SD/40 and 60.

NUMBER OF SPECIMENS-18.

REPOSITORY-UMC 1060-4, 5.

Cordylodus rotundatus Pander s.f.
P1. *5*, fig. 3

Cordylodus rotundatus Pander, 1856, p. 33, pl. 2, figs. 32, 33; Lindström, 1955, p. 553-554, p1. 5, figs. 17-20; text fig. 3F; Mound, 1968, in part, p. 409, pl. 2, fig. 4; Ethington and Clark, 1971, pl. 1, fig. 17; Druce and Jones, 1971, p. 71-72, pl. 3, figs. 8a-10c; text fig. 23t; Jones, 1971, p. 49, pl. 2, figs. 10a, b, 11a-c; Willer, 1973, p. 36-37, pl. 11, figs. 8a, b; 9, 10; text figs. 2H; 10a, b; Viira, 1974, p. 63, pl. 1, figs. 4, 5, 10.

Cordylodus subangulatus Furnish, 1938, p. 338, pl. 42, fig. 32; text fig. 2D; Abaimova, 1972, text fig. 1(25); Abaimova, 1975, p. 110111, pl. 10, figs. 6, 8, 9, 11; text figs. 8(29-31, 36, 37).

OCCURRENCE-This widespread form occurs in the upper part of the Tremadocian Stage of the Baltic Shield (Pander, 1856; Lindström, 1955, 1971; Viira, 1974), in the Pander Greensand in northwest Australia (Jones, 1971), in the upper part of the Ninmaroo Formation in western Queensland, Australia (Druce and Jones, 1971), in the upper part of the Shirgesht Formation in northern Iran (Müller, 1973) and in the Chun'sk Stage from the southeast part of the Siberian Platform (Abaimova, 1972, 1975). In North America, *C. rotundatus* occurs in the lower third of the House Formation in western Utah and in the Manitou Formation in central Colorado (Ethington and Clark, 1971), in the Blue Earth beds in Minnesota (Furnish, 1938), in the Monocline Valley Formation of Nevada as used by Longwell and Mound (1967), and in the uppermost McKenzie Hill Formation in southern Oklahoma (Mound, 1968). It was found in samples SD/0, 20, 40, 60, and 100 in the El Paso Group at Scenic Drive.

NUMBER OF SPECIMENS-17.

REPOSITORY-UMC 1058-6.

GENUS *CRISTODUS* n. gen.
TYPE SPECIES: *Cristodus loxoides* n. sp.

The single known species of this genus has two hyaline element types, one having a single denticle, and another having several denticles above a long posteriorly tapering base. A V-shaped groove runs along the underside of the base. Denticles are fused for most of their length, and the posteriormost denticle lies sub parallel to the base. The anterior and oral edges are keeled.

Multidenticulate elements of *Cristodus* resemble those of *Loxodus*. Elements of the latter genus, however, have a relatively deeper basal cavity that also is thinly sheathed. Because they are hyaline and have similar invagination of their basal margins, *Cristodus*, *Ulrichodina*, and *"?Spathognathodus* sp." s.f. may be related.

DERIVATION OF *NAME-cristus* (L.), the comb or crest of a bird.

Cristodus loxoides n. sp.
Pl. *5*, figs. 6, 7

MULTIDENTICULATE element:

Loxodus sp. aff. *L. bransoni* Furnish. Barnes and Tuke, 1970, p. 87, pl. 20, figs. 1, 4, 15-17.

The elements are bladelike, having a long horizontal base that is excavated along its aboral side, a large anterior denticle that is erect above the base, and three to six denticles between the anterior denticle and the base that diverge postero-orally and that increase in size posteriorly. Denticles are fused for most of their length and arise from the angle formed by the oral margin of the base and the anterior denticle. The anterior denticle may maintain its anteroposterior width distally or may widen distally to about two-thirds along its length and then taper toward the apex. The anterior edge is sharply rounded to keeled and may be erect or slightly proclined. The aboral end of the anterior edge is invaginated posteriorly for a very short distance upon reaching the aboral margin. The base is long, with a small keel along the oral edge. The aboral surface of the base is excavated along its length by a V-shaped groove that widens and deepens anteriorly and splits into two short anterolaterally directed segments, one on each side of the invagination of the anterior edge. The basal part of the anterior denticle flares into a boss on each side; each boss corresponds to one of the anterolateral segments of the basal groove. The entire unit is laterally compressed, bladelike, and slightly concavoconvex.

MONODENTICULATE element:

The element consists of a long, horizontal, aborally excavated base and a long, laterally compressed denticle that arises at the anterior end of the base and extends posteriorly parallel to the base. The denticle and base are fused for most of their length. Either the denticle or the base may be the longer of the two; rarely, the two are subequal in length. The denticle and the nonfused part of the oral edge of the base are sharply keeled. The anterior edge of the denticle may run orally at right angles to the basal margin, or the edge may be proclined to a point of inflection at which the denticle becomes reclined posteriorly. The basal margin is straight in profile; the base is excavated along its length by a groovelike basal cavity, widest and deepest under the point at which the posterior edge of the denticle and the oral edge of the base meet. The cavity apex is at this point and is inclined anteriorly; in profile, the edge of the cavity anterior to the apex is concave anteriorly and the posterior side is nearly straight. The element is widest at a point coinciding with the location of the widest part of the basal cavity; part of the element anterior to this widest point is deflected slightly to one side.

DISCUSSION-Barnes and Tuke (1970) recovered the multidenticulate element of *C. loxoides* from the St. George Formation of Newfoundland and discussed its distinguishing features. The two anterolateral segments of the basal cavity and the intervening deflection of the anterior edge may be bilaterally symmetrical or asymmetrical. Barnes and Tuke (1970, p. 87) stated that their specimens had bosses only on the inner side. This possibly is a result of the bilateral asymmetry of their specimens.

Variation is significant in the monodenticulate element. The oral edge of the denticle may be parallel to the basal margin or it may slope downward posteriorly. As mentioned above, the denticle and base may vary in length. The amount of lateral deflection of the anterior part of the element also varies.

DERIVATION OF *NAME-loxoides*, after the form genus *Loxodus*, which the multidenticulate element of *Cristodus loxoides* resembles superficially.

OCCURRENCE-Cristodus *loxoides* is present in the St. George Formation of Newfoundland (Barnes and Tuke, 1970), the Jefferson City Dolomite of Missouri (Moore, 1970), the West Spring Creek Formation of Oklahoma (Potter, 1975), and the Eleanor River Formation, Canadian Arctic Islands, (G. Nowlan, personal communication, 1978), as well as in the El Paso Group. The Scenic Drive occurrences are in samples SD/700, 760, 800, 821, 880, 900, 940, and 960.

NUMBER OF SPECIMENS-Multidenticulate element-1; monodenticulate element-15.

REPOSITORY-UMC 1066-11 (holotype); UMC 1067-2.

GENUS *DISTACODUS* Hinde, 1879

TYPE SPECIES: *Machairodus incurvus* Pander, 1856

Distacodus expansus (Graves and Ellison) s.f.
Pl. 6, fig. 2

Acodus expansus Graves and Ellison, 1941, p. 8, pl. 1, fig. 6.
Distacodus expansus (Graves and Ellison). Lindström, 1955, p. 555, pl. 3, figs. 13-17; text fig. 2g-i; Wolska, 1961, p. 347, pl. 1, fig. 4; Viira, 1974, p. 64, text fig. 61.
non Distacodus expansus (Graves and Ellison). Ethington, 1972, pl. 1, fig. 23 [= *Drepanodus proteus* s.f.].
Paroistodus parallelus (Pander). Lindström, 1971, in part, p. 48, drepanodiform element only; Bergstrom and others, 1972, in part, fig. la, le only; Serpagli, 1974, in part, p. 61-62, pl. 14, figs. 10-12; pl. 25, fig. 4 only; van Wamel, 1974, in part, p. 79-80, pl. 7, figs. 12, 14, 16.

DISCUSSION-D. *expansus* s.f. is very similar in the form sense to *Drepanodus proteus* s.f. The presence of lateral costae distinguishes the former from the latter. These costae are rather subdued on the El Paso specimens. The specimen figured as *D. expansus* s.f. by Ethington (1972) does not possess lateral costae.

Lindström (1971) and others (Bergstrom and others, 1972; Serpagli, 1974; van Wamel, 1974) working with North Atlantic Province faunas, assigned elements of *D. expansus* s.f. to the multielement species *Paroistodus parallelus* (Pander). However, van Wamel (1974) included in his *Paroistodus parallelus* apparatus not only the drepanodiform element of *P. parallelus* of Lindström (1971), but also the drepanodiform elements Lindström assigned to *P. proteus* and *P. originalis.* In the El Paso Group, *Oistodus* cf. *0. parallelus* s.f. first appears much lower than does *Distacodus expansus* s.f. or *Drepanodus proteus* s. f. , and *Oistodus originalis* s.f. has not been identified. At present, I believe that evidence is insufficient to assign *Distacodus expansus* s.f. from the Scenic Drive collection to a multielement apparatus.

OCCURRENCE-Samples SD/600-660, 720, 1,140, 1,260, 1, 315.

NUMBER OF SPECIMENS-14.

REPOSITORY-UMC 1066-3.

GENUS *DREPANODUS* Pander, 1856

TYPE SPECIES: *Drepanodus arcuatus* Pander, 1856

Drepanodus aff. D. amoenus Lindström s.f.
P1. *5.* fig. 8

aff. *Drepanodus amoenus* Lindström, 1955, p. 558, pl. 2, figs. 25-26; text fig. 4b.

DISCUSSION-This element has an inflated base and basal cavity compared with the cusp size, but otherwise it is similar to *D. amoenus* s.f. of Lindström.

OCCURRENCE-Samples SD/320, 360, 580, 600, 821-940, 1,000, 1,020, 1,140, 1,158, 1,279, 1,315, 1,342.

NUMBER OF SPECIMENS-109.

REPOSITORY-UMC 1064-15.

Drepanodus arcuatus Pander s.f.
Pl. 6, fig. 1

Drepanodus arcuatus Pander, 1856, p. 20, pl. 1, figs. 4-5 *[non* figs. 2, 17, 30, 31]; Lindström, 1955, p. 558-560, pl. 2, figs. 30-33; text fig. 3J; van Wamel, 1974, in part, p. 61-62, pl. 1, fig. 10 only; Landing, 1976, in part, p. 632, pl. 1, figs. 17, 19, *[non* pl. 1, figs. 16, 18, 21-23].
non Drepanodus arcuatus Pander. Rhodes, 1953, p. 292, pl. 21, fig. 110; Rhodes, 1955, p. 126, pl. 10, fig. 24; Carlson, 1960, pl. 1, figs. 7-8; Hamar, 1964, p. 264, pl. 2, figs. 1-2; text fig. 6(4); Winder, 1966, p. 56, pl. 9, fig. 10; text fig. 3(10); Serpagli, 1974, p. 27, pl. 8, figs. 8-10; pl. 20, figs. 13-15; Lee, 1975a, p. 84, pl. 1, fig. 13; text fig. 3-L.
non Drepanodus sp. cf. *D. arcuatus* of Lindström (1955) *non* Pander (1856). Schopf, 1966, p. 55, pl. 5, fig. 13.
?Drepanodus arcuatus Pander. Fa hraeus, 1966, p. 21, pl. 3, fig. 15. *? Drepanodus* cf. *arcuatus* Pander. Hamar, 1966, p. 57-58, pl. 1, fig. 16 *[non* pl. 1, fig. 17; text fig. 2(7)].
cf. *Drepanodus numarcuatus* Lindström. Ethington, 1972, p. 22, pl. 1, fig. 19.

DISCUSSION-This element agrees closely with Lindström's (1955) description of *D. arcuatus* s.f. The element is being kept in the form sense here because the status of *D. arcuatus* s.f. in a multielement apparatus in North America is uncertain (Ethington, 1972, p. 22).

D. numarcuatus s.f. *sensu* Ethington (1972) is listed in the synonymy because of its deep basal cavity; however, Ethington (1972, p. 22) remarked that his material was compared directly with material supplied by Lindström.

OCCURRENCE-D. *arcuatus* s.f. occurs in the Scenic Drive section in samples SD/360-420, 502-540, 580-960, 1,000, 1,140-1,180, 1,220, 1,260, 1,279, 1,315- 1, 342.

NUMBER OF SPECIMENS-230.

REPOSITORY-UMC 1064-14.

?*Drepanodus* cf. *D. arcuatus* Lindström s.f. Pl. 6, fig. 4

?*Drepanodus* cf. *arcuatus* Lindström, 1955, p. 560-561, p1. 2, figs. 45-46; text fig. 4c.

DISCUSSION-The El Paso specimens placed here differ from Lindström's (1955) description and figures of *D.* cf. *D. arcuatus* s.f. in that the former have a straighter basal margin (however, Lindström's pl. 2, fig. 46, does illustrate a specimen that has a straight margin). The El Paso specimens also have a basal cavity which is not as deep as that of *D.* cf. *D. arcuatus* s.f. The posterior edge of the cavity in side view is convex, and the cavity tip points anteriorly, as is true of Lindström's specimens.

Lindström (1971) placed *D.* cf. *D. arcuatus* s.f. in his multielement species *Drepanodus arcuatus.* As identification of the El Paso Group forms cannot be made positively, I am keeping them in form taxonomy.

OCCURRENCE-Samples SD/180, 240.

NUMBER OF SPECIMENS -6.

REPOSITORY -UMC 1061-19.

Drepanodus concavus (Branson and Mehl) s.f. Pl. 6, fig. 11

Oistodus concavus Branson and Mehl, 1933, p. 59, pl. 4, fig. 6.
Drepanodus concavus (Branson and Mehl). Glenister, 1957, p. 724, pl. 86, fig. 10; Barnett, 1965, pl. 70, pl. 1, fig. 17; Mound, 1965, in part, p. 16-17, pl. 2, figs. 4, 6 [*non* fig. 5]; Winder, 1966, p. 56, pl. 9, fig. 18; text fig. 3(18).
cf. *Drepanodus concavus* (Branson and Mehl). Lee, 1975b, p. 172, pl. 1, fig. 8.

DISCUSSION-A few drepanodiform elements from the El Paso agree well with Branson and Mehl's (1933) figured cotype of *D. concavus.* This form is hyaline except for the growth axis.

OCCURRENCE-*D. concavus* s.f. has been reported from the Jefferson City Dolomite (Branson and Mehl, 1933), the Maquoketa Shale (Glenister, 1957), the Jacksonburg Limestone (Barnett, 1965), the Cobourg Formation as used by Winder (1966), and from Korea (Lee, 1975b). The El Paso elements are in samples SD/80, 300-440, 480, 640, 700, 740-800, 861, 880, 1,180, 1,315, 1,342.

NUMBER OF SPECIMENS-69.

REPOSITORY-UMC 1060-12.

Drepanodus cf. *D. conulatus* Lindström s.f. P1. 6, fig. 5

cf. *Drepanodus conulatus* Lindström, 1955, p. 561, pl. 2, fig. 34; pl. 4, fig. 34.

DISCUSSION-The specimens assigned here conform closely to Lindström's (1955) description. The oral edge of the basal margin is keeled, and the inner face of the keeled cusp is slightly carinate. The outer cusp face may be very faintly carinate distally.

Lindström (1971) placed *D. conulatus* s.f. in the multielement species *Scandodus furnishi,* to which apparatus he also assigned *Scandodus furnishi* s.f. and *Drepanodus cyranoicus* s.f. This last form species is not present in the El Paso Group collections. Ethington (1972) reported *S. furnishi* s.f. and *Drepanodus cyranoicus* s.f., but not *Drepanodus conulatus* s.f. from the Ninemile Formation in Nevada. Because the constituents of *Scandodus furnishi* have not been found to occur together in western North America, *S. furnishi* s.f. and *D.* cf. *D. conulatus* s.f. are retained in the form sense.

Van Wamel (1974) has considered the Baltic apparatus *Scandodus furnishi sensu lato* to be a species within the genus *Drepanoistodus* and has given the apparatus the name *Drepanoistodus conulatus* (Lindström).

OCCURRENCE-Samples SD/760 and 800.

NUMBER OF SPECIMENS-40.

REPOSITORY-UMC 1068-15 .

Drepanodus? gracilis (Branson and Mehl) s.f. P1. 6, fig. 6

Drepanodus? gracilis (Branson and Mehl). Lindström, 1955, p. 562-563, pl. 4, fig. 44; pl. 5, figs. 6, 7.
Drepanodus arcuatus Pander. Van Wamel, 1974, in part, p. 61-62, pl. 1, fig. 13 only.

DISCUSSION-The El Paso elements are similar to the Balto-Scandic forms except that the Texas specimens have a noticeable flaring of the inner side of the basal margin posterior to the midline.

Van Wamel (1974) placed *D.? gracilis* s.f. in *Drepanodus arcuatus* Pander. If my form identifications are correct, and if *D. pandus* from the El Paso Group is conspecific with van Wamel's *D. sculponea,* then study of further collections may enable us to recognize van Wamel's reconstruction of *D. arcuatus* in the El Paso, as nearly all the forms occur here in one sample or another.

OCCURRENCE-Samples SD/400, 440, 502, 600, 640, 660, 720, 800, 839-880, 940, 1,140, 1,180, 1,315, 1,332.

NUMBER OF SPECIMENS-63.

REPOSITORY-UMC 1064-20.

Drepanodus pandus (Branson and Mehl) s.f. P1. 6, fig. 7

Oistodus pandus Branson and Mehl, 1933, p. 61, pl. 4, figs. 21-22.
Drepanodus pandus (Branson and Mehl). Moskalenko, 1967, in part, p. 106-107, pl. 23, figs. 1-2; text fig. 8 [*non* pl. 23, figs. 2-4]; Barnes and Tuke, 1970, p. 85-86, pl. 20, figs. 18-19.
non Oistodus pandus Branson and Mehl. Furnish, 1938, p. 330, pl. 42, fig. 5; Graves and Ellison, 1941, pl. 1, figs. 2, 31, 34; pl. 2, fig. 34.

DISCUSSION-These forms have been compared with the figured cotypes (Branson and Mehl, 1933). *D. pandus* s.f. is similar to *Oistodus gracilis* s.f. in overall size and hyaline structure, and these two forms generally have been reported to occur together. Possibly they could be involved in a common apparatus.

OCCURRENCE-*D. pandus* s.f. has been reported from Missouri (Branson and Mehl, 1933), Siberia (Moskalenko, 1967), and Newfoundland (Barnes and Tuke, 1970). The El Paso specimens are in samples SD/300-360, 400, 821, 940, 1,102, 1,240, 1,260, 1,330-1,342.

NUMBER OF SPECIMENS-60.

REPOSITORY-UMC 1064-1.

Drepanodus parallelus Branson and Mehl s.f.
P1. 6, figs. 9, 10

Drepanodus parallelus Branson and Mehl, 1933, p. 59, pl. 4, fig. 17; Jones, 1971, p. 52-53, pl. 8, figs. 5a-c [synonymy to 1971]; Lee, 1975a, p. 85-86, pl. 1, fig. 16; text fig. 3-M.
Drepanodus arcuatus Branson and Mehl, 1933, p. 58, pl. 4, figs. 7, 8, 13, 16.
Drepanodus simplex Branson and Mehl, 1933, p. 58, pl. 4, fig. 2; Müller, 1973, p. 37, pl. 5, fig. 5; Greggs and Bond, 1971, p. 1,467, pl. 1, figs. 3-4.
?*Drepanodus tortus* Furnish, 1938, p. 329, pl. 42, fig. 6.
Drepanodus subarcuatus Furnish. Ethington and Clark, 1971, p. 72-74, pl. 2, fig. 1; Müller, 1973, in part, p. 37, pl. 5, figs. 9-11 [? pl. 5, figs. 8a, b]; Abaimova, 1975, p. 66-67, pl. 5, figs. 1-5, 7, 9; text fig. 7-1.
?*Drepanodus simplex* Branson and Mehl. Druce and Jones, 1971, in part, p. 74, pl. 13, figs. 1, 2, 4; text fig. 24b [? *non* pl. 13, figs. 3a-c].
?*Drepanodus parallelus* Branson and Mehl. Abaimova, 1975, p. 6364, pl. 6; text fig. 7-6, 40.
"Drepanodus" subarcuatus Furnish. Repetski and Ethington, 1977, p. 95, 97.

DISCUSSION-After examination of the type specimens of *D. parallelus, D. arcuatus* Branson and Mehl *[non* of Pander, 1856], *D. simplex,* and *D. subarcuatus,* I conclude that all these forms are conspecific in the form sense. This form species is quite variable.

Jones (1971, p. 52) argued that *D. simplex* should be kept separate because its cusp is broad in the medial part "yet obtusely tapered at the distal end." Although apparent in Branson and Mehl's illustration, these features are somewhat misleading artifacts of the illustration of that particular specimen. The apparent broadening of the cusp above the base is a result of a twisting of the cusp in this region, which brings the faintly keeled broadest part into the plane of the photograph. If the element were viewed from an oral or aboral position, this medial part would appear to be the thinnest part. The obtuse tapering at the distal ends of at least the cotypes is because this region has been either a) broken and only partly regrown, or b) partly resorbed, the growth axis being more resistant to resorption.

One of the elements of *D. simplex* figured by Druce and Jones (1971, pl. 13, figs. 3a-c) does appear to broaden distally, and I have withheld this form from the synonymy.

OCCURRENCE-D. *parallelus* s.f. is a common element in Lower Ordovician rocks (as reflected in the synonymy list). The El Paso specimens were found in samples SD/O, 20, 100, 160, 320, 400-440, 520-1,220, 1,260, and 1,279.

NUMBER OF SPECIMENS-500.

REPOSITORY-UMC 1059-2, 3.

Drepanodus cf. *D. planus* Lindström s.f.
P1. 6, fig. 8

cf. *Drepanodus planus* Lindström, 1955, p. 565-566, pl. 2, figs. 3537; text fig. 4a.
cf. *Drepanoistodus forceps* (Lindström). Van Wamel, 1974, in part, p. 64-65, pl. 2, fig. 17 only.

DISCUSSION-The El Paso collection contains drepanodiform elements that conform closely to *Drepanodus planus* s.f. Lindström (1971) assigned *D. planus* s.f. to the apparatus of *Drepanoistodus forceps.* I have not recognized the complete apparatus of *D. forceps* in the El Paso Group, thus *Drepanodus* cf. *D. planus* is treated here in the form sense.

OCCURRENCE-Samples SD/861, 940, 960, 1,140, 1,220, and 1,260.

NUMBER OF SPECIMENS-13 .

REPOSITORY-UMC 1070-11.

Drepanodus proteus Lindström s.f.
P1. 6, fig. 3

Drepanodus proteus Lindström, 1955, p. 566-567, pl. 3, figs. 18-21; text fig. 2a-f, j; Viira, 1974, p. 71, p1. 2, figs. 29-34; text figs. 75, 76.
Paroistodus proteus (Lindström). Lindström, 1971, in part, p. 46-47, drepanodiform element only.
Distacodus expansus (Graves and Ellison). Ethington, 1972, p. 23, pl. 1, fig. 23.
Paroistodus parallelus (Pander). Van Wamel, 1974, in part, p. 79-80, pl. 7, figs. 12, 14 only.

DISCUSSION-This drepanodiform element is non-costate laterally, as is the specimen figured as *dus expansus* s.f. by Ethington (1972).

Lindström (1971) placed *Drepanodus proteus* s.f. in the multielement species *Paroistodus proteus.* Recently, van Wamel (1974) included *P. proteus* and *P. originalis* in *P. parallelus,* pointing out that the drepanodiform elements used to distinguish the three apparatuses form an intergradational series morphologically. Clearly, conflict exists at present as to whether one or three species should be recognized, at least within the Baltic material. This problem cannot be resolved here, so I am retaining *Drepanodus proteus* in the form sense.

Viira (1974) illustrated the variation within *D. proteus* s.f. (1974, text fig. 75) and the possible phylogenetic relationship among the elements *D. numarcuatus* s.f., *D. amoenus* s.f., *D. proteus* s.f., *Distacodus expansus* s.f., and *Drepanodus originalis* s.f. (1974, text fig. 15). My specimens resemble her forms of *Drepanodus proteus* s.f. that lack anterior inversion of the basal cavity.

OCCURRENCE-Samples SD/420, 440, 502, 520, 560, 580, 621, 760, 780, 821, 880-920, 960, 1,000, 1,158, 1,220, 1,260, 1,279, 1,315-1,342.

NUMBER OF SPECIMENS-106.

REPOSITORY-UMC 1065-2.

Drepanodus pseudoconcavus n. sp. s.f.
P1. 7, figs. 1, 2

Oistodus concavus Branson and Mehl. Furnish, 1938, p. 329, pl. 41, figs. 16-17.
Drepanodus concavus (Branson and Mehl). Mound, 1968, p. 410, pl. 2, figs. 18-19.

The specimens described as *Oistodus concavus* s.f. by Furnish (1938) differ from Branson and Mehl's type material (1933) in that the Shakopee and Blue Earth forms have an erect basal cavity, whereas the Jefferson City cotypes have basal cavities that point anteriorly. In profile, the basal cavity of *D. pseudoconcavus* s.f. is only very slightly convex upward posterior to the erect tip and is straight to slightly concave upward anterior to the tip. Other than having extensive white matter in its cusp, *D. pseudoconcavus* s.f. is similar in shape and curvature to *D. concavus* (Branson and Mehl) s.f.

The elements figured by Mound (1968) show a basal cavity whose shape is similar to that of *D. pseudoconcavus.*

DERIVATION OF NAME-pseudo, = false. This form is not *Drepanodus concavus* (Branson and Mehl).

OCCURRENCE-This form species has been reported previously in the Shakopee Dolomite and in the Blue Earth beds of the Upper Mississippi Valley by Furnish (1938) and in the upper McKenzie Hill of southern Oklahoma (Mound, 1968). The El Paso elements are in samples SD/40, 120-180, 240-300.

NUMBER OF SPECIMENS-28.

REPOSITORY-UMC 1059-8 (holotype), 20.

Drepanodus sculponea Lindström s.f. Pl. 7, fig. 9

Drepanodus sculponea Lindström, 1955, p. 567, pl. 2, fig. 40; text fig. 3L; Viira, 1974, p. 66.

?Drepanodus arcuatus Pander. Lindström, 1971, in part, p. 41-42 [*Drepanodus sculponea* s. f. only].

DISCUSSION-Lindström (1971) stated that *D. sculponea* s.f. might belong in the apparatus of *Drepanodus arcuatus.*

OCCURRENCE-*D. sculponea* has been recovered previously from Sweden (Lindström, 1955) and Estonia (Viira, 1974). In the El Paso Group it is present in samples SD/621, 640, 680, 700, 839, 861, 900-940, 1,000, 1, 140-1,180, 1,260, 1,279.

NUMBER OF SPECIMENS-53.

REPOSITORY-UMC 1066-6.

Drepanodus toomeyi Ethington and Clark s.f. Pl. 7, fig. 4

Drepanodus toomeyi Ethington and Clark, 1964, p. 690, pl. 113, fig. 17, pl. 114, fig. 22; text fig. 2H; Barnes and Poplawski, 1973, p. 773, pl. 2, fig. 10 [synonymy to date].

?Drepanodus cf. *D. toomeyi* Ethington and Clark. Cooper and Druce, 1975, pl. 1, fig. 15.

non Drepanodus cf. *D. toomeyi* Ethington and Clark. Cooper and Druce, 1975, pl. 1, figs. 17, 18.

DISCUSSION-Ethington and Clark (1964) gave an excellent description of this form in their report on conodonts from the El Paso Group.

Of the specimens from New Zealand illustrated by Cooper and Druce (1975), fig. 15 appears to be similar to *D. toomeyi* s.f., but, as was pointed out by Cooper and Druce, the specimens figured in figs. 17 and 18 have an elongated anterobasal angle.

OCCURRENCE-*D. toomeyi* s.f. has been reported from Texas (Ethington and Clark, 1964; ?Bradshaw, 1969; this report), Newfoundland (Barnes and Tuke, 1970), Quebec (Barnes and Poplawski, 1973) and New Zealand (Cooper and Druce, 1975). The specimens in my collections are in samples SD/360-400, 480, 600, 640, 680, 720, 760, 800-861, 900-940, 980, 1,000, 1,140, 1, 180, 1,315, 1,332.

NUMBER OF SPECIMENS-57.

REPOSITORY-UMC 1064-18.

Drepanodus aff. D. sp. 3 of Serpagli (1974) s.f. Pl. 7, fig. 3

aff. Drepanodus sp. 3 Serpagli, 1974, p. 45, pl. 10, figs. 7a, b; p1. 21, fig. 15.

Elements have an erect to recurved cusp above a short base whose anterior margin is drawn out aborally as a short tonguelike process. The cusp is keeled anteriorly and posteriorly; the anterior keel is directed toward the inner side of the cusp near the base. At the cusp-base juncture, the anterior keel becomes directed anteriorly, causing the cusp to appear twisted above the base. The outer face of the cusp is strongly convex; the inner face less convex. Rare specimens have a linear concavity on the inner face of the cusp posterior to the anterior keel. The basal cavity is relatively deep. In profile, the cavity margins are gently convex; the apex is directed anteriorly and orally.

The basal margin is oval in aboral view, but the margin may be widest between the midline and the anterior margin. The posterobasal angle is 60-90 degrees. The basal margin flares orally, either anteriorly or, more typically, on the inner side adjacent to the anterior end. The outer anterolateral part of the margin extends aborally as a rounded spatulate process. This process may include the anterior keel or may be entirely on the outer side of that keel.

DISCUSSION-Drepanodus aff. *D.* sp. 3 s.f. is distinctive in its tonguelike anterolateral anticusp. This form is very similar to *Drepanodus* sp. 3 s.f. of Serpagli (1974); however, the latter form has a notch on each side of its basal margin, and its anticusp is situated anteriorly, not anterolaterally as on the El Paso forms. The only difference is that Serpagli's form is bilaterally symmetrical and these forms are not. The two forms probably are included in the same, or closely related, species.

OCCURRENCE-The element is rare and was found only in samples SD/440, 480, 502, 580, 600, and 760.

NUMBER OF SPECIMENS-9.

REPOSITORY-UMC 1065-8.

Drepanodus sp. s.f. P1. 7, fig. 6

cf. *Cordylodus simplex* Branson and Mehl, 1933, p. 64, pl. 4, fig. 11.

DISCUSSION-This drepanodiform element is very similar to the cordylodiform element of *Acodus delicatus*, that is *Cordylodus simplex* s.f. The posterior margin of this new form is more rounded, and the anterior margin projects farther posteroaborally than does that of *C. simplex* s.f.

OCCURRENCE-Samples SD/440, 480, 502, and 600.

NUMBER OF SPECIMENS-26.

REPOSITORY-UMC 1065-10.

Drepanodus n. sp. 1 s.f. P1. 7, fig. 5

Drepanodus n. sp. 1 s.f. is a small drepanodiform element that has an upward flaring of the inner anterolateral part of its basal margin. The cusp is slightly reclined and consists of white matter above the base. The cusp is narrowly lanceolate in cross section. The short, straight oral margin of the base is approximately normal to the posterior edge of the cusp and intersects the aboral margin at approximately a 60-degree angle. The outer segment of the basal margin is essentially straight; the inner segment is broadly convex outward to

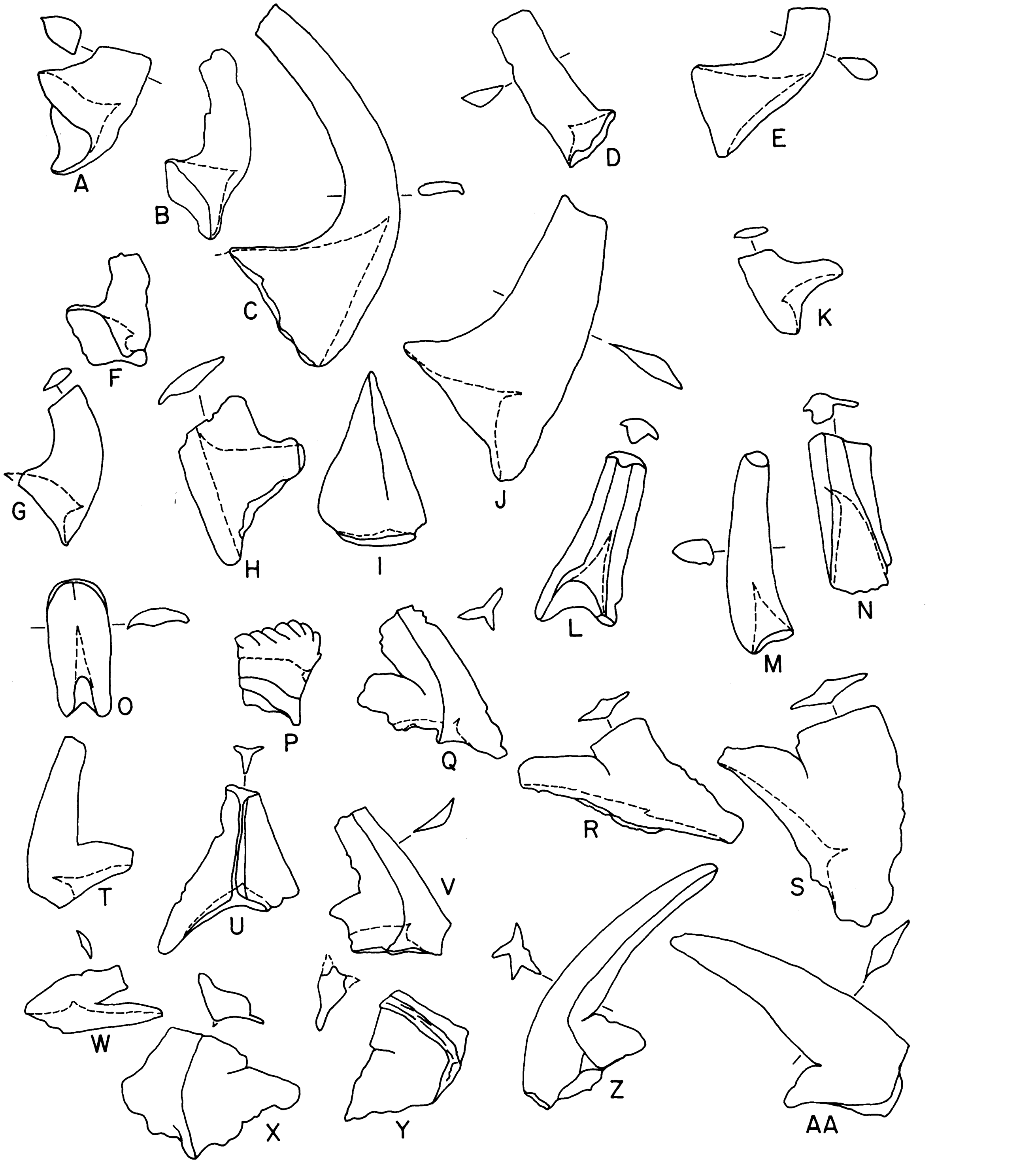

FIGURE 5-*A-Drepanodus* aff. *D.* sp. 3 of Serpagli (1974) s.f. Inner lateral view, x 61. UMC 1065-8. *B--Drepanodus pseudoconcavus* n. sp. s.f. Lateral view, x 43. UMC 1059-8. *C-Drepanodus* sp. s.f. Inner lateral view, x 61. UMC 1065-10. *D-Drepanodus* n. sp. 2 s.f. Lateral view, x 62. UMC 1064-16. *E-Drepanodus* n. sp. 3 s.f. Lateral view, x 57. UMC 1063-19. *F-Drepanodus* n. sp. 1 s.f. Inner lateral view, x 60. UMC 1060-13. *G-Drepanodus* n. sp. 6 s.f. Lateral view, x 31. UMC 1070-5. *H-Drepanodus* n. sp. 7 s.f. Inner lateral view, x 62. UMC 1070-6. *I-Histiodella donnae* n. sp. Posterior view, x 59. UMC 1062-16. *J-Drepanodus* n. sp. 4 s.f. Inner lateral view, x 59. UMC 1064-8. *K-Drepanodus?* n. sp. 5 s.f. Lateral view, x 54. UMC 1064-19. *L-Juanognathus variabilis* Serpagli. Posterior view, x 49. UMC 1069-14. *M-Juanognathusjaanussoni* Serpagli. Posterior view, x 60. UMC 1071-9. *N-Juanognathus?* n. sp. 1. Posterior view, x 62. UMC 1070-16. *O-Juanognathus hayesi* n. sp. Posterior view, x 50. UMC 1071-16. *P-Loxodus bransoni* Furnish s.f. Inner lateral view, x 57. UMC 1058-5. Q, R, *S-Oelandodus* cf. *O. costatus* van Wamel. All x 58. Q) Triangulariform element, lateral view. UMC 1069-6; R) Oistodiform element, lateral view. UMC 1069-7; S) Elongatiform element, outer lateral view. UMC 1069-8. T, U, *V-Oelandodus* cf. *O. elongatus* (Lindstrom). T) Oistodiform element, lateral view, x 56. UMC 1068-7; U) Triangulariform element, posterior view, x 60. UMC 1068-9; V) Elongatiform element, outer lateral view, x 53. UMC 1068-11. *W-Oistodus cf. O. inaequalis* Pander s.f. Inner lateral view, x 59. UMC 1064-4. X, Y, Z, *AA-Oistodus* n. sp. X) Triangulariform element, outer lateral view, x 53. UMC 1067-18; Y) Deltaform element, lateral view, x 52. UMC 1067-15; Z) Paltodiform element, lateral view, x 29. UMC 1067-16; AA) Oistodiform element, inner lateral view, x 27. UMC 1067-18.

the posterior to anterolateral flared part. The edge of the aboral margin, where flared upward, also flares outward. The basal cavity is shallow; in lateral view, the cavity tip points anteriorly and upward. The cavity margin posterior to the apex is straight to slightly convex outward; anterior of the apex, the cavity margin is concave outward.

DISCUSSION-This element is very rare in the Scenic Drive collection. The upward flaring of the anterolateral corner of its basal margin distinguishes the element.

OCCURRENCE-Drepanodus n. sp. 1 s.f. was recovered only in sample SD/140.

NUMBER OF SPECIMENS-1.

REPOSITORY-UMC 1060-13.

Drepanodus n. sp. 2 s.f.
Pl. 7, figs. 7, 8

A drepanodiform element, this specimen has a straight proclined cusp above a very short, slightly expanded base. In cross section, it is lanceolate throughout the length of the element. The base is short and is expanded only at the aboral margin. The basal cavity is shallow; the cavity apex is directed anteriorly and is situated medially. A low carina is present on each face of the straight, proclined, bladelike cusp.

DISCUSSION-D. n. sp. 2 s.f. most closely resembles the scandodiform element of *Scolopodus rex paltodiformis* except that the cusp of the former is not curved or twisted above the base, and the base is thinner laterally.

OCCURRENCE-Sample SD/320.

NUMBER OF SPECIMENS-2.

REPOSITORY —UMC 1064-16,17.

Drepanodus n. sp. 3 s.f.
P1. 7, figs. 11, 12

The cusp is erect to slightly recurved above a rather long base which has a very deep basal cavity. The cavity profile forms a long anteriorly directed triangle with straight sides and an apex that is very near the anterior margin of the cusp. The growth axis is straight and erect above the cavity tip. The basal margin is straight in profile. The anterobasal angle is acute at approximately 60 degrees. The posterobasal angle is approximately a right angle. In cross section, the basal margin may be lanceolate or a laterally compressed oval. The posterior of the base and cusp bears a thin low keel. The anterior of the element may be thinly keeled or rounded; if rounded, then the unit may or may not bear an indistinct anterolateral costa.

REMARKS-In some respects, this drepanodiform element resembles *D. tenuis* s.f. and *D.* cf. *D. verutus* s.f. of Moskalenko (1967). However, on both of these latter forms, the oral margin of the basal cavity runs nearly parallel to the oral margin of the base, whereas these two edges diverge at a low angle on *D.* n. sp. 3 s.f. This new form resembles the drawings of *D.* cf. *D. cavus* s.f. of Viira (1974, p. 67), but the margins of the basal cavity of *D.* cf. *D. cavus* s.f. are shown to be slightly concave instead of straight.

OCCURRENCE-Drepanodus n. sp. 3 s.f. is relatively common in some samples. The element is present in samples SD/300, 320, 380-440.

NUMBER OF SPECIMENS-170.

REPOSITORY —UMC 1063-19,20.

Drepanodus n. sp. 4 s.f.
P1. 7, fig. 10

Laterally compressed, the bladelike cusp is erect or slightly proclined above a short but sharply edged base. The oral edge of the base is short and makes an angle of about 45 degrees with the aboral margin. The aboral margin is concave in profile and the anterobasal angle is acute. The basal cavity is shallow; in profile, the anterior edge of the cavity runs at right angles to the oral edge of the basal margin. The posterior edge of the cavity is straight also. The sharp apex of the cavity points anteriorly and is located just anterior of the midline at the base of the cusp. The inner face of the element is flat except for a slightly convex basal margin and distal part of the cusp. The cusp is twisted slightly above the base. The outer face of the element is broadly carinate medially; areas on either side of the carina are flat, and the blade tapers to sharp edges. Both base and cusp are broad anteroposteriorly, thin laterally, and bladelike.

OCCURRENCE-Sample SD/300.

NUMBER OF SPECIMENS-5.

REPOSITORY-UMC 1064-8.

Drepanodus? n. sp. 5 s.f.
Pl. 8, fig. 2

These laterally compressed elements have an erect cusp above a base that has short anterior and posterior processes. Processes are sharply edged and adenticulate; the posterior process has an oral edge that is straight for most of its length, then is convex posteriorly. The anterior process is convex anteriorly. The aboral margin is deeply concave in profile so that the anterior and posterior portions of the margin are at right angles to each other. The basal cavity is shallow and its tip points anteriorly. The anterior edge of the cavity in profile is concave and shorter than the convex posterior edge. The cavity extends as shallow grooves under the processes. The basal margin flares outward very slightly in the medial position. The erect blade is compressed laterally.

DISCUSSION-The elements in this collection are very small. Possibly they are juveniles of some other form. *D. ?* n. sp. 5 is distinctive in its shallow basal cavity and its nontwisted, flattened-blade appearance.

OCCURRENCE-Samples SD/400 and 480.

NUMBER OF SPECIMENS-5.

REPOSITORY—UMC 1064-19.

Drepanodus n. sp. 6 s.f.
Pl. 8, figs. 1, 3

In this form a lanceolate reclined cusp is above a rather long base that has a drawn-out anterior end. The cusp is twisted slightly and has sharp anterior and posterior margins. Curving rather strongly just above the base, the cusp is nearly straight distally; above the base, the cusp axis is parallel to the aboral margin. The base is fairly long anteroposteriorly but not deep. The oral margin of the base is very short and makes an acute angle with the nearly straight aboral margin. The anterobasal angle is about 45 degrees; the anterior margin of the cusp curves posteriorly along the basal extent to the anteroaboral angle. The thin anterior margin is deflected inward basally. The basal cross section is lachrymiform and has a rounded posterior and pointed anterior; the base is biconvex, the outer side being more strongly convex than the inner side. The basal cavity is very shallow and triangular and the apex is located just anterior of the midline under the cusp. The cusp contains white matter.

DISCUSSION-*Drepanodus* n. sp. 6 s.f. resembles *D. homocurvatus* s.f. somewhat, but the former is recurved much more strongly in the region of the base-cusp juncture, and the cusp of this new form is nearly straight distally.

OCCURRENCE-Samples SD/839-940, 1,140, 1,200, 1,279, 1, 315.

NUMBER OF SPECIMENS-32.

REPOSITORY-UMC 1070-4, 5.

Drepanodus n. sp. *7* s.f.
P1. 8, fig. 4

The drepanodiform elements have a sharply keeled, thinly sheathed base. The cusp is lanceolate in cross section and is proclined to erect; the posterior edge of the cusp meets the straight oral edge of the base at about 120 degrees. The posterobasal and anterobasal angles are acute; the basal cavity is expansive and forms an equilateral triangle in profile view. The outer face of the base is gently convex. Basally, the anterior keel is deflected strongly toward the inner side and has a rather prominent groove adjacent to it that widens and deepens basally. The basal sheath flares laterally posterior to the groove.

DISCUSSION-The strong deflection of the anterior keel is the distinctive feature of this element.

OCCURRENCE-Samples SD/861, 880, 920, 1,279, 1,315, 1, 332.

NUMBER OF SPECIMENS-19.

REPOSITORY-UMC 1070-6.

GENUS *DREPANOISTODUS* Lindström, 1971
TYPE SPECIES: *Oistodus forceps* Lindström, 1955

Drepanoistodus suberectus subsp. A, n. subsp. (Branson and Mehl)
Pl. 7, fig. 13; pl. 8, fig. 5

SUBERECTIFORM element:

Oistodus suberectus Branson and Mehl, 1933, p. 111, pl. 9, fig. *7.*
Drepanodus suberectus (Branson and Mehl). Jones, 1971, p. 53-55, pl. 8, figs. 6a-7c [partial synonymy to 1971]; Lee, 1970, p. 322-323, pl. 7, fig. 18; Ethington and Clark, 1971, p. 69, pl. 1, fig. 7; Müller, 1973, p. 38, pl. 5, figs. 3, 6-7; Viira, 1974, p. 66, pl. 3, figs. 26-30; Lee, 1975a, p. 86-87, pl. 2, fig. 8; text fig. 4-F; Abaimova, 1975, p. 68-69, pl. 5, figs. 10-12; text fig. 7(2, 7-8); Cooper and Druce, 1975, p. 573, pl. 1, fig. 20.
? *Drepanodus suberectus* (Branson and Mehl). Lee, 1975b, p. 174.

HOMOCURVATIFORM element:

Oistodus curvatus Branson and Mehl, 1933, p. 110, pl. 9, figs. 4, 10, 12.
Drepanodus homocurvatus Lindström. Jones, 1971, p. 51-52, pl. 3, figs. 2a-c; pl. 8, figs. 4a-b [partial synonymy to 1971]; Lee, 1970, p. 320-322, pl. 7, figs. 16-17; Ethington and Clark, 1971, p. 69, pl. 1, fig. 1; Viira, 1974, p. 66, pl. 3, figs. 19-20; Greggs and Bond, 1971, p. 1, 465, pl. 1, figs. 6-7; Moskalenko, 1973, pl. 15, fig. 6; Abaimova, 1975, p. 61-62, pl. 4, figs. 1-5; text fig. 6(22-23).
cf. *Drepanodus homocurvatus* Lindström. Lee, 1975a, p. 85, pl. 2, fig. 1; text fig. 4-A.
? *Drepanodus homocurvatus* Lindström. Lee, 1975b, p. 173-174.

Both elements of this species have been well described in many other reports.

DISCUSSION-The Early Ordovician representative of *D. suberectus* apparently did not contain an oistodiform element. Clark (1972, p. 148) discussed the problem of whether the Early Ordovician *D. suberectus* is an ancestor of *D. suberectus suberectus* in Middle and Upper Ordovician rocks of North America, which does contain an oistodiform element. As the problem cannot be resolved here, I choose to retain the name *D. suberectus* for the El Paso elements, but I have added the subspecific designation to distinguish the Early Ordovician form.

Both homocurvatiform and suberectiform elements show considerable variation in the shape of the basal margin and basal cavity, and, in the case of the homocurvatiform element, in the degree of curvature of the cusp.

As mentioned in the discussion of *Acanthodus uncinatus* s.f., some of the broken elements of that form species may be included here as homocurvatiform elements.

Lee included *Drepanodus planus* Lindström s.f. (Lee, 1970) and *D. amoenus* Lindström s.f. (Lee, 1975a, b) in his concept of *D. homocurvatus* s.f.

OCCURRENCE-This species is present in nearly all collections of Early Ordovician conodonts. The El Paso homocurvatiform elements were found in samples SD/ 60-100, 140-180, 240-440, 480, 560-1,020, 1,1401,180, 1,220, 1,260-1,300, and 1,332.

The suberectiform elements are in samples SD/0, 40-100, 180, 200, 240, 280-400, 440, 480, 600, 640, 740-780, 821-880, 960, 980, 1,158, and 1,315.

NUMBER OF SPECIMENS-Homocurvatiforms-594; suberectiforms-105.

REPOSITORY-UMC 1059-18, 19.

GENUS *HISTIODELLA* Harris, 1962
TYPE SPECIES: *Histiodella altifrons* Harris, 1962

Histiodella donnae n. sp.
Pl. 8, figs. 6, 7

This form is characterized by thin, flat to strongly concavoconvex leaf-shaped blades. The blade is extremely compressed laterally, triangular in lateral view, and has a base length about two-thirds the height. The apex is sharp and the anterior and posterior ends are rounded in lateral view. The basal margin is nearly straight to very slightly sigmoidal along the inner side and bowed outward on the outer side. The basal cavity is low and slitlike; the cavity extends the length of the base and has its shallow apex directed orally under the axial denticle. The cavity is widest at midpoint. The blade consists of denticles that diverge outward and orally from a point just above the apex of the basal cavity. The denticles are completely fused laterally and are detectable most easily in transmitted light, as they consist medially, but not peripherally, of white matter. A central, or axial, denticle extends to the tip of the blade. This axial denticle is slightly thicker than the other denticles, thus it is discernible as a medial carina on each lateral face. In lateral view, the blade may be symmetrical or asymmetrical; when the blade is asymmetrical, the axial denticle is inclined slightly posteriorly, the basal cavity has its apex somewhat farther anteriorly than it does on symmetrical elements, and the anterior part of the blade is less broad anteroposteriorly than is the posterior part. Symmetrical elements may be strongly concavoconvex laterally and the most pronounced deflection is along the upper part of the base-blade junction and in the central region. The oral edges of the blade are very sharp and nonserrate. There is a symmetry transition from asymmetrical, nearly planar elements to symmetrical, strongly concavoconvex elements. Recently, R. L. Ethington (personal communication, 1978) informed me that he recovered a trichonodelliform element of *H. donnae* from the Manitou Formation of Colorado.

DISCUSSION-This new form is placed in *Histiodella* because of its similarity in shape and structure to elements of that genus. I have examined the type material of *H. altifrons* s.f. and *H. serrata* s.f. in making this diagnosis. *H. donnae* is very similar to *H. altifrons* s.f. in overall shape, except that *H. donnae* may be strongly concavoconvex, whereas *H. altifrons* s.f. is fairly flat. Also, the apex of the basal cavity is more distinct on the El Paso specimens. The radiating arrangement of the fused denticles is not discernible on the type of *H. altifrons* s.f., but this arrangement is barely visible on *H. serrata* s.f. However, *H. serrata* s.f. has an anterior extension that shows the roots of the blade-forming denticles emerging vertically above the base and subparallel to each other. The radiating arrangement can be seen only on the parts of the blade immediately anterior and posterior to the main denticle.

McHargue (1974), after studying thousands of *Histiodella* elements from the Joins Formation (Whiterockian Stage) of southern Oklahoma, recognized several multielement species of *Histiodella.* Similar apparatuses could not be recognized in my material, however, because of the rarity of these elements.

OCCURRENCE-In addition to its occurrence in the El Paso, *H. donnae* s.f. is present in the Fillmore Formation of western Utah and in the Manitou Formation in central Colorado (R. L. Ethington, personal communication, 1978). The El Paso elements are in samples SD/280-320 and possibly in 1,279 (specimen in SD/1,279 appears to be abraded and probably has been reworked).

DERIVATION OF NAME-After my wife, Donna Kohler Repetski.

NUMBER OF SPECIMENS-14.

REPOSITORY —Holotype: 1062-16; also UMC 1062-17.

GENUS *JUANOGNATHUS* Serpagli, 1974
TYPE SPECIES: *Juanognathus variabilis* Serpagli, 1974

Juanognathus hayesi n. sp.
Pl. 9, figs. 4, 5, 9

The unit is compressed anteroposteriorly, with a rather short cusp curved above a long base. A wide, sharp, keel-like costa forms each lateral edge of the element. The costae run the length of the element and extend as short lateral processes beyond the opening of the basal cavity. The cusp terminates distally as a small sharp peglike tip, which is approximately erect. The anterior face of the element is smoothly convex. The posterior face is concave except for a medial convexity formed by the posterior sheath of the basal cavity. The cavity is a tall narrow cone extending for half the length of the element. The cavity tip is sharp and is located near the anterior margin; the cavity may be located symmetrically or slightly asymmetrically with respect to the element edges, and the cavity tip may be deflected slightly from the axis of the cavity. The posterior part of the basal margin opens higher than the anterior part. The cavity extends as shallow grooves beneath short lateral processes.

DISCUSSION-This form shows the same range of symmetry variation as does *Juanognathus variabilis. J. hayesi* differs from *J. variabilis* in that the lateral costae of the former constitute a much greater proportion of the element relative to the cusp and, in posterior view, the edges of *J. hayesi* are subparallel until very near the distal end, whereas *J. variabilis* tapers more noticeably. *Acodina bifida* Abaimova (1971) resembles *J. hayesi,* but the lateral edges of the former do not appear to extend below the opening of the basal cavity.

DERIVATION OF NAME-After P. T. Hayes, author of several papers concerning the El Paso Group.

OCCURRENCE-J. *hayesi* is present in the Lower Ordovician of the Great Basin in the western United States (R. L. Ethington, personal communication, 1975) and in the uppermost part of the El Paso, in samples SD/ 1,300 and 1,315.

NUMBER OF SPECIMENS-10.

REPOSITORY—UMC 1071-16, 17 (holotype), 18.

Juanognathus jaanussoni Serpagli
Pl. 8, fig. 8

Juanognathus jaanussoni Serpagli, 1974, p. 50-51, pl. 11, figs. 8-12; p1. 23, figs. 1-5; text fig. 9.

Conodont undet., Uyeno and Barnes, 1970, p. 118-119, pl. 22, figs. 16, 17.

non Acodus n. sp. Ethington and Clark, 1965, p. 187, pl. 2, figs. 3, 4 [= *Acanthodus lineatus].*

non Paltodus n. sp., Lee, 1970, p. 331, p1. 8, figs. 2a, b [= *Protopanderodus* sp.].

DISCUSSION-The specimens studied appear to be identical to those figured by Serpagli (1974). The specimens recovered from the San Juan Limestone of Argentina (Serpagli, 1974) occurred in strata higher than those bearing *J. variabilis,* and Serpagli (1974, p. 35) deduced that the latter species was the direct ancestor of the former. In the El Paso, *J. jaanussoni* occurs only in the highest samples, but it does occur with *J. variabilis.* If *J. variabilis* did give rise to *J. jaanussoni,* as seems reasonable, then either the elements of *J. variabilis* found in the highest samples are reworked (although these elements do not appear to have been abraded) or the two species coexisted for a period of time. Another reasonable hypothesis is that the animal bearing juanognathiform elements bore both *variabilis-type* and *jaanussoni-type* elements for part of its temporal range.

Serpagli placed *Acodus* n. sp. of Ethington and Clark (1965) in synonymy with *J. jaanussoni*, but the former is actually an element of *Acanthodus lineatus.* Also, I think that *Paltodus* n. sp. of Lee (1970) is an element of the species that I am referring to as *Protopanderodus leein.* sp.

OCCURRENCE-J. *jaanussoni* occurs in the San Juan Limestone of Argentina (Serpagli, 1974), in a conglomeratic unit within the Levis Formation of Quebec (Uyeno and Barnes, 1970), and in the uppermost part of the El Paso Group, in samples SD/1,315 and 1,342.

NUMBER OF SPECIMENS-5.

REPOSITORY-UMC 1071-9.

Juanognathus variabilis Serpagli
Pl. 8, fig. 9; pl. 9, figs. 1, 2

Juanognathus variabilis Serpagli, 1974, p. 49-50, pl. 11, figs. 1-7; pl. 22, figs. 6-17; text fig. 8 [synonymy].

cf. *Protopanderodus?* sp. Barnes and Poplawski, 1973, p. 785, pl. 1, fig. 15.

Gen. nov. B Cooper and Druce, 1975, p. 579, fig. 30.

AMENDED DIAGNOSIS-Elements of *J. variabilis* may have one or two fine, very shallow longitudinal grooves which extend medially along the posterior face of the element.

DISCUSSION-Representatives of this species in the El Paso Group conform exactly with Serpagli's (1974) description and illustrations and show the complete range of variation that he reported.

An element illustrated by Cooper and Druce (1975, fig. 30) appears to be a specimen of *J. variabilis* that bears a median groove along the posterior face. Many of the El Paso specimens of *J. variabilis* also have these faint median longitudinal grooves posteriorly, as do specimens that the author has seen from Alabama (U.S. Geological Survey locality number 6148-CO, from the Odenville Limestone; unpublished collection of J. A. Drahovzal from the Harpersville, Alabama, 7^1/2-min quadrangle). One of Serpagli's paratypes (Serpagli, 1974; pl. 22, fig. 16) shows one or two faint posterior grooves.

Interestingly, although *J. variabilis* has the same stratigraphic range as *Oepikodus smithensis* in the San Juan Limestone of Argentina, the range of *J. variabilis* cides with that of *Oepikodus communis* in the upper part of the El Paso.

OCCURRENCE-J. *variabilis* is present in the San Juan Limestone of Argentina (Serpagli, 1974), in the Lower Ordovician of Malaya (Igo and Koike, 1967), in Alabama (see above), in the Fillmore Formation of Utah (Ethington and Clark, 1971), in the upper West Spring Creek Formation of Oklahoma (Potter, 1975), in Nelson, New Zealand, and the Georgina Basin, Australia (Cooper and Druce, 1975), and possibly in the Mystic Conglomerate of Quebec (Barnes and Poplawski, 1973). *J. variabilis* is an important member of faunas of the upper part of the El Paso Group at Scenic Drive and was recovered in samples SD/839, 1,180, 1,220, 1,2601, 342.

Juanognathus? n. sp. 1
Pl. 9, figs. 3, 6

This form consists of nearly straight cones with two asymmetrically situated costae and a very tall basal cavity. The element is straight basally and the cusp is only slightly curved. The unit is compressed at an angle to the anteroposterior plane. The anterior and outer anterolateral faces are convex; distally, the cusp may bear a rounded anterior carina.

Two costae extend the entire length of the unit, one along the inner anterolateral edge and the other along the outer posterolateral edge. Costae are sharp along the cusp but may be sharply rounded near the basal margin. The inner face is dominated by a prominent carina that widens basally and that may have a slightly flattened face. The posterior edge of the carina is sharper than the rounded anterior edge. The carina is separated from costae on each side by a sharp, deep groove. The carina and costae extend to the basal margin which has a thin edge.

The basal cavity is a very tall narrow cone. The apex is very near the anterior margin. The surface of the element bears fine longitudinal striations.

DISCUSSION-Because of the striated surface and anteriorly pointed basal cavity, *J. ?* n. sp. 1 resembles species of *Scolopodus.* However, *J. ?* n. sp. 1 has the same general shape and shows the same symmetry transition as is found in *Juanognathus. Protopanderodus asymmetricus* is similar to *J. ?* n. sp. 1, but the former is more evenly curved throughout its length and its inner side grooves are not nearly as deep or wide as those of *J. ?* n. sp. 1.

OCCURRENCE-SD/900, 920, and 960.

NUMBER OF SPECIMENS-9.

REPOSITORY-UMC 1070-15, 16.

GENUS *LOXODUS* Furnish, 1938
TYPE SPECIES: *Loxodus bransoni* Furnish, 1938

Loxodus bransoni Furnish s.f.
P1. 9, fig. 7

Loxodus bransoni Furnish, 1938, p. 339, pl. 42, figs. 33-34; text fig. 2A; Hass, *in* Sando, 1958, p. 841, pl. 2, fig. 17; Longwell and Mound, 1967, p. 409, pl. 1; Mound, 1968, p. 412-413, pl. 3, figs. 14-16; Ethington and Clark, 1971, p. 72-73, pl. 1, fig. 11; Abaimova, 1975, p. 112, 114, pl. 10, figs. 12-13, 15; text figs. 8(35, 40, 43); Repetski and Ethington, 1977, p. 95-96, pl. 1, fig. 2.

This unit consists of a series of posteriorly reclined denticles. The anterior denticle is erect, but those posterior to this first one progressively become more reclined. The fourth or fifth denticle is reclined at about 45 degrees above the basal margin and the angle gradually decreases toward the posteriormost denticles. The anterior denticle is larger than those two or three immediately adjacent, but the largest denticle is the third or fourth from the anterior end. Behind this largest denticle is a gradual decrease in denticle height posteriorly. Denticles are fused except at the distal ends and the axes of the denticles are albid. The basal margin is straight except for the aboral deflection as the anterobasal corner is approached. The basal cavity is thin walled; cavity depth is greatest under the anterior denticle, decreasing gradually posteriorly. The unit is twisted inward slightly near the anterior end. The basal part of the entire unit also is twisted inward slightly so that the basal cavity opens somewhat toward the inner side.

DISCUSSION-The El Paso specimens conform well with Furnish's description (Furnish, 1938) except for the inward deflection of the basal margin, not shown on the Prairie du Chien specimens. Thus, the narrow basal attachment of the Prairie du Chien forms lies approximately in the same plane as the conodont elements proper, but the basal attachment of the El Paso specimens becomes shelflike extending downward but deflected inward at about 35-45 degrees out of the plane of the conodont element. The specimen figured by Sando (1958, pl. 2, fig. 17) also appears to show this deflection of the basal attachment.

Loxodus is similar to *Coleodus* Branson and Mehl, which is present in several Middle Ordovician Midcontinent-type faunas (Branson and Mehl, 1933; Sweet and others, 1971; Repetski, 1973), but there have been no obvious descendants of *Loxodus* described from the upper part of the Canadian Series and the morphological similarity also could be attributed to homeomorphy.

OCCURRENCE-This unusual form species has been recovered from the Oneota Dolomite of Iowa and the Blue Earth beds of Minnesota (Furnish, 1938), from the upper part of the Stonehenge Limestone of south-central Pennsylvania (Sando, 1958), from the Monocline Valley Formation of Nevada (Longwell and Mound, 1967), from the Grove Creek Formation of Montana as used by Goodwin (1965), from the upper part of the McKenzie Hill Formation of Oklahoma (Mound, 1968), from the House Limestone of western Utah (Ethington and Clark, 1971), from the southeast part of the Siberian Platform (Abaimova, 1975), from the Collier Shale of Arkansas (Repetski and Ethington, 1977), and from the Manitou Formation of Colorado (R. L. Ethington, undescribed collections). The El Paso specimens were recovered from samples SD/0, 20, 40, 60, 80, and 100.

NUMBER OF SPECIMENS-29.

REPOSITORY-UMC 1058-5.

GENUS *MACERODUS* Fohraeus and Nowlan, 1978
TYPE SPECIES: *Macerodus dianae* Fohraeus and Nowlan, 1978

Macerodus dianae Fohraeus and Nowlan
Pl. 15, figs. 10, 11

Macerodus dianae Fohraeus and Nowlan, 1978, p. 461, pl. 1, figs. 26-27.
Paltodus sp. C. Ethington and Clark, 1971, p. 73, pl. 2, fig. 11.
Panderodus compressus (Branson and Mehl). Mound, 1968, p. 415, 416, pl. 4, figs. 42-52.
Stereoconus plenus Branson and Mehl. Lee, 1975b, p. 180-181, pl. 1, figs. 19-20.

A form species whose base is very broad anteroposteriorly and very compressed laterally, this unit has an erect cusp above the base marked by a groove on each lateral face. The upper margin of the base is straight in lateral view and makes an angle of about 60-80 degrees with the basal margin. The basal margin is essentially straight and the anterobasal angle is acute. The greatest anteroposterior dimension is along the basal margin; this anteroposterior width decreases rapidly above the basal margin for a short distance along the anterior margin above the anterobasal angle. The part of the anterior margin of the base above this most aboral segment is essentially straight to the region of the base-cusp juncture.

The cusp is very small relative to the base; the cusp is thin laterally and about twice as broad anteroposteriorly as it is laterally. The anterior and posterior edges are rounded along the entire unit. A groove runs longitudinally along each side of the cusp; at the base-cusp juncture, the grooves widen basally and become shallow, broad, lateral depressions on each side of the uppermost part of the base.

The basal cavity is very deep and a strongly tapered apical part extends slightly into the cusp. In lateral view the margins of the basal cavity are concave outward, strongly so near the basal margin because of great expansion in the anteroposterior width in this region. In the upper half of the base, the cavity fills only the central part of the element.

The part of the cusp above the base is white matter and the surface of the base, at least, appears to be ornamented with very fine longitudinal striations. The entire unit is flat and has no lateral twisting.

DISCUSSION-This form is distinctive because of the disproportionately small size of its cusp relative to the base and because of its lateral thinness. The base of the El Paso Group specimens is somewhat shorter than the base on the figured types of *M. dianae* (Fohraeus and Nowlan, 1978).

OCCURRENCE-*Macerodus dianae* appears to be a very useful biostratigraphic tool, as its range is rather restricted. *M. dianae* has been reported from part of the Fillmore Formation of western Utah (Ethington and Clark, 1971), from the middle part of the Cool Creek Formation of southern Oklahoma (as *Panderodus compressus)* (Mound, 1968) and from North Korea (Lee, 1975b), and from the Cow Head Group in western Newfoundland (Fâhraeus and Nowlan, 1978). The El Paso specimens are in samples SD/300, 320, 400, 440, and 880 (specimen in SD/880 appears to be abraded and probably is reworked).

NUMBER OF SPECIMENS-30.

REPOSITORY-UMC 1063-8, 9.

GENUS *MICROZARKODINA* Lindström, 1971
TYPE SPECIES: *Prioniodina flabellum* Lindström, 1955

Microzarkodina? cf. *M. marathonensis* (Bradshaw)
Pl. 10, figs. 1-7, 9

GOTHODIFORM element:

Gothodus communis Ethington and Clark. Mound, 1965, p. 20, pl. 2, figs. 24-25.

cf. *Gothodus marathonensis* Bradshaw, 1969, p. 1,151, pl. 137, figs. 13-15.

TRICHONODELLIFORM element:

cf. *Roundya* sp. Bradshaw, 1969, p. 1,160, pl. 137, fig. 17.

CORDYLODIFORM element:

Cordylodus flexuosus (Branson and Mehl). Mound, 1965, p. 14, pl. 1, fig. 26.

cf. *Paracordylodus* sp. Bradshaw, 1969, p. 1,159, pl. 136, figs. 12-13.

OISTODIFORM element:

aff. Oistodus longiramis Lindström. Mound, 1965, p. 28, pl. 3, fig. 32.

This is a multielement species whose apparatus consisted of oistodiform, ozarkodiniform, and multiramiform elements, all of which are characterized by being extremely compressed laterally, having a thin, shallow, basal groove and cavity, and having a drawn-out anteroaboral angle or anticusp. Also, all the elements have a concave aboral profile. The main cusp is carinate on lateral faces not possessing lateral costae.

The ozarkodiniform element has an erect cusp with a sharp anterior edge and a posterior process that bears sharp, keeled denticles. The cusp is deflected slightly out of the plane of the posterior process, producing a slight outer lateral bulge and inner lateral groove at the juncture of the cusp and the process. The lateral process is rather high and the aboral part of the process is as high as the denticles. The height of the posterior process decreases posteriorly. The main cusp is drawn out anterobasally. The aboral margin is straight to slightly concave in the lateral profile and the aboral margin rises posteriorly.

Multiramiform elements include cordylodiform, gothodiform, oepikodiform, and trichonodelliform elements. The anterior and lateral costae were produced posterobasally as an adenticulate process. The anterior costa on cordylodiform, gothodiform, and oepikodiform elements extends as an anticusp and may be longer than the oral part of the main cusp. The posterior process is arched aborally behind the cusp, then continues straight distally. Denticles on the posterior process are fused aborally and are sharp and keeled distally. The main cusp is proclined slightly whereas denticles on the posterior process are erect. The posterior process is deflected laterally from the plane of the cusp, but the cordylodiform element may be very nearly planar. The anterior edge of the cusp is sharply keeled and may be laterally deflected on cordylodiform and gothodiform elements. Lateral costae on gothodiform, oepikodiform, and trichonodelliform elements diverge laterally and posteriorly as they extend aborally. The basal cavity is shallow and asymmetrically triangular and its apex is directed anteriorly; the cavity is thinly sheathed between processes and extends along the aboral edges of the processes as a shallow, thin groove.

The oistodiform element has a carinate, sharply keeled bladelike cusp reclined above a long base. The anteroaboral angle is sharply acute as the anterior end of the base is drawn out as an anticusp. The posterior part of the base is arched and very long and bears a rather high oral keel. The basal cavity flares laterally on the inner side. In profile, the anterior margin is convex and the aboral margin is concave. The angle between the oral edge of the base and the posterior edge of the cusp is sharply acute.

DISCUSSION-This species appears to belong to *Microzarkodina* because of its adenate lateral costae and its high ozarkodiniform element. The oistodiform element, however, possesses a drawn-out anterior end, contrary to Lindström's (1971) diagnosis, and thus the queried generic assignment here. Individual elements of *M.?* cf. *M. marathonensis* have been recovered and described as *Gothodus communis, Cordylodus flexuosus*, and, probably, *Oistodus longiramis* (Mound, 1965), *Gothodus marathonensis, Roundya* sp. , and *Paracordylodus* sp. (Bradshaw, 1969).

OCCURRENCE-M.? cf. *M. marathonensis* (Bradshaw) has been recovered from the Fort Pala Formation of Texas (Bradshaw, 1969), from the Joins Formation of Oklahoma (Mound, 1965; McHargue, 1974), and from the Jefferson City Dolomite of Missouri (Moore, 1970). In the Scenic Drive collection, this species occurs in samples SD/740-800, 900, 960-1,020, 1,060, 1,140-1,220, 1,260, and 1,279.

NUMBER OF SPECIMENS-Oistodiform elements-54; cordylodiform elements-32; gothodiform elements-21; oepikodiform elements-12; trichonodelliform elements-32; and ozarkodiniform elements-33.

REPOSITORY-UMC 1067-19, 20, 1068-1 through 6.

GENUS *OELANDODUS* van Wamel, 1974

TYPE SPECIES: *Oistodus elongatus* Lindström, 1955

Oelandodus cf. *0. costatus van* Wamel
Pl. 10, figs. 8, 10, 12

Oistodus longiramis Lindström. Ethington and Clark, 1964, p. 693-694, pl. 114, figs. 2, 7.

cf. *Oelandodus costatus* van Wamel, 1974, p. 72-74, pl. 7, figs. 5-7.

DISCUSSION-Elements closely resembling those of *0. costatus* occur in the upper El Paso, although never in abundance. The distinctive feature is the rounded costa running along the basal sheath on each side.

OCCURRENCE-Samples SD/800, 861-1,000.

NUMBER OF SPECIMENS-Oistodiform elements-34; elongatiform elements-23; triangulariform elements-7.

REPOSITORY-UMC 1069-6 through 8.

Oelandodus cf. *0. elongatus* (Lindström)
Pl. 10, fig. 11; pl. 11, figs. 1, 2

cf. *Oistodus elongatus* Lindström, 1955, p. 574, pl. 4, figs. 32-33; text fig. 5(b).

cf. *Oelandodus elongatus* (Lindström). Van Wamel, 1974, p. 71-72, pl. 7, figs. 1-4.

DISCUSSION-Specimens assigned here conform closely to van Wamel's (1974) diagnosis of *Oelandodus elongatus* with a few minor differences. Besides oistodiform elements conforming exactly to van Wamel's description, the El Paso species has an oistodiform element that, although identical in all other aspects, has no costa running along the lateral faces (it is very compressed laterally). In addition, the angle between the cusp and the oral margin is approximately 90 degrees rather than 20-50 degrees as in the other oistodiform elements. These elements resemble the elongatiform elements, but lack the carina and are not bent laterally. I am including these specimens with the oistodiform elements.

The El Paso triangulariform elements differ from van Wamel's description only in that these elements are nearly symmetrical; that is, they would better be termed trichonodelliform elements. One odd specimen has only one anterolateral processlike edge and a carina on the opposite cusp face. This specimen appears to be transitional between the elongatiform and triangulariform elements.

OCCURRENCE-*Oelandodus* cf. *0. elongatus* occurs in samples SD/720-760, 839-900, 940, 1,020, 1,1581,200, and 1,260-1,300.

NUMBER OF SPECIMENS-Oistodiform elements-45; elongatiform elements-74; triangulariform elements-28.

REPOSITORY -UMC 1068-7 through 10.

GENUS *OEPIKODUS* Lindström, 1955

TYPE SPECIES: *Oepikodus smithensis* Lindström, 1955

REVISED DIAGNOSIS (HEREIN)-The prioniodiform element may have adentate anterior and lateral processes. The ramiform elements have one posterior denticulate process and one, two, or three adentate processes (anterior and more or less developed lateral processes).

DISCUSSION-As *Oepikodus smithensis* Lindström s. f. is the type species of the genus and also is an element of the multielement apparatus named *Oepikodus* by Lindström (1975), *0. smithensis is* the type species of the multielement genus by original designation (ICZN, Art. 68a), *contra* Lindström (1975, p. 237).

The revised diagnosis above takes into account the adentate anterior and lateral processes of the prioniodiform element of *0. communis* (Ethington and Clark, 1964) as well as the fact that some of the ramiform elements of *0. communis* may have two adentate processes (anterior and only one lateral process).

Oepikodus communis (Ethington and Clark) Pl. 11, figs. 5-8, 10, 12

PRIONIODIFORM *element:*

Gothodus communis Ethington and Clark, 1964, p. 690, 692, pl. 114, figs. 6, 14; text fig. 2F; Ethington and Clark, 1965, p. 193, pl. 1, fig. 21; Ethington and Clark, 1971, p. 77, pl. 2, fig. 24; Sweet and others, 1971, p. 166, pl. 1, fig. 27; Ethington, 1972, p. 24, pl. 1, fig. 20; Barnes, 1974, p. 228-229, pl. 1, fig. 6; Repetski and Ethington, 1977, p. 97.

Prioniodus evae communis (Ethington and Clark). McTavish, 1973, in part, p. 45-46, pl. 3, figs. 27, 31, 32 only.

Prioniodus (Oepikodus) intermedius Serpagli, 1974, in part, p. 67-73, pl. 15, figs. la, b only; pl. 27, figs. 3-5 only; pl. 31, figs. 5-6 only; text fig. 15-D only.

Prioniodus (Oepikodus) communis (Ethington and Clark). Serpagli, 1974, in part, p. 67, text fig. 15-G only.

RAMIFORM elements:

?Cordylodus quadratus Graves and Ellison, 1941, p. 10-11, pl. 1, figs. 22, 25.

?Cordylodus multidentatus Graves and Ellison, 1941, p. 10, pl. 1, fig. 21.

Oepikodus equidentatus Ethington and Clark, 1964, p. 692-693, pl. 113, figs. 6, 8, 10, 11, 14.

Subcordylodus sp. aff. *S. delicatus* (Branson and Mehl). Ethington and Clark, 1964, p. 701-702, pl. 115, figs. 1, 5, 7, 10.

Oepikodus quadratus (Graves and Ellison). Ethington and Clark, 1965, p. 193-194, pl. 2, fig. 9; Ethington and Clark, 1971, p. 77, pl. 2, fig. 26; Sweet and others, 1971, p. 166, pl. 1, fig. 20; Ethington, 1972, p. 23, p1. 1, figs. 24-27; Repetski and Ethington, 1977, p. 97, 99.

Subcordylodus sp. Ethington and Clark, 1965, p. 201-202, pl. 2, fig. 6.

Prioniodus evae communis (Ethington and Clark). McTavish, 1973, in part, p. 45-46, pl. 3, figs. 29, 37 only.

Prioniodus (Oepikodus) intermedius Serpagli, 1974, in part, p. 67, 69-73, pl. 15, figs. 2, 3 only; pl. 27, figs. 1, 7 only; text fig. 15-E only.

Prioniodus (Oepikodus) communis (Ethington and Clark). Serpagli, 1974, in part, p. 67, text fig. 15-H only.

non Gothodus communis Ethington and Clark. Mound, 1965, p. 20, pl. 2, figs. 24-25.

FALODIFORM element:

Oistodus longiramis Lindström. Ethington and Clark, 1965, p. 195-196, pl. 1, fig. 5; Ethington and Clark, 1971, p. 77, pl. 2, fig. 15; Ethington, 1972, pl. 1, fig. 3.

Oistodus longiramis Lindström? Sweet and others, 1971, p. 166, pl. 1, fig. 17.

Prioniodus evae communis (Ethington and Clark). McTavish, 1973, in part, p. 45-46, pl. 3, fig. 30 only.

Prioniodus (Oepikodus) intermedius Serpagli, 1974, in part, p. 67, 69-73, pl. 15, figs. 4a, b only; pl. 27, fig. 2 only; pl. 31, fig. 4 only; text fig. 15-F only.

DISCUSSION-Ethington and Clark (1964) described the prioniodiform and the ramiform transition-series elements of *0. communis* from the El Paso Group, and they later (1965) illustrated these and the falodiform element from Alberta, Canada. McTavish (1973) recognized that these three elements were contained in a *Prioniodus-like* apparatus, to which he gave the name *Prioniodus evae communis.* McTavish considered the *communis* apparatus to represent a subspecies of *P. evae (= P. smithensis)* because of the similarity of the prioniodiform (gothodiform) elements of *P. evae evae* and *P. evae communis.* The difference between these prioniodiform elements is sufficient to warrant that *0. communis* should be distinguished from *0. evae (= O. smithensis)* on a higher level than subspecies. The prioniodiform element of *0. communis* lacks denticles on the lateral and anterior processes, and its posterior process is normally longer than that of the prioniodiform element of *0. smithensis.* McTavish (1973) observed correctly that the posterior process is straight on most specimens of the *0. communis* prioniodiform element; however, the El Paso collection at hand does contain many elements on which the posterior process is bowed laterally, producing a concave inner side.

Serpagli (1974) erected *Prioniodus (Oepikodus) intermedius* and distinguished it from *P. (0.) communis* in that the former has: 1) a prioniodiform element with a more posteriorly deflected anterior process and a less strongly arched posterior process that curves upward distally; 2) hindeodelloid denticulation of the posterior process on the transition-series elements; and 3) a falodiform element having a long anterior process. Examination of hundreds of specimens of *0. communis* elements from the El Paso Group shows that these elements include in their variation the features Serpagli noted as distinguishing *P. (0.) intermedius.* The prioniodiform element of *0. communis* varies in the degree of posterior deflection of the anterior process. Most of the specimens do not have a posterior process that arches as strongly as that illustrated by Serpagli (1974; text fig. 15-G), and the posterior process may curve upward distally. Some specimens of the ramiform transition-series elements of *0. communis* do exhibit the type of hindeodelloid denticulation shown by Serpagli (1974; pl. 27, figs. 1, 6, 7; Ethington and Clark, 1971; pl. 2, fig. 26). The hindeodelloid denticulation shown by elements of *Oepikodus smithensis* s.f. is much more pronounced and regular . Finally, the falodiform element from the El Paso (Ethington and Clark, 1964; pl. 114, fig. 7) that Serpagli (1974; text fig. 15-I) attributed to *0. communis* does not belong to that species but to *Oelandodus* cf. *0. costatus* van Wamel. The proper falodiform element of *0. communis* has been illustrated (Ethington and Clark, 1965, pl. 1, fig. 5; Ethington and Clark, 1971, pl. 2, fig. 15; Sweet and others, 1971, pl. 1, fig. 17; Ethington, 1972, pl. 1, fig. 3) and can be seen to have a long pointed anterior process and a rather sharply acute angle between the cusp and the posterior process. From the above points, I believe that *0. cornmunis* is conspecific with, and the senior synonym of, *P. (0.) intermedius.*

I agree with Serpagli (1974) that *Oepikodus communis* should be distinguished from *Prioniodus,* as typified by *P. elegans,* whose apparatus was established by Bergstrom (1968, 1971). However, my reasons for maintaining the distinction differ from those of Serpagli (1974). The real difference between the two groups is that the lateral and anterior processes of the ramiform elements of *Prioniodus* are denticulate, whereas these elements are nondenticulate in *Oepikodus.* In addition to the prioniodiform and falodiform elements, *Prioniodus* contains a symmetry transition series of ramiform elements consisting of belodiform, tetraprioniodiform, and hibbardelliform members. In *Oepikodus* this same transition series is present (containing, in addition, a cordylodiform morph) within what has been called the oepikodiform element by McTavish (1973) and by Serpagli (1974). This transition series (included in *Oepikodus quadratus* s.f.) was discussed and illustrated previously by Ethington (1972). Therefore, the argument that *Prioniodus* has five elements and *Oepikodus* only three is not valid, for, considering the elements of the transition series, *Oepikodus* actually contains six elements. The point is that *Prioniodus* consists of an anteriorly denticulate falodiform element, a fully denticulate prioniodiform element, and ramiform elements that show the *Cordylodus-Roundya* transition series and denticulate anterior and lateral processes. I agree with the concept of *Oepikodus* followed by Fohraeus and Nowlan (1978, p. 463).

OCCURRENCE-O. *communis* has been recovered from Alberta, Canada (Ethington and Clark, 1965), Utah (Sweet and others, 1971), Nevada (Ethington and Clark, 1971; Ethington, 1972), Missouri (Moore, 1970), Western Australia (McTavish, 1973), western Argentina (Serpagli, 1974), New York (Repetski, 1977), Oklahoma (McHargue, 1974; Potter, 1975), Arctic Canada (Barnes, 1974), Arkansas (Repetski and Ethington, 1977), and western Texas (Ethington and Clark, 1964; this report). One of the dominant elements of the upper El Paso Group fauna, *0. communis* was recovered in samples SD/839-1,020, 1,140-1,342.

NUMBER OF SPECIMENS —Prioniodiform elements-603; transition-series elements-1,033; falodiform elements-571.

REPOSITORY-UMC 1069-17 through 20, 1070-1, 2.

Oepikodus? n. sp.
P1. 16, figs. 1-3, 6, 8, 10

This is a multielement species whose apparatus contains a laterally compressed, adenticulate, keeled oistodiform element and posteriorly denticulate ramiform, oepikodiform, and trichonodelliform elements having proclined cusps.

The ramiform elements have a proclined cusp which has sharply keeled edges leading to three or four processes. The posterior process tapers posteriorly and is narrowly triangular in cross section; the process is slightly arched and has a sharp, high oral edge consisting of laterally compressed, fused denticles. The trichonodelliform element has a smoothly convex anterior face. Lateral edges of the cusp are sharp. The lateral processes diverge laterally and extend beyond the aboral margin. Oepikodiform elements may have lateral processes located symmetrically or asymmetrically. Lateral processes extend posteriorly and aborally; the processes are adentate and sharp orally. Sharp, posterolaterally directed costae extend the length of the cusp. The anterior edge of the cusp extends posteroaborally as a short process which is deflected laterally below the cusp. A thin basal sheath connects adjacent processes aborally. The basal cavity is pyramidal and has its sharp apex directed anteriorly. In profile, the posterior edge of the cavity is arched and the anterior edge is concave anteriorly. The cavity extends under the processes as a thin-walled groove.

The oistodiform element has an arched posterior process bearing a high, arched oral keel. The unit is only slightly bowed laterally. Its cusp makes an acute angle with the posterior process; the anterior margin of the cusp is sharp, slightly convex in profile, and is drawn out only a short distance anteriorly. The aboral margin is concave with a minor flare in the region of the basal cavity tip. A low rounded carina runs along each side of the cusp. The basal cavity has the same shape as that of the ramiform elements.

DISCUSSION-Elements of this species are similar to those of the *Oepikodus communis* apparatus. The differences are that *0. ?* n. sp. has a more strongly proclined cusp on the ramiform elements, and these elements have indistinct fused denticles. The lateral processes of the oepikodiform elements extend more posteriorly than laterally. No prioniodiform element was identified in this small collection. The oistodiform element is not drawn out anteriorly nearly as far as is the oistodiform element of *0. communis.*

OCCURRENCE-Samples SD/1,300-1,342.

NUMBER OF SPECIMENS-Trichonodelliform elements-34; oepikodiform elements-21; oistodiform elements-38.

REPOSITORY-UMC 1070-20. 1071-1 through 5.

GENUS *OISTODUS* Pander, 1856
TYPE SPECIES: *Oistodus lanceolatus* Pander, 1856

Oistodus forceps Lindstrom s.f.
P1. 9, fig. 8

Oistodus forceps Lindström, 1955, p. 574-576, pl. 4, figs. 9-13; text fig. 3M; Ethington and Clark, 1965, p. 194-195, pl. 1, fig. 18 [synonymy to 1965]; Moskalenko, 1967, p. 109-110, pl. 24, fig. 1;

text fig. 11; Ethington and Clark, 1971, p. 76, pl. 2, fig. 8; Moskalenko, 1973, pl. 15, fig. 9.
non Oistodus sp. aff. *0. forceps* Lindström. Ethington and Clark, 1964, p. 694, pl. 113, fig. 19; pl. 114, fig. 9 [= *Oistodus inaequalis* s f.]
?Drepanoistodus forceps (Lindström). Serpagli, 1974, p. 46-47, pl. 10, figs. 8-12; pl. 21, figs. 9-14 [synonymy to date].

DISCUSSION-I am treating *0. forceps* in the form sense here, although Lindström (1971) has erected a multielement species *Drepanoistodus forceps* that bears this element. The relationship between elements that make up this multielement assemblage (and others) in the Baltic region and similar (identical?) elements in western North America is, as yet, not clearly understood (Ethington, 1972, p. 23). Serpagli (1974, p. 47) speculated that *Drepanoistodus forceps* occurred only in the North Atlantic Province. If this is true, then the El Paso forms must belong to another apparatus. A conservative taxonomic approach is called for until more is known about this form species.

OCCURRENCE-The form species *0. forceps* has a widespread distribution. The reader is referred to Serpagli's (1974) discussion of the distribution of this form. The El Paso elements occur in samples SD/320-440, 520, 580, 621, 980, 1,020, 1,140, 1,180-1,220, and 1,260-1,342.

NUMBER OF SPECIMENS-87.

REPOSITORY-UMC 1064-9.

Oistodus gracilis Branson and Mehl s.f.
P1. 9, fig. 10

Oistodus gracilis Branson and Mehl, 1933, p. 60, pl. 4, fig. 20.
Oistodus aff. *parallelus* Pander. Moskalenko, 1967, p. 110-111, pl. 24, fig. 2; Moskalenko, 1973, pl. 15, fig. 10.
?Oistodus parallelus Pander. Ethington and Clark, 1971, p. 73, pl. 2, fig. 23.
non Oistodus gracilis Lindström, 1955, p. 576, pl. 5, figs. 1, 2 [= part *Paracordylodus gracilis].*

DISCUSSION-The El Paso specimens have been compared directly with Branson and Mehl's (1933) type material, and the similarity is very close. Some of the Texas specimens possess more white matter in the cusp than do the cotypes.

Oistodus gracilis s.f. appears to be very similar to *0. parallelus* s.f. and may be the North American (and Siberian?) homologue of the latter. Lindström (1971) recognized elements of *0. parallelus* s.f. in the skeletons of *Paroistodus numarcuatus, P. proteus,* and *P. parallelus.* Only in the first of these is the oistodiform element said to lack an inverted basal cavity along its anterior part. None of the El Paso specimens of *0. gracilis* s.f. appear to show inversion.

OCCURRENCE-0. *gracilis* s.f. is present in the Jefferson City Dolomite (Branson and Mehl, 1933), possibly in Nevada (Ethington and Clark, 1971), in Siberia (Moskalenko, 1967, 1973), and in west Texas, in samples SD/240-340 , 440 , 940-1,000 , 1,060 , 1,140 , 1,180 , 1,260, and 1,300-1,342.

NUMBER OF SPECIMENS-78.

REPOSITORY-UMC 1062-14.

Oistodus cf. *0. inaequalis* Pander s.f.
P1. 9, fig. 11

cf. *Oistodus inaequalis* Pander. Lindström, 1955, p. 576-577, pl. 3, figs. 52-57.
Oistodus sp. aff. *0. forceps* Lindström. Ethington and Clark, 1964, p. 694, pl. 113, fig. 19; pl. 114, fig. 9.
Scandodus furnishi Lindström. Ethington and Clark, 1964, in part, p. 698, pl. 114, fig. 24 only *[non* fig. 11].
non Oistodus inaequalis Pander. Lee, 1975a, p. 87, pl. 2, figs. 2, 3; text fig. 4(B, C).

DISCUSSION-This element is very close to *0. inaequalis* s.f. of Lindström (1955). The posterior part of the base is very long on the El Paso forms, and the postero-oral angle is very acute. The elements figured as *Oistodus* aff. *0. forceps* s.f. and one of the specimens assigned to *Scandodus furnishi* s.f. by Ethington and Clark (1964) belong to *0.* cf. *0. inaequalis* s.f.

The specimens figured by Lee (1975a, pl. 2, figs. 2-3) have rounded anterior margins, whereas *0. inaequalis* s.f. has a straighter anterior edge and a more sharply acute anterobasal angle.

I was unable to recognize either *Paltodus deltifer* or *P. inconstans sensu* Lindström (1971). These species are the multielement apparatuses to which Lindström assigned the form element *0. inaequalis* s.f.

OCCURRENCE-Samples SD/320, 360-400, 480, 502, 600, 621, 680-1,020, 1,060, 1,180, 1,279, and 1,315.

NUMBER OF SPECIMENS-221.

REPOSITORY-UMC 1064-4.

Oistodus n. sp.
Pl. 11, figs. 3, 4, 9, 11

Paltodus jeffersonensis Branson and Mehl, 1933, pl. 4, fig. 18.
Oistodus sp. Ethington and Clark, 1964, p. 694, pl. 114, fig. 21.

Costae thicken basally and extend a short distance beyond the basal margin. The basal margin between the costae is a thin sheath. A deep pyramidal basal cavity extends as a shallow groove below the aboral extension of each costa. The basal cross section of the paltodiform element is asymmetrical, with posterior projection, two anterolateral projections (the outer anterolateral one is slightly stronger), a strong outer lateral projection, and, on some specimens, a very slight projection on the inner side where the inner lateral carina reaches the basal margin. Parts of the basal margin between these projections are concave.

The deltaform element has two prominent anterolateral costae situated slightly asymmetrically. The lateral face of the side of the cusp having the more anterior costa is broadly convex; the opposite face is flat. The cusp increases in lateral width from a very sharp posterior edge to a costate anterior end. The basal cross section is widest under the midline of the cusp, tapering evenly to a sharp posterior; anterior from the widest point the margin narrows and then probably widens again where the anterolateral costae reach the margin. Rare deltaform elements take on a trichonodelliform aspect with a broadly convex anterior face.

Oistodiform elements are present in the collection but are fragmented. Triangularform elements are similar to paltodiforms but have only anterior, posterior, and strong anterolateral costae.

DISCUSSION-This species is placed in *Oistodus* because of its similarity to *Oistodus lanceolatus.* The variation among the paltodiform specimens at hand shows that the inner lateral face ranges from nearly flat to very strongly carinate, even approaching costate basally. *0.* n. sp. also is very similar to the four- and five-costate elements of *Oistodus? lecheguillensis* n. sp. Unfortunately, the former species is so rare in the El Paso Group that the full range of variation cannot be studied from the collection at hand. *0.* n. sp. is very similar to *0.?* n. sp. 1 of Serpagli (1974).

Ethington and Clark (1964) described a paltodiform specimen of this species, but the base of that specimen is not complete.

OCCURRENCE-Branson and Mehl (1933) illustrated *0.* n. sp. (as *Paltodus jeffersonensis)* from the Jefferson City Dolomite of Missouri, but they did not describe the species. Later, Moore (1970) recovered and described specimens, also from the Jefferson City. The El Paso Group specimens are rare in samples SD/740, 760, 821, 839, 880-920, 960, 1,000.

NUMBER OF SPECIMENS-Paltodiform elements-3; deltaform elements-4; oistodiform elements-5; trianguláriform elements-5.

REPOSITORY-UMC 1067-15 through 18.

Oistodus cf. *0. lanceolatus* Pander
P1. 11, fig. 13; pl. 12, figs. 2, 4, 6-8

cf. *Oistodus lanceolatus* Pander, 1856, p. 27, pl. 2, figs. 17-18 *[non* fig. 19]; Branson and Mehl, 1944, p. 240, pl. 93, fig. 23; Lindström, 1971, p. 38 [synonymy].
cf. *Acontiodus* sp. Branson and Mehl, 1944, p. 239, pl. 93, fig. 43. ? *Oistodus* cf. *0. lanceolatus* Pander. Cooper and Druce, 1975, pl. 2, fig. 23.

DISCUSSION-A multielement species of *Oistodus* very similar to *0. lanceolatus* is present in the uppermost El Paso. The oral edge of the posterior process of the El Paso cordylodiform and cladognathodiform elements is arched and that process has a higher keel than does *0. lanceolatus*, as figured previously. The posterior process of this form resembles that of *Oistodus multicorrugatus.*

The element figured by Cooper and Druce (1975, fig. 23) as *0.* cf. *0. lanceolatus* appears to be similar to the cordylodiform element of the El Paso species. However, Cooper and Druce recovered their specimens in beds also containing *Cordylodus angulatus, Scolopodus sexplicatus,* and *Acodus deltatus.* These latter forms occur only in the lower and middle parts of the El Paso Group at Scenic Drive.

OCCURRENCE-Samples SD/1,180, 1,220, 1,260, and 1,300-1,342.

NUMBER OF SPECIMENS-Cordylodiform elements-10; cladognathodiform elements-14; trichonodelliform elements-1.

REPOSITORY-UMC 1072-3 through 6; 1129-4.

Oistodus? lecheguillensis n. sp.
P1. 12, figs. 1, 3, 5, 9

This is a multielement species composed of multicostate, laterally compressed, recurved bladelike cones. The basal cavity is triangular in profile, and the posterior leg is longer than the anterior. The cavity tip is pointed anteriorly. The cusp is recurved above the base but is nearly straight distally. The basal margin is widest posterior of the midline and is drawn out anteriorly. In profile, the basal margin is sinusoidal with a concave segment posterior to the anterior point; the posterior half of the margin is convex downward. The oral edge of the base is straight and keeled orally, although the keel may be indistinct on the tricostate element. The oral edge abuts against the cusp at the cusp-base juncture and is not continuous with a costa on the cusp. The oral edge makes a 90-degree angle with the intercostal part of the cusp. Observed elements possess three, four, or five costae on the cusp.

The tricostate element has a broad sharp anterior costa in the same vertical anteroposterior plane as the oral margin of the base. One lateral costa is immediately adjacent to the posterior oral edge, forming a very small angle with the oral edge. The third costa is sharp but not as prominent as the other two; this costa is situated laterally at about midline. The three intercostal faces are nearly flat.

Quadricostate elements form a transition series between end members whose outerlateral costa is either poorly or prominently developed. If the costa is poorly developed, it is located medially on the outer face; the anterolateral face is gently convex, and the other intercostal areas are sharply concave. The anterior costa is deflected inward somewhat. If the outer lateral costa is strongly developed, then it is located at the anterolateral corner. On these specimens, the anterior costa is deflected inward nearly 45 degrees, and the inner lateral costa is situated posterolaterally adjacent to the posterior oral edge of the base. All intercostal faces of this element are sharply concave.

The quinquecostate element has two costae situated posterolaterally, near the oral edge o f the base but located asymmetrically from the oral edge. The anterior of the element has two costae adjacent to each other but divergent. One of these may be directed anteriorly or both may be deflected slightly toward the inner anterolateral direction. The outer lateral face bears a fifth sharp costa near the midline.

All elements observed are hyaline, although several show white matter along the growth axis.

DISCUSSION-The tricostate element of *O.? lecheguillensis* has an overall similarity to the trianguláriform element of *0. lanceolatus.* The quadricostate and quinquecostate elements have a split anterior reminiscent of that of the deltaform element of *0. lanceolatus.* A cordylodiform element in this species is not known at present.

DERIVATION OF NAME-From *Agave lecheguilla,* a notoriously sharp cactus found in the southern Franklin Mountains.

OCCURRENCE-Samples SD/380-440. This species also occurs in the Goodwin Limestone in Nevada (R. L. Ethington, personal communication, 1978).

NUMBER OF SPECIMENS-Tricostate elements-20; quadricostate elements-37; quinquecostate elements-2.

REPOSITORY-UMC 1065-3, 4, 5 (holotype), 6.

Oistodus mehli Furnish s.f.
Pl. 13, figs. 1, 4

Gistodus mehli Furnish, 1938, p. 330, p1. 42, figs. 7, 8.

DISCUSSION-The El Paso specimens agree well with Furnish's (1938) syntypes. *0. mehli* s.f. is distinctive in having a slight longitudinal concavity just posterior to

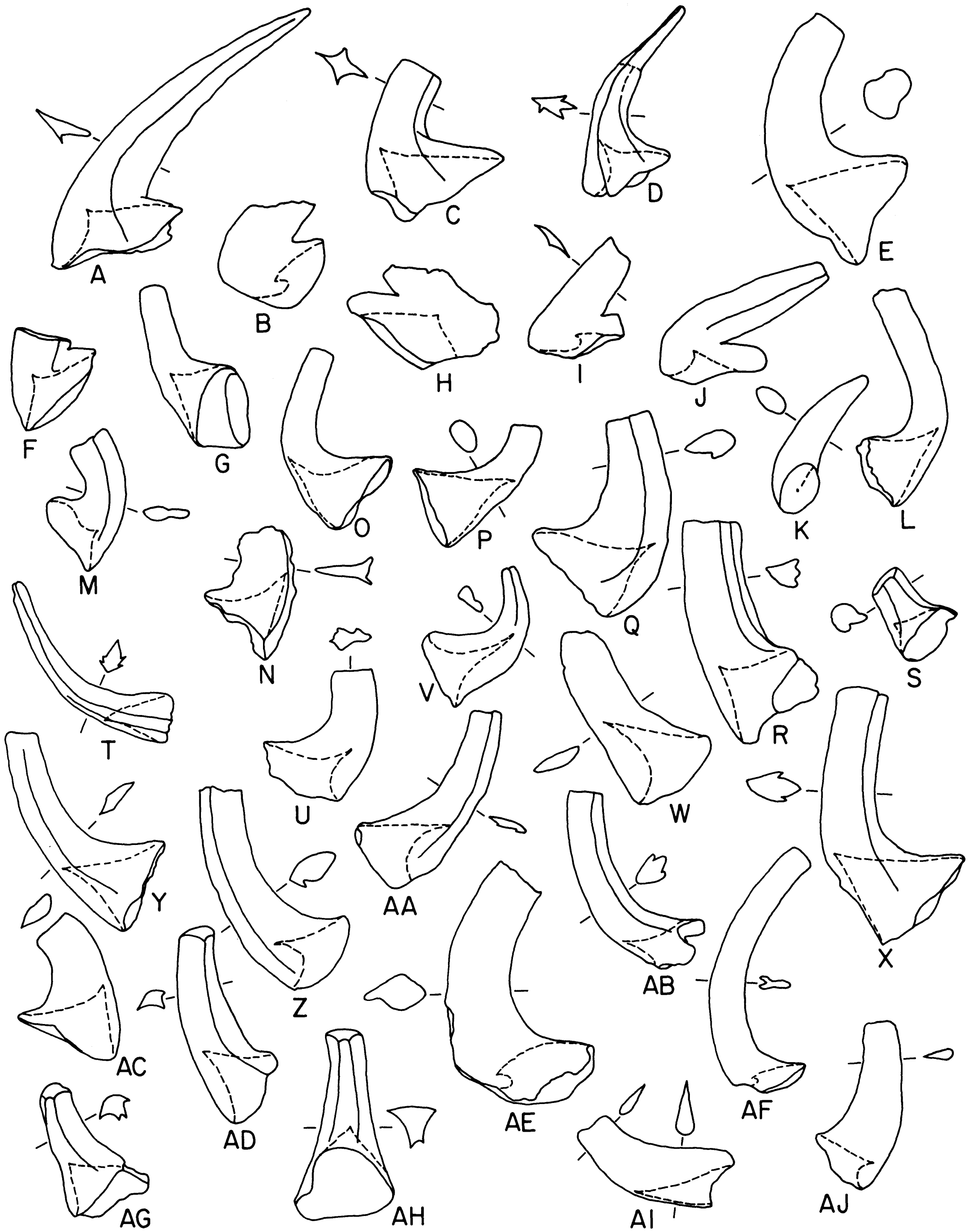

FIGURE 6-A, C, *D-Oistodus?* ***lecheguillensis*** **n. sp. Lateral views. A) Tricostate element, x 60. UMC 1065-5 (holotype); C) Quadricostate element, x 60. UMC 1065-3; D) Quinquecostate element, x 62. UMC 1065-4.** *B-Oistodus* **cf.** ***0. parallelus*** **Pander s.f. Lateral view, x 60. UMC 1063-4.** *E-Oistodus* ***mehli*** **Furnish s.f. Lateral view, x 43. UMC 1072-12.** *F-Oistodus* ***aff. 0. selenopsis*** **Serpagli s.f. Inner lateral view, x 60. UMC 1064-7.** *G-Oneotodus* ***simplex*** **(Furnish) s.f. Posterolateral view, x 47. UMC 1058-8.** *H-Oistodus?* **cf.** ***O.? striolatus*** **Serpagli. Outer lateral view, x 32. UMC 1068-12.** *I-Oistodus* **sp. 1 s.f. Inner lateral view, x 54. UMC 1062-2.** *J-Oistodus* **sp. 2 s.f. Inner lateral view, x 54. UMC 1062-9.** *K-Oneotodus?* **sp. B s.f. Posterolateral view, x 49. UMC 1062-1.** *L-Oneotodus* ***gracilis*** **(Furnish) s.f. Lateral view, x 53. UMC 1060-8.** *M-Paltodus* ***spurius*** **Ethington and Clark s.f. Lateral view, x 57. UMC 1058-15.** *N-Paltodus?* ***sweeti*** **Serpagli s.f. Lateral view, x 56. UMC 1065-16.** *O-Oneotodus* **cf.** ***0. variabilis*** **Lindstr6m s.f. Lateral view, x 54. UMC 1061-1.** *P-Oneotodus?* **sp. A s.f. Lateral view, x 47. UMC 1058-11.** *Q-Paltodus* ***bassleri*** **Furnish. Inner lateral view, x 48. UMC 1058-13.** *R-Paltodus?* **sp. s.f. Posterolateral view, x 41. UMC 1061-15.** *S-Paltodus* **n. sp. s.f. Posterolateral view, x 59. UMC 1065-13.** *T-Protopanderodus* ***elongatus*** **Serpagli. Lateral view, x 48. UMC 1062-19. U, Z,** *AA-Protopanderodus* ***gradatus*** **Serpagli. Lateral views, all x 60. U) UMC 1070-12; Z) UMC 1070-14; AA) UMC 1070-13.** *V-Macerodus* ***dianae*** **Fohraeus and Nowlan. Lateral view, x 59. UMC 1063-8.** *W-Protopanderodus* **cf.** ***P. gradatus*** **Serpagli. Lateral view, x 50. UMC 1070-18.** *X-Protopanderodus* ***leonardii*** **Serpagli. Lateral view, x 62. UMC 1068-17.** *Y-Protopanderodus* **sp. Scandodiform element. Outer lateral view, x 43. UMC 1062-7. AE, AB,** *AF-Protopanderodus* **cf.** ***P. rectus*** **(Lindström). All x 61. AE) Scandodiform element, inner lateral view. UMC 1068-19; AB) Acontiodiform element, lateral view. UMC 1068-20; AF) Sulcatiform element, inner lateral view. UMC 1069-1. AC, AG, AD,** *AH-Protopanderodus* ***leei*** **n. sp. AC) Scandodiform element, outer lateral view, x 43. UMC 1062-7; AG) Acontiodiform element, posterolateral view, x 38. UMC 1062-10; AD) Acodiform element, inner lateral view, x 60. UMC 1062-12; AH) Distacodiform element, posterior view, x 38. UMC 1062-13.** *AI-Protopanderodus?* **n. sp. 1 s.f. Lateral view, x 59. UMC 1064-12.** *AJ-Protopanderodus?* **n. sp. 2 s.f. Lateral view, x 59. UMC 1064-10.**

the midpoint of the basal margin. The anterior costa is deflected laterally somewhat on the base, and this costa continues aborally slightly beyond the plane of the basal opening.

OCCURRENCE-O. *mehli* s.f. occurs in the Blue Earth beds and in the Oneota Dolomite (Furnish, 1938) and also in the lower part of the El Paso at Scenic Drive, in samples SD/O, 60, 80, 120, and 140.

NUMBER OF SPECIMENS-34.

REPOSITORY-UMC 1058-14, 1072-12.

Oistodus cf. *0. multicorrugatus* Harris
Pl. 13, figs. 2, 3, 6, 7

COSTATE OISTODIFORM element:

cf. *Oistodus multicorrugatus* Harris, 1962, p. 204, pl. 1, fig. 2.
Oistodus sp. A Sweet and others, 1971, p. 172, p1.2, fig. 1.

SMOOTH OISTODIFORM element:

cf. *Oistodus pseudomulticorrugatus* Mound, 1965, p. 29, pl. 4, figs. 3-5, 8, 9.

DELTAFORM element:

?Oistodus lanceolatus Pander. Bradshaw, 1969, cladognathodiform element, p. 1,156-1,157, pl. 133, fig. 18 only.

DISCUSSION-In profile, the aboral margin of *0. multicorrugatus* is deflected through nearly 90 degrees. The El Paso form has a straighter aboral margin; the anterior portion is deflected only about 45-60 degrees above the posterior part. Aside from the aboral margin, the El Paso species is very similar to *0. multicorrugatus,* and perhaps was the ancestor of the latter.

OCCURRENCE-Samples SD/1,220, 1,300, and 1,315.

NUMBER OF SPECIMENS-Costate oistodiform elements-13; smooth oistodiform elements-7; deltaform elements-0.

REPOSITORY—UMC 1072-7 through 10.

Oistodus cf. *0. parallelus* Pander s.f.
Pl. 13, fig. 5

cf. *Oistodus parallelus* Lindström, 1955, p. 579, 580, pl. 4, figs. 2631, 43; text fig. 3N, 0.
non Oistodus parallelus Pander. Lee, 1975a, p. 87-88, pl. 2, figs. 4, 6; text fig. 4-D.

DISCUSSION-Numerous elements in the Scenic Drive section resemble the form species *0. parallelus* Pander, *sensu* Lindström (1955). The El Paso specimens do not show anterior inversion of the basal cavity.

Lindström (1971) assigned elements of *0. parallelus* s. f. to three separate multielement apparatuses—*Paroistodus numarcuatus* (Lindström), *P. proteus* (Lindström), and *P. parallelus* (Pander); he stated that only the oistodiform element of *P. numarcuatus* lacks inversion. I am unable, at this time, to recognize any of these multielement associations in the material at hand; therefore, I will maintain form taxonomy for this element.

OCCURRENCE-Samples SD/300, 320, 360, 380, 580, 621-660, 720, 740, 780, 900, 920, 1,000, 1,140, 1,158, 1,279, 1, 315-1,342.

NUMBER OF SPECIMENS-86.

REPOSITORY—UMC 1063-4.

Oistodus cf. *0. pseudoramis* Serpagli s.f.
Pl. 13, fig. 9

cf. *Oistodus pseudoramis* Serpagli, 1974, p. 55-56, pl. 13, figs. 7-10; pl. 23, figs. 10-12.

DISCUSSION-An oistodiform element occurring in the uppermost El Paso closely resembles *0. pseudoramis* s.f. , except that the El Paso form seems to have a sharper anterobasal angle and a slightly longer posterior process.

OCCURRENCE-Samples SD/1,315-1,342.

NUMBER OF SPECIMENS-140.

REPOSITORY-UMC 1071-19.

Oistodus aff. 0. selenopsis Serpagli s.f.
Pl. 13, fig. 8

aff. Oistodus selenopsis Serpagli, 1974, p. 56-57, p1. 13, figs. 4-6; p1. 23, figs. 8, 9.

DISCUSSION-An oistodiform element in the El Paso resembles *Oistodus selenopsis* s.f. *sensu* Serpagli (1974). However, a definite assignment cannot be made because of apparent differences in the two elements. The El Paso form has a sharper, slightly longer anterobasal angle, as its cusp is deflected aborally less strongly anteriorly than is *0. selenopsis* s.f. The base of *0.* aff. *0. selenopsis* s. f. is slightly higher also; otherwise, the similarity between these forms is close. Serpagli (1974) suggested that *0. brevibasis* s.f. *sensu* Ethington (1972) is conspecific with *0. selenopsis* s.f.; however, the latter form has a straighter basal margin, in profile, and this assignment is questioned.

OCCURRENCE-Samples SD/340 and 400.

NUMBER OF SPECIMENS-3.

REPOSITORY—UMC 1064-7.

Oistodus? cf. *O. ? striolatus* Serpagli
Pl. 13, fig. 10

cf. *Oistodus? striolatus* Serpagli, 1974, p. 57, pl. 12, figs. 5-9; pl. 24, figs. 5-7; pl. 30, figs. 7, 8.

DISCUSSION-A few incomplete specimens appear to be identical with *Oistodus? striolatus* Serpagli (1974) except that the El Paso elements do not show any obvious striation in the basal region as do the forms from Argentina. The inadequacy of the collection at hand and the preservation of the specimens prevents any refinement on the original description.

OCCURRENCE-Samples SD/800.

NUMBER OF SPECIMENS-2.

REPOSITORY-UMC 1068-12.

Oistodus vulgaris Branson and Mehl s.f.
Pl. 13, fig. 12

Oistodus vulgaris Branson and Mehl, 1933, p. 60-61, pl. 4, fig. 5.
non Oistodus vulgaris Branson and Mehl. Graves and Ellison, 1941, p. 5, pl. 2, fig. 14.

DISCUSSION-This form species is rare in the upper part of the El Paso.

OCCURRENCE-O. *vulgaris* s.f. has been reported from the Jefferson City Dolomite (Branson and Mehl, 1933; Moore, 1970) and from the Fort Peña Formation of west Texas (Graves and Ellison, 1941). The Fort Peña specimen figured by Graves and Ellison (1941) is not a specimen of *0. vulgaris*. The El Paso elements are in samples SD/1,020, 1,060, and 1,081.

NUMBER OF SPECIMENS-5.

REPOSITORY-UMC 1070-17.

Oistodus sp. s.f.
P1. 13, fig. 11; pl. 14, figs. 1, 2

This is an oistodiform element whose cusp diverges from the posterior process by about 45 degrees and has a rather wide keellike part anterior to a rounded carina. The carina curves posteriorly and flares laterally where it comes onto the base. The anterobasal end is acutely rounded.

OCCURRENCE-Samples SD/1,315-1,342.

NUMBER OF SPECIMENS -78 .

REPOSITORY -UMC 1071-20. 1072-1. 2.

Oistodus sp. 1. s.f.
P1. 14, figs. 3-4

This unit has a sharply keeled cusp rising at about 45 degrees above the oral margin of a short sharply keeled posterior process. The cusp is twisted inward above the base. The inner face of the cusp carries a prominent rounded carina that, at the base, swings about 90 degrees posteroaborally and marks an inward flaring of the basal margin. The outer face of the cusp is flat or may have a very subdued rounded median carina. The anterior edge of the blade is nearly straight and the anteroaboral angle is acute. The basal cavity is very shallow and the apex of the cavity is inclined anteriorly at the point that the carina on the cusp joins the carina on the base. The cavity extends under the anterior and posterior processes as a very shallow slitlike groove. The basal margin is sigmoidal; the anterior and posterior segments are nearly parallel to each other and to the oral edge of the posterior process. The medial part of the basal margin extends postero-orally beneath the inner flare.

DISCUSSION-This element resembles the oistodiform element of *0. lanceolatus,* but the anterior part of the former is shorter and the posterior process of *0.* sp. 1 s. f. is not as broad as is that of *0. lanceolatus. 0.* sp. 1 s.f. is a very small element in this collection.

OCCURRENCE-Samples SD/200, 240, 280, 380, 400, and 600.

NUMBER OF SPECIMENS-56.

REPOSITORY-UMC 1062-2, 3.

Oistodus sp. 2 s.f.
Pl. 14, figs. 5, 6

These oistodiform elements have a short, rounded anterior margin because the anterior edge of the cusp is deflected aborally rather than drawn out anteriorly as a process. The cusp is sharply keeled and slightly twisted above the base. The inner face of the cusp possesses a rounded median carina; the outer face has a more broadly rounded carina extending to the anterior edge of the cusp. The aboral margin is straight or slightly convex and the basal cavity is narrow and shallow. The posterior process is moderately long; the oral edge of the posterior process is sharply keeled. The angle between the cusp and the posterior process is small (less than 45 degrees).

DISCUSSION-Oistodus sp. 2 s.f. is a very small element; its distinguishing characteristics are the low angle of divergence of the cusp from the base and the abruptly rounded anterior end. *0.* sp. 2 s.f. resembles the oistodiform element of *Histiodella altifrons* Harris (McHargue, 1974). Perhaps this oistodiform element belongs to the apparatus of *H. donnae* n. sp. (this idea also suggested by Ethington and Nowlan, personal communication, 1978).

OCCURRENCE-Samples SD/240 and 320.

NUMBER OF SPECIMENS-92.

REPOSITORY-UMC 1062-8, 9.

GENUS *ONEOTODUS* Lindström, 1955
TYPE SPECIES: *Distacodus? simplex* Furnish, 1938

Oneotodus gracilis (Furnish) s.f.
Pl. 14, fig. 8

Distacodus? gracilis Furnish, 1938, p. 327-328, pl. 42, fig. 23.
Oneotodus gracilis (Furnish). Moskalenko, 1967, p. 111-112, pl. 24, figs. 3, 4; Druce and Jones, 1971, p. 82, pl. 14, figs. 9-13; pl. 15, fig. 1; text fig. 26h; Jones, 1971, p. 57-58, pl. 3, figs. 9a-10c; pl. 9, fig. la-c; Moskalenko, 1973, pl. 15, fig. 11; Abaimova, 1975, p. 81-82, pl. 6, figs. 19-23; text figs. 7 (14, 29, 30, 34, 35).

DISCUSSION-This form species is uncommon in the lower El Paso at Scenic Drive.

OCCURRENCE-Oneotodus *gracilis* s.f. occurs in the Prairie du Chien Group (Furnish, 1938), in Siberia (Moskalenko, 1967, 1973; Abaimova, 1975), and in Australia (Druce and Jones, 1971; Jones, 1971). It is present in the El Paso in samples SD/120, 160, 240, 320, and 360.

NUMBER OF SPECIMENS-32.

REPOSITORY-UMC 1060-8.

Oneotodus simplex (Furnish) s.f.
Pl. 14, figs. 9, 11

Distacodus? simplex Furnish, 1938, p. 328, pl. 42, figs. 24-25; text fig. 1-0.
Oneotodus simplex (Furnish). Jones, 1971, p. 59-60, pl. 4, figs. 6a-9c [synonymy to date]; Greggs and Bond, 1971, p. 1,467, pl. 1, figs. 12, 12a; Abaimova, 1975, p. 83-84, pl. 6, figs. 16-18; text figs. 7 (12, 26).

DISCUSSION-This is a rare element of the lower El Paso at Scenic Drive.

OCCURRENCE-This element occurs in various Lower Ordovician sections (summarized in Jones, 1971). The El Paso specimens are in samples SD/0, 20, 60-100, and 320.

NUMBER OF SPECIMENS-10.

REPOSITORY-UMC 1058-7, 8.

Oneotodus cf. *0. variabilis* Lindström s.f.
Pl. 14, figs. 13, 14

cf. *Oneotodus variabilis* Lindström, 1955, p. 582, pl. 2, figs. 14-18, 47; pl. 5, figs. 4, 5; text fig. 6; Greggs and Bond, 1971, p. 1,467, 1,468, pl. 1, figs. 10, 11, 13-16a.

DISCUSSION-The elements assigned here are generally small and variable, but they appear to be within the range of variation of *0. variabilis* s.f.

OCCURRENCE-Oneotodus cf. *0. variabilis* is present in samples SD/180, 240, 320-360, 400, 440, 520, and 720.

NUMBER OF SPECIMENS-39.

REPOSITORY-UMC 1060-20, 1061-1.

Oneotodus? sp. A s.f. P1. 14, fig. 15

A few specimens appear to be identical with the tall costate forms of *Acanthodus lineatus* s.f., except that the former lack costae and have subcircular cross sections. These specimens may be abraded *A. lineatus* s.f. elements or they may be new. In the form sense, they are placed tentatively in *Oneotodus*.

OCCURRENCE-Rare in samples SD/0 and 160.

NUMBER OF SPECIMENS-7.

REPOSITORY-UMC 1058-11.

Oneotodus? sp. B s.f. P1. 14, fig. 7

The cusp is erect and curved to one side above a very short base that opens posteriorly. The basal margin is oval in cross section. The basal cavity is extremely shallow; the apex is a pit at the center of the cavity. The cusp is oval in cross section, and its long dimension is directed laterally. The cusp is twisted at a right angle to the base at the base-cusp juncture; then it extends orally and laterally towards the distal tip. The cusp consists of white matter above the base.

DISCUSSION-This form is tentatively placed in *Oneotodus* s.f. because of its nearly circular basal and cusp cross sections.

OCCURRENCE-Only one specimen was recovered, in sample SD/240.

NUMBER OF SPECIMENS-1.

REPOSITORY-UMC 1062-1.

GENUS *PALTODUS* Pander 1856
TYPE SPECIES: *Paltodus subaequalis* Pander, 1856

Paltodus bassleri Furnish P1. 14, fig. 12

Paltodus bassleri Furnish, 1938, p. 331, pl. 42, fig. 1; Ethington and Clark, 1971, p. 72, pl. 2, figs., 2, 4, 6; Repetski and Ethington, 1977, p. 95-96, pl. 1, fig. 1.
?Distacodus sp. B. Hass, *in* Sando, 1958, p. 840, pl. 2, fig. 22.
Paltodus variabilis Furnish, 1938, p. 331, pl. 42, figs. 9, 10; text fig. 1E; Graves and Ellison, 1941, p. 5, pl. 2, fig. 17; Ethington and Clark, 1965, p. 197-198; Mound, 1968, p. 415, pl. 4, figs. 18-38. *? Scandodus rectus* Lindström. Müller, 1964, p. 98, pl. 12, figs. 1, 6, 10.
?non Paltodus variabilis Furnish. Lee, 1970, p. 331, pl. 7, fig. 31 [= *? Paltodus spurius s.*f.].
?Scolopodus bassleri (Furnish). Druce and Jones, 1971, p. 91-92, pl. 17, figs. la-4d; text fig. 30b; Jones, 1971, p. 62-63, pl. 5, fig. 3, 6; pl. 9, figs. 2-3.
?Paltodus variabilis Furnish. Lee, 1975a, p. 88-89, pl. 2, figs. 9, 12; text figs. 4-G, H; Lee, 1975b, p. 177.
cf. *Paltodus (?) variabilis* Furnish. Abaimova, 1975, p. 92-93, pl. 7, figs. 12, 16; text figs. 8-2, 3.
cf. *Paltodus (?) bassleri* Furnish. Abaimova, 1975, p. 88-89, pl. 7, figs. 8, 14, 15, 17-19; text figs. 7 (41, 42, 44-46).

DISCUSSION-Study of the abundant collections of these elements from the El Paso and from the Manitou Formation (R. L. Ethington, undescribed collections) indicates that there is a complete gradation from symmetrical to asymmetrical forms. Furnish (1938, p. 331) noted that the two form species *P. bassleri* and *P. variabilis* are related; I think that they are members of a symmetry-transition series.

OCCURRENCE-P. *bassleri* occurs in the Blue Earth beds and the Oneota Dolomite (Furnish, 1938), in the Fort Peña Formation (Graves and Ellison, 1941), low in the Columbia Ice Fields section of Alberta (Ethington and Clark, 1965), in the upper part of the McKenzie Hill and in the Cool Creek Formation of southern Oklahoma (Mound, 1968), in the Collier Shale of Arkansas and Oklahoma (Repetski and Ethington, 1977), and probably also in the Stonehenge Limestone (Sando, 1958), in the Choson Group of Korea (Müller, 1964), in Siberia (Abaimova, 1975), and in Australia (Druce and Jones, 1971; Jones, 1971). El Paso elements were recovered in samples SD/0-120, 160-200, 240, and 260.

NUMBER OF SPECIMENS-295.

REPOSITORY-UMC 1058-13.

Paltodus comptus Branson and Mehl s.f. P1. 14, fig. 10

Paltodus comptus Branson and Mehl, 1933, p. 61, pl. 4, fig. 9.

DISCUSSION-Elements of this distinctive form are nearly identical with the holotype. *P. comptus* s.f. may be a five-costa paltodiform element of the *Acodus delicatus* apparatus. David Kennedy (1980) studied this problem in his reevaluation of Jefferson City taxonomy.

OCCURRENCE-P. *comptus* s.f. is present in the Jefferson City Dolomite of Missouri (Branson and Mehl, 1933; Moore, 1970) and in the upper El Paso at Scenic Drive, in samples SD/821, 940-1,020, 1,060, 1,180, and 1,220.

NUMBER OF SPECIMENS-17.

REPOSITORY-UMC 1067-3.

Paltodus spurius Ethington and Clark s.f. P1. 15, figs. 2, 4, 6

Paltodus spurius Ethington and Clark, 1964, p. 695, pl. 114, figs. 3, 10; text fig. 2B; Ethington and Clark, 1971, p. 72, pl. 1, fig. 12. *? Paltodus variabilis* Furnish. Lee, 1970, p. 331, pl. 7, fig. 31.
non Paltodus spurius Ethington and Clark. Greggs and Bond, 1971, p. 1, 468, pl. 2, figs. 1, 2, 2a.

DISCUSSION-This form species has a distinctive cross section that is bilaterally symmetrical. Each lateral cusp face has two blunt costae separated by a prominent longitudinal groove. The part of the cusp anterior to this groove is thinner than is the posterior part.

The specimens recorded from the March Formation of southeastern Ontario by Greggs and Bond (1971) probably are not *P. spurius*. The illustrations show that the Ontario specimens have their greatest width anterior to the lateral constriction. The El Paso specimens (including the holotype) are widest posterior to the lateral grooves. The posterior margin of *P. spurius* is not flat, as was stated for the March Formation specimens (Greggs and Bond, 1971, p. 1,468).

OCCURRENCE-Paltodus *spurius* has hitherto been recovered only from the lower part of the El Paso Limestone at Blue Mountain, southeast Arizona (Ethington and Clark, 1964) and from the upper part of the House Limestone of western Utah (Ethington and Clark, 1971). It is present in the lowermost part of the El Paso Group at Scenic Drive in samples SD/20 and 40.

NUMBER OF SPECIMENS-31.

REPOSITORY-UMC 1058-15 through 17.

Paltodus? sweeti Serpagli s.f.
Pl. 15, fig. 8

Paltodus? sweeti Serpagli, 1974, p. 58-59, pl. 14, figs. 13-14; pl. 24, figs. 8-10; text fig. 12.
?Paltodus sp. B Ethington and Clark, 1971, p. 73, pl. 2, fig. 13.

DISCUSSION-Serpagli (1974) described this element adequately. The El Paso representatives of *P. ? sweeti* s.f. are poorly preserved.

OCCURRENCE-P. *? sweeti* s.f. has been reported only from Argentina and Newfoundland (Serpagli , 1974), possibly from Nevada (Ethington and Clark, 1971), and from Texas in sample SD/480.

NUMBER OF SPECIMENS-2.

REPOSITORY-UMC 1065-16.

Paltodus? sp. s.f.
P1. 15, fig. 12

This element has a nearly erect, proclined cusp above a posteriorly expanded base. The cusp cross section is asymmetrical; the anterior of the cusp is sharply rounded. The posterior of the cusp bears two sharp posterolateral costae; a sharp median costa is separated from the posterolateral costae by sharp, deep grooves. The outer anterolateral face of the cusp is strongly convex outward; the inner anterolateral face is flat to very slightly concave. Cusp ornamentation is twisted distally about one-eighth of a turn along the cusp. The base is expanded posterolaterally and posteriorly. The basal cavity is relatively spacious and the tip of the cavity points anteriorly. The cusp consists of white matter.

DISCUSSION-This paltodiform element superficially resembles an *Acontiodus* s.f. in cusp cross section. The basal region, however, resembles that of an element of the form genus *Scolopodus*. The basal margin is broken, and therefore its shape is not known.

OCCURRENCE-Paltodus? sp. s.f. only occurs in sample SD/180.

NUMBER OF SPECIMENS-1.

REPOSITORY-UMC 1061-15.

Paltodus n. sp. s.f.
Pl. 15, fig. 9

The element consists of a cusp having a convex anterior face, a sharply rounded costa along each side, and a sharp posterior keel above a posteriorly expanded base. Lateral costae are situated asymmetrically and are directed posterolaterally. The posterior keeled costa is nearly as wide anteroposteriorly as the cusp width across the lateral costae. The cusp is proclined and curved smoothly at the base-cusp juncture; the distal part of the cusp is unknown. The basal margin is broken. The basal cavity is an asymmetrical straight-sided cone that has an anterior side and apex very near the anterior margin. Grooves between the posterior and lateral costae do not extend to the basal margin. The base flares outward posterolaterally and posteriorly.

DISCUSSION-This asymmetrically costate element is placed in the form genus *Paltodus*, although it has a basal cavity similar to *Scolopodus*. The form does not seem to have the surface striations common on specimens of *Scolopodus*.

OCCURRENCE-Samples SD/600 and 760.

NUMBER OF SPECIMENS-3.

REPOSITORY -UMC 1065-13 .

GENUS *PA RACORDYLODUS* Lindström, 1955
TYPE SPECIES: *Paracordylodus gracilis* Lindström, 1955

Paracordylodus gracilis Lindström
Pl. 15, figs. 3, 5, 7

Oistodus gracilis Lindström, 1955, p. 576, pl. 5, figs. 1-2.
Paracordylodus gracilis Lindström, 1955, p. 584-585, pl. 6, figs. 1112; Barnes and Poplawski, 1973, p. 778-779, pl. 1, figs. 6-8; McTavish, 1973, p. 50, pl. 3, figs. 36, 41; Serpagli, 1974, p. 60-61, pl. 24, figs. 14-16; pl. 31, figs. 7-8; text fig. 13 [synonymy to 1974]; van Wamel, 1974, p. 77-78, pl. 4, figs. 11-13; Landing, 1976, p. 634-635, pl. 2, fig. 18; Repetski and Ethington, 1977, p. 96.

REMARKS-Barnes and Poplawski (1973) and van Wamel (1974) independently determined that there is a cyrtoniodiform element (= cordylodiform of van Wamel) in the apparatus of *P. gracilis.* The cyrtoniodiform element in the El Paso collections differs from the figured specimens of these authors only in a few details. The main denticle of the El Paso form is broader anteroposteriorly than those figured previously. In addition, the El Paso form does not show any flaring of the basal margin in the anterobasal region as does that of van Wamel (1974, p. 77). The cyrtoniodiform element is quite rare.

The elements of *P. gracilis* are among the smallest recovered in the Scenic Drive section. This extremely small size and the frosted surfaces of these elements (the result, perhaps, of diagenetic etching) prohibits observation of surface micromorphology (see illustrations of Bergström and others, 1972, and of Serpagli, 1974).

OCCURRENCE-Paracordylodus gracilis has been reported previously from the Baltic area (Lindström, 1955; van Wamel, 1974), Scotland (Lamont and Lindström, 1957), Newfoundland and Pennsylvania (Bergström and others, 1972), Nevada (Ethington, 1972), Quebec (Barnes and Poplawski, 1973), Western Australia (McTavish, 1973), Oklahoma (Repetski and Ethington, 1977), New York (Landing, 1976), and Argentina (Serpagli, 1974). The El Paso specimens are in samples SD/320, 340, 420, and 440.

NUMBER OF SPECIMENS -Oistodiform element-10; paracordylodiform element-24; cyrtoniodiform element-6.

REPOSITORY-UMC 1063-12 through 14.

GENUS *PROTOPANDERODUS* Lindström, 1971
TYPE SPECIES: *Acontiodus rectus* Lindström, 1955

Protopanderodus asymmetricus Barnes and Poplawski s.f. Pl. 15, fig. 1

Paltodus sp. A Sweet and others, 1971, p. 168, pl. 1, fig. 14.
Protopanderodus asymmetricus Barnes and Poplawski, 1973, p. 781-782, pl. 1, figs. 12, 14, 16; text fig. 2A.

DISCUSSION-This distinctive form was described and well illustrated by Barnes and Poplawski (1973).

OCCURRENCE-P. *asymmetricus* s.f. is present in the Mystic Formation of Quebec (Barnes and Poplawski, 1973), in the Wah Wah Limestone in Utah (Sweet and others, 1971), in the upper West Spring Creek Formation of Oklahoma (Potter, 1975), and in the upper part of the El Paso, in samples SD/1,140, 1,180, and 1,2601, 315.

NUMBER OF SPECIMENS-20.

REPOSITORY-UMC 1072-11.

Protopanderodus elongatus Serpagli P1. 16, figs. 4, 5, 7, 9, 11, 12

Protopanderodus elongatus Serpagli, 1974, p. 73-75, pl. 16, figs. 8a-11c; p1. 25, figs. 13-16; pl. 30, fig. 4; text fig. 16 [synonymy to date].

DISCUSSION-The El Paso specimens assigned here agree well with Serpagli's (1974) description of *P. elongatus*, and the reader is referred to that work for a diagram showing the various base and cusp cross sections within this transition series (Serpagli, 1974; text fig. 16).

Some of the El Paso Group acontiodiform elements appear to have their lateral costae situated slightly more anteriorly than those figured by Serpagli, but they seem to be well within the limits of variation of this species.

OCCURRENCE-This is the first report of *P. elongatus* since it was described by Serpagli (1974) from the San Juan Limestone of Argentina. Serpagli (1974, p. 75) noted that forms from the Lower Setul Limestone of Malaya referred to *Scolopodus vulgaris* by Igo and Koike (1967) may be close to *P. elongatus*. El Paso forms are in samples SD/280-380 and 580.

NUMBER OF SPECIMENS-500.

REPOSITORY -UMC 1062-18 through 20, 1063-1, 2, 1128-19.

Protopanderodus gradatus Serpagli Pl. 17, figs. 1-5

Protopanderodus gradatus Serpagli, 1974, p. 75-77, pl. 15, figs. 5-8; pl. 26, fig. 11-15; pl. 30, figs. la, b; text fig. 17.
?Cordylodus simplex Branson and Mehl. Graves and Ellison, 1941, in part, p. 3, p1. 1, fig. 11 only.

DISCUSSION-In side view, *P. gradatus* resembles closely the sulcatiform element of *P. rectus*. The *P. gradatus* element has a more blunt anterior edge; however, the two species appear to be closely related.

OCCURRENCE-P. *gradatus* is present in the San Juan Limestone of Argentina (Serpagli, 1974), possibly in the Marathon Limestone of Texas (Graves and Ellison, 1941), and in the upper El Paso Group in samples SD/1,180-1,220, 1,260, and 1,300-1,342.

NUMBER OF SPECIMENS-117.

REPOSITORY-UMC 1070-12 through 14, 1128-20, 1129-1.

Protopanderodus cf. *P. gradatus* Serpagli Pl. 17, figs. 6-7

cf. *Protopanderodus* cf. *P. gradatus* Serpagli, 1974, p. 75-77, pl. 15, figs. 5-8; pl. 26, figs. 11-15; pl. 30, figs. la, b; text fig. 17.

These are drepanodiform elements with a biconvex cross section. The anterior is sharp; the posterior margin is rounded but bears a narrow keel. The oral margin of the base is straight, and the cusp is smoothly recurved above the base. The aboral margin is oval in cross section but is widest posteriorly. In profile, the aboral margin is convex; the posterior segment is more strongly convex than the anterior segment. The basal cavity is deep and thins to an apex near the anterior margin. In profile, the posterior edge of the cavity is gently convex and the anterior edge is strongly convex.

DISCUSSION-This drepanodiform element is similar in curvature, basal cavity shape, and overall shape to the elements assigned here to *P. gradatus*. The only difference is that *P.* cf. *P. gradatus* has no lateral costae or grooves. Because *P.* cf. *P. gradatus* has essentially the same stratigraphic range as *P. gradatus*, as well as having all the morphological similarities, I think that this drepanodiform element may be the symmetrical element of the *P. gradatus* apparatus.

OCCURRENCE-Samples SD/1,220, 1,260, 1,315, and 1, 342.

NUMBER OF SPECIMENS-17.

REPOSITORY-UMC 1070-18, 19.

Protopanderodus leei n. sp. Pl. 18, figs. 8-11

Paltodus n. sp. Lee, 1970, p. 331-332, pl. 8, figs. 2a, b.

This is a symmetry-transition series consisting of cones possessing large bases, deep basal cavities, and two to four costae. The symmetry transition is from symmetrical distacodiform elements through asymmetrical distacodiform, scandodiform, and acodiform elements to symmetrical acontiodiform elements. The base is expanded toward the aboral margin. The cusp is erect to slightly proclined; the cusp is curved just above the base and is straight distally. The basal cavity is deep and directed anteriorly. The cavity apex is located near the anterior margin. Costae reach the aboral margin which is thinly sheathed between the costae.

The acontiodiform and asymmetrical distacodiform elements have two closely spaced costae along the posterior; the other two costae on these forms are widely spaced, either symmetrically or asymmetrically bilaterally, on either edge of a wide anterior or outer anterolateral face. This anterior face is gently convex but is rather sharply rounded along the medial part on bilaterally symmetrical elements. Both base and cusp are widest anteriorly. On asymmetrical distacodiform and some acodiform elements, the inner anterior costa extends very far anteriorly toward the basal margin; these specimens have a comma-shaped basal cross section, with the point of the comma at the inner anterolateral position. The inner lateral costa of acodiform elements is sharp to rounded.

The base of symmetrical distacodiform elements is widest just anterior of the midline; cusps of these specimens have symmetrical diamond-shaped cross sections.

The anterior costa of the scandodiform element is deflected inward above the base, forming a narrow groove immediately posterior to the costa on the inner side. The inner side of the scandodiform element carries a broad rounded carina that joins an inward flaring of this side of the base.

DISCUSSION-This species of *Protopanderodus* is similar to *P.* n. sp. of Barnes and Poplawski (1973, p. 784), but the latter differs in having its costae continued aborally beyond the basal margin and in having a base that is not expanded as markedly as that in the El Paso Group species.

I think *Paltodus* n. sp. of Lee (1970) is a bilaterally symmetrical element of this species.

DERIVATION OF NAME-After Professor Ha-Young Lee of Yonsei University, Seoul, Korea.

OCCURRENCE-P. *leei* occurs in Korea (Lee, 1970) and in west Texas in samples SD/240-440.

NUMBER OF SPECIMENS -Scandodiform elements-10; acodiform elements-22; distacodiform elements-86; acondiodiform elements-39.

REPOSITORY -UMC 1062-7, 10, 12, 13 (holotype).

***Protopanderodus leonardii* Serpagli**
P1. 17, figs. 8, 10

Protopanderodus leonardii Serpagli, 1974, p. 77-79, pl. 16, figs. 1-4; pl. 27, figs. 12-16; text fig. 18.

cf. *Acontiodus arcuatus* Lindström. Lee, 1970, p. 313, pl. 7, figs. 3, 4.

DISCUSSION-The specimens assigned here agree well with Serpagli's (1974) description and illustrations. I have not included *Scandodus?* n. sp. of Ethington and Clark (1965) in the synonymy here because it lacks lateral costae along the cusp, although from the illustradon (Ethington and Clark, 1965, pl. 1, fig. 6), its profile and basal region do resemble those features of *P. leonardii*.

OCCURRENCE-Protopanderodus leonardii is known from the San Juan Limestone of Argentina (Serpagli, 1974) , and from the El Paso Group in samples SD/800880, 1, 000, 1,020, 1,180, 1,220, 1,260, 1,279, and 1,332.

NUMBER OF SPECIMENS-92.

REPOSITORY -UMC 1068-17, 18.

***Protopanderodus longibasis* (Lindström)**
Pl. 17, figs. 11, 12

Drepanodus longibasis Lindström, 1955, p. 564, pl. 3, fig. 31; Ethington and Clark, 1965, p. 190; Greggs and Bond, 1971, p. 1,465.

Protopanderodus longibasis (Lindström). Van Wamel, 1974, p. 92, pl. 4, figs. 4-6.

Cornuodus longibasis (Lindström). Serpagli, 1974, p. 43, pl. 7, fig. 2; pl. 20, fig. 12.

Drepanodus aff. *D. longibasis* Lindström. Viira, 1974, p. 68-69, text fig. 69.

DISCUSSION-Van Wamel (1974) discussed and illustrated the variation in morphology within this species. All the elements are long, conical, and deeply excavated. The variation involves 1) degree of reclination of the cusp above the base, 2) the anteroposterior width of the base, and 3) degree of twisting of the element. The El Paso specimens show very little torsion effect; most of the elements have circular or oval basal cross sections.

P. longibasis is very similar to *Scolopodus filosus* s.f. The only differences are that *P. longibasis* may have a noncircular basal cross section, and the distal part of the cusp of *P. longibasis* is keeled anteriorly and posteriorly. The cusp of *S. filosus* s.f. maintains a circular cross section throughout its length.

OCCURRENCE-Protopanderodus longibasis has been reported previously from the Baltic region (Lindström, 1955; van Wamel, 1974; Viira, 1974); Alberta, Canada (Ethington and Clark, 1965); southeast Ontario (Greggs and Bond, 1971); and Argentina (Serpagli, 1974). The El Paso Group specimens are in samples SD/300, 320, 360, 580, 600, 760, 780, 821, 839, 880, 900, 940, 1,180, and 1, 260.

NUMBER OF SPECIMENS-57.

REPOSITORY -UMC 1063-15, 16.

***Protopanderodus* c.f. *P. rectus* (Lindström)**
Pl. 17, fig. 9; pl. 18, figs. 2-3

cf. *Acontiodus rectus* Lindström, 1955, p. 549, pl. 2, figs. 7-11; text fig. 2, k-m; text figs. 3-B; Lee, 1975a, p. 83, pl. 1, fig. 5; text fig. 3-E.

cf. *Protopanderodus rectus* (Lindström). emend. Lindström, 1971, p. 50; van Wamel, 1974, p. 93, pl. 4, figs. 7-10.

cf. *Acontiodus rectus sulcatus* Lindström, 1955, p. 550, pl. 2, figs. 1213; text fig. 3-D.

cf. *Scandodus rectus* Lindström, 1955, p. 593-594, pl. 4, figs. 21-25; text fig. 3-K.

? Scandodus rectus Lindström. Lee, 1975b, p. 178, pl. 1, fig. 15.

DISCUSSION-Elements placed here closely resemble those of *P. rectus.* The El Paso forms, however, are recurved throughout the length of the cusp instead of straightening distally as do the Baltic and Korean forms. The sulcatiform elements have a rather shallow basal cavity and have a long aboral margin. See remarks under *P. gradatus.*

OCCURRENCE-Samples SD/821, 861-900, 9601, 000, 1,060, 1,180.

NUMBER OF SPECIMENS -Acontiodiform elements-3; sulcatiform elements-12; scandodiform elements-1.

REPOSITORY -UMC 1068-19, 20, 1069-1.

***Protopanderodus?* n. sp. 1 s.f.**
Pl. 18, figs. **1,** 5

These are long recurved elements having a nonexpanded base, rounded anterior, and a prominent posterior keel. The basal cavity is deep, conical, and inclined toward the anterior margin; the cavity tip is sharp and erect. The basal margin is straight in profile; in cross section, the basal margin is circular or, if the posterior keel is strong in the basal part, drawn to a point posteriorly. The posterior keel is broad anteroposteriorly and sharp; above the base, the keel may be as broad as the cusp. On lateral faces the cusp may be separated from the keel by a shallow groove above the base. With the posterior edge of the base oriented horizontally, the cusp usually is proclined but is erect on a few specimens. In cross section the element is bilaterally symmetrical throughout the length.

DISCUSSION-This form species differs from *P.?* n. sp. 2 s.f. only in that the former has a deep basal cavity and *P. ?* n. sp. 2 has a shallow cavity. Perhaps the two forms are parts of a common apparatus. These two forms appear to be assignable to the genus *Protopanderodus* as defined by Lindström (1971). *P. ?* n. sp. 1 appears to show inconspicuous fine striations on its base, but further investigation with better preserved specimens is necessary to confirm this observation.

OCCURRENCE-Samples SD/320, 360, and 440.

NUMBER OF SPECIMENS-13 .

REPOSITORY —UMC 1064-12, 13.

Protopanderodus? n. sp. 2 s.f.

Pl. 18, figs. 4, 6

The elements have a long proclined cusp above a short base and a low basal cavity. The anterior margin is rounded; the posterior of the unit has a prominent sharp keel. The basal cross section is slightly compressed laterally; the anterior is rounded and the posterior is sharp. The base is short and the basal cavity is low, asymmetrically conical, and has its tip near the anterior margin. The posterior edge of the cavity profile is straight and extends anteroaborally; the anterior edge is slightly concave. The posterior keel may be separated from the cusp by a shallow groove on each face of the cusp. One side of the element may flare outward somewhat, causing bilateral asymmetry.

DISCUSSION-Protopanderodus? n. sp. 2 s.f. is very similar to *P. ?* n. sp. 1 s.f. except for the shallow basal cavity of the former. The reader is referred to the latter form species for further discussion.

OCCURRENCE-Samples SD/320, 360-400, 580, 600.

NUMBER OF SPECIMENS-64.

REPOSITORY —UMC 1064-10, 11.

GENUS *REUTTERODUS* Serpagli, 1974

TYPE SPECIES: *Reutterodus andinus* Serpagli, 1974

Cooper and Druce (1975, p. 579, figs. 34, 35) illustrated two poorly preserved specimens from New Zealand that may belong in this genus.

Reutterodus andinus? Serpagli

P1. 18, fig. 7; pl. 19, figs. 1-3

?Reutterodus andinus Serpagli, 1974, p. 79-81, pl. 17, figs. 9a-d; pl. 28, figs. 1-9; text figs. 19, 20.

DISCUSSION-The conelike specimens in the El Paso are indistinguishable from those figured by Serpagli (1974). Only a few unibranched elements, and no bibranched elements, were recovered from the Scenic Drive section, hence the queried species assignment. Serpagli noted (1974, p. 81) that some of his samples contained only conelike elements, but he still recovered nearly as many bibranched elements as cones, and he reported very few unibranched elements. The El Paso species may be different from the Argentinian species, but at least their conelike elements appear to be identical.

The elements assigned to *Drepanodus arcuatus* by Graves and Ellison (1941) probably are not elements of *R. andinus*, as postulated by Serpagli (1974).

OCCURRENCE-R. *andinus* is known only from Argentina and now probably from the El Paso Group, in samples SD/1,180-1,220, 1,260, 1,279, and 1,315- 1, 342.

NUMBER OF SPECIMENS —Conelike elements-50; unibranched elements-14; bibranched elements-O.

REPOSITORY —UMC 1071-6 through 8, 1129-2.

Reutterodus borealis n. sp.

P1. 19, figs. 4-7

This is a multielement species consisting of conelike unibranched and bibranched elements, the last two elements possessing a denticulate posterior process.

The conelike element bears an erect cusp, which is smoothly curved and continuous with the curvature of the base. The base is rather short and the oral edge extends posteriorly much farther than does the anterior margin. In profile, the basal margin is convex; the anteroaboral angle is very obtuse and is nearly a smooth curve. The posteroaboral angle is approximately 60-70 degrees. The outer face of the cusp is very gently convex, with a very shallow groove just anterior of the posterior margin, which is sharp. The anterior face of the cusp is rounded. A sharply rounded costa runs longitudinally along the inner side of the anterior margin. A prominent carina makes up the inner side of the cusp; this carina is separated from the anterolateral costa and sharp posterior margin by sharp, narrow grooves. The anterolateral costa reaches the basal margin but does not extend beyond the margin. The basal cavity is a long narrow cone whose apex points anteriorly near the anterior margin. In profile, the oral edge of the basal cavity is inclined downward toward the apex.

The unibranched elements resemble the conelike elements except that the cusp is reduced in size, and the posterior and anterolateral costae are developed as denticulate processes. On some specimens the posterior process is twisted outward distally and the inner lateral process is poorly developed. Other specimens have a nontwisted posterior process and a fairly long inner lateral process which extends posteroaborally and has a convex anterior face and a concave posterior face. The basal cavity extends as a groove along the aboral side of the processes. Processes of branched elements are laterally compressed and possess denticles that are fused for nearly all their length and that decrease in height distally along each process.

The bibranched elements have a rather high posterior process and two anterolateral processes; each of the latter curves posterolaterally. The posterior process is situated subsymmetrically to asymmetrically between an arc formed by the two lateral processes. This arc may be rather sharply convex or very gently convex anteriorly.

DISCUSSION-The conelike element of *R. borealis* n. sp. differs from that of *R. andinus* by having a less sharp inner anterolateral costa that does not extend beyond the basal margin. The base of the conelike element of the new species extends farther posteriorly and extends basally along a smooth curve that is continuous with the cusp. The branched elements of *R. borealis* resemble those of *R. andinus,* except that the former bear posterior denticulate processes.

The conelike elements of *R. borealis* resemble *Scolopodus* aff. *S. parabruptus* s.f., except that elements of the latter have a more expansive basal cavity and their base is more rounded in cross section. Depending on the amount of variability in the conelike elements of *R. borealis, S.* aff. *S. parabruptus* s.f. could belong to that species.

DERIVATION OF *NAME-borealis* [L., fr. Gk., = north], referring to the discovery of this species in the northern hemisphere.

OCCURRENCE-Samples SD/861-900, 940, 960, and 1, 220.

NUMBER OF SPECIMENS-Conelike elements-15; unibranched elements-2; bibranched elements-10.

HOLOTYPE-UMC 1069-2.

REPOSITORY-UMC 1069-3 through 5.

GENUS *SCANDODUS* Lindström, 1955

TYPE SPECIES: *Scandodus furnishi* Lindström, 1955

Scandodus aff. S. flexuosus Barnes and Poplawski s.f. Pl. 20, figs. 1, 2

aff. *Scandodus flexuosus* Barnes and Poplawski, 1973, p. 785-786, pl. 2, figs. 1, 4; text fig. 2L.

DISCUSSION-Specimens in the lower part of the El Paso resemble the early Middle Ordovician form species *S. flexuosus* s.f. described by Barnes and Poplawski from the Mystic Formation in southern Quebec. The only differences are that the El Paso specimens have a more symmetrically erect basal cavity than that illustrated for the Mystic specimens (Barnes and Poplawski, 1973, text fig. 2L). Furthermore, the inner face of the El Paso specimens is slightly more strongly convex than is the outer face; the opposite was reported for the Mystic forms.

The cusps of the El Paso specimens consist of white matter beginning abruptly at a level slightly above (distally) the level of the basal cavity tip.

OCCURRENCE-Rare to common in samples SD/0, 40, 60, 120, 140, 180, 220, 240, 300, 320, 360, and 621.

NUMBER OF SPECIMENS-63.

REPOSITORY-UMC 1059-11, 12.

Scandodus furnishi Lindström s.f. Pl. 20, figs. 3, 4

Scandodus furnishi Lindström, 1955, p. 592, pl. 5, fig. 3; Lee, 1970, in part, p. 332, pl. 8, fig. 4 *[non* pl. 8, fig. 3]; Ethington, 1972, p. 22, pl. 1, fig. 6; Abaimova, 1975, p. 95-96, p1.9, figs. 1, 2; text figs. 8-10, 15.

?Scandodus furnishi Lindström. Jones, 1971, p. 61, p1.4, fig. 11; Ethington and Clark, 1971, p. 73, pl. 2, fig. 27.

non Scandodus furnishi Lindström. Ethington and Clark, 1964, p. 698, pl. 114, figs. 11, 24; Druce and Jones, 1971, p. 88-89, pl. 13, figs. 6a-9c; text fig. 29.

DISCUSSION-The El Paso material assigned here agrees closely with Lindström's (1955) description of this form species.

Lindström (1971) assigned *S. furnishi* s.f. to a skeletal apparatus that also contains *Drepanodus cyranoicus* s.f. and *D. conulatus* s.f. Of these latter two, only *D. conulatus* s.f. has been recovered from the El Paso, and it is only sparsely represented.

The element figured by Jones (1971) resembles *S. furnishi* s.f., but its cusp abruptly becomes white matter a short distance above the base.

OCCURRENCE-S. *furnishi* s.f. occurs in the Baltic area (Lindström, 1955, 1971), in Korea (Lee, 1970), in Siberia (Abaimova, 1975), and in Nevada (Ethington, 1972). Other possible occurrences are in northwestern Australia (Jones, 1971) and in Colorado (Ethington and Clark, 1971). The El Paso specimens are in samples SD/ 240, 320, 360-440, 480, 502, 560, 640, 680, 740, 760, 800, 960, 1,000, 1,020, 1,060, 1,279, and 1,300.

NUMBER OF SPECIMENS-97.

REPOSITORY-UMC 1062-4, 5.

Scandodus aff. S. furnishi Lindström s.f. Pl. 20, figs. 6, 7

aff. *Scandodus furnishi* Lindström, 1955, p. 592, pl. 5, fig. 3.

DISCUSSION-This form species resembles *S. furnishi* s. f. except for a few features. The cusp of the El Paso form is reclined rather than erect; the angle between the posterior edge of the cusp and the oral edge of the base is acute-45-60 degrees. The anterobasal angle of *S.* aff. *S. furnishi* s.f. is acute also and the anterior edge is not bent forward near the base as it is on *S. furnishi* s.f. The broad lanceolate blade of the El Paso forms is twisted above the small base; one or both faces may be broadly carinate medially, the carinae being defined by shallow grooves adjacent to the sharp anterior and posterior edges.

This form shows a gross similarity to the illustration of *Oistodus contractus* s.f. of Barnes and Poplawski (1973, pl. 4, fig. 14). That figured specimen, however, does not show a sharp anterobasal angle, and the basal margin appears to be convex in profile, whereas the basal margin of *S.* aff. *S. furnishi* s.f. has a straight profile.

OCCURRENCE-Samples SD/320, 340, 400, and 420.

NUMBER OF SPECIMENS-186.

REPOSITORY-UMC 1064-2, 3.

Scandodus cf. *S. furnishi* Lindström s.f. Pl. 20, fig. 8

cf. *Scandodus furnishi* Lindström, 1955, p. 592, p1. 5, fig. 3.
Scandodus cf. *furnishi* Lindström. Serpagli, 1974, p. 85, p1. 17, figs. 10a-c; p1.27, fig. 8.

DISCUSSION-Serpagli (1974) has described and illustrated this form. *S.* cf. *S. furnishi* s.f. differs from *S. furnishi* s.f. in having its basal margin widest across the medial part rather than toward the posterior end. A distinctive flaring of the inner side of the basal margin is also present. As mentioned by Serpagli (1974), enough is not yet known about the range of variation of *S. furnishi s.f.*

OCCURRENCE-S. cf. *S. furnishi* s.f. is present in the San Juan Limestone of Argentina (Serpagli, 1974), and

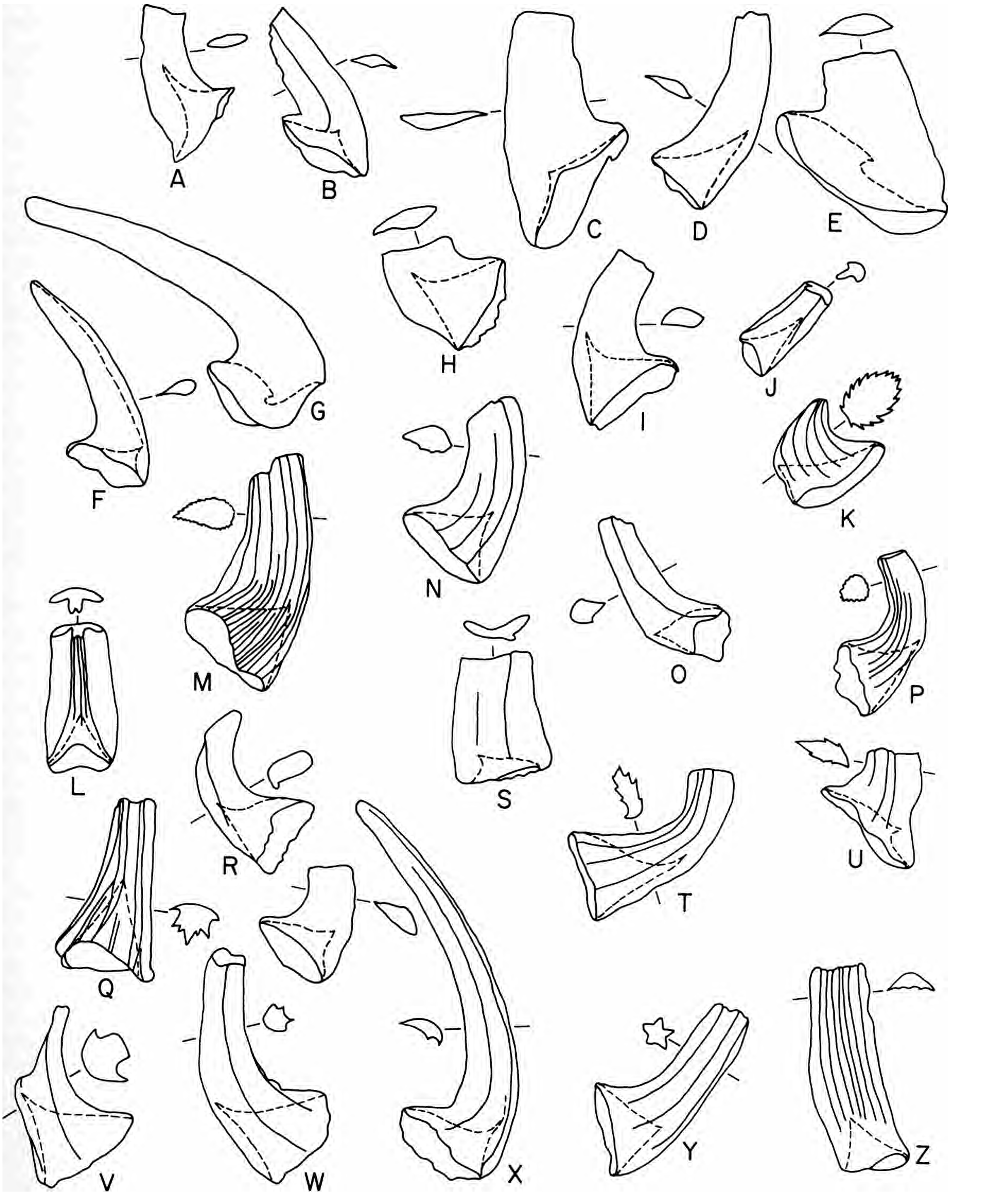

FIGURE 7-A-*Scandodus* aff. *S. flexuosus* Barnes and Poplawski. Inner lateral view, x 54. UMC 1059-11. B-*Scandodus* aff. *S. furnishi* Lindström s.f. Inner lateral view, x 42. UMC 1064-2. C-*Scandodus cf. S. furnishi* Lindstrom s.f. Inner lateral view, x 61. UMC 106814. D-*Scandodus* **aff.** *S. mysticus* Barnes and Poplawski s.f. Inner lateral view, x 62. UMC 1066-9. E-*Scandodus* n. sp. 1 s.f. Outer lateral view, x 42. UMC 1063-7. F-*Scandodus* n. sp. 2 s.f. Inner lateral view, x 62. UMC 1066-7. G-*Scandodus* cf. *S. pipa* Lindström s.f. Lateral view, x 43. UMC 1061-18. H-*Scandodus* n. sp. 3 s.f. Inner lateral view, x 60. UMC 1066-4. I-*Scandodus* n. sp. 4 s.f. Inner lateral view, x 62. UMC 1066-10. J-*Scolopodus acontiodiformis angularis* n. subsp. s.f. Posterolateral view, x 60. UMC 1064-6. K-*Scolopodus abruptus* n. sp. s.f. Lateral view, x 59. UMC 1065-12 (holotype). L-*Scolopodus bolites* n. sp. Posterior view, x 48. UMC 1063-5. M-*Scolopodus filosus xyron* n. subsp. s.f. Inner lateral view, x 61. UMC 1065-14. N-*Scolopodus rex paltodiformis* (Lindström). Inner lateral view of paltodiform element, x 48. UMC 1061-7. O-*Scolopodus acontiodiformis* n. sp. s.f. Posterolateral view of two-grooved element, x 55. UMC 1060-7. P-*Scolopodusparabruptus* n. sp. Lateral view of element with subcircular cusp, x 60. UMC 1063-17. Q-*Scolopodus pseudoquadratus* Branson and Mehl s.f. Posterior view, x 42. UMC 1066-5. R-*Scolopodus* aff. *S. parabruptus* s.f. Inner lateral view, x 62. UMC 1066-19. S-*Scolopodus gracilis* Ethington and Clark. Asymmetrical triangulariform element, inner lateral view, x 54. UMC 1061-14. T-*Scolopodus cornutiformis* Branson and Mehl s.f. Lateral view, x 53. UMC 1067-1. U-*Scolopodus kelpi* n. sp. s.f. Inner lateral view, x 63. UMC 1065-1. **V, W,** X-*Scolopodus floweri* n. sp. Lateral views. V) x 60, UMC 1060-16; W) x 48, UMC 1060-19; X) x 41, UMC 1060-18. Y-*Scolopodus sulcatus* Furnish s.f. Outer lateral view, x 56. UMC 1060-9. Z-*Scolopodusparabruptus* n. sp. Posterolateral view of element with lanceolate cusp, x 47. UMC 1063-18.

in the El Paso in samples SD/800-839, 880, 900, 980, and 1,000.

NUMBER OF SPECIMENS -3 8.

REPOSITORY-UMC 1068-14.

Scandodus aff. S. mysticus Barnes and Poplawski s. f. P1. 20, fig. 9

aff. *Scandodus mysticus* Barnes and Poplawski, 1973, p. 786, p1. 4, figs. 1, 2; text fig. 2K.

DISCUSSION-This form resembles *S. mysticus* s.f. in overall shape and basal cavity morphology. *S.* aff. *S. mysticus* s.f. does not appear to be as strongly compressed laterally and it is nearly bilaterally symmetrical. *S.* aff. *S. mysticus* s.f. appears to be very closely related to *Scandodus* n. sp. 4 s.f., the only difference being the bilateral asymmetry of the latter.

OCCURRENCE-Samples SD/660, 720, 800, 880-920, 960, 1,020, and 1,180.

NUMBER OF SPECIMENS-19.

REPOSITORY-UMC 1066-9.

Scandodus cf. *S. pipa* Lindström s.f. P1. 20, fig. 5

cf. *Scandodus pipa* Lindström, 1955, p. 593, pl. 4, figs. 38-42; text fig. 3-P.
? Drepanodus gracilis (Branson and Mehl). Lee, 1975a, p. 85, pl. 1, fig. 14; text fig. 3-J; Lee, 1975b, p. 173, text fig. 3-I.
Drepanodus pandus (Branson and Mehl). Abaimova, 1975, p. 62-63, p1. 4, figs. 7, 10, 11; text figs. 6-31, 34.

DISCUSSION-The El Paso specimens assigned here are quite variable, as is the collection of Lindström's figured specimens (Lindström, 1955). As mentioned by Ethington and Clark (1964, p. 698) in the discussion of their single specimen referred to *S. pipa* s.f., this form is very difficult to distinguish from *Drepanodus gracilis* (Branson and Mehl). Added to this difficulty, many of the specimens in my collection are broken in the basal region.

Lindström (1971) included *S. pipa* s.f. in his multi-element species *Drepanodus arcuatus* Pander. However, because I am not confident that my *S. pipa* s.f. elements are identical with the Swedish material, I am treating my material in the form sense.

Lee's illustrations of *Drepanodus gracilis* s.f. (Lee, 1975a, b) show a rounded juncture of the posterior edge of the cusp with the oral edge of the base. *Oistodus gracilis* Branson and Mehl s.f. has a sharp angle at that juncture. Lee's specimens appear to be closer to *Scandodus pipa s .f* .

OCCURRENCE-The El Paso specimens are in samples SD/160, 180, 240-360, 400, 540-621, 660-960, 1,000, 1, 020, 1,140-1,180, 1,220, and 1,260-1,342.

NUMBER OF SPECIMENS-508.

REPOSITORY -UMC 1061-18.

Scandodus n. sp. 1 s.f. Pl. 20, fig. 11

This element is characterized by a robust recurved hyaline cusp above a small base with a short oral margin. The base is flared slightly near the margin and the basal margin is convex on the outer side. The inner part of the basal margin is asymmetrically sigmoidal, with a very shallow concave segment near the anterior and the concave segment widest posterior to the midline. The anteriormost part of the inner side of the basal margin flares inward and upward very slightly. The inner face of the base and cusp is broadly and evenly convex. The outer face of the element is nearly flat. The outer face of the cusp may be barely convex, with an extremely shallow linear concavity that runs immediately adjacent to the anterior edge and then along the base parallel to the basal margin and just above this margin, causing the outer basal margin to appear slightly flared. In side view, the posterior three-fourths of the basal margin is nearly straight, forming a very acute posteroaboral angle. The anterior one-fourth of the basal margin nearly parallels the oral edge of the short posterior part of the base. The anteroaboral angle is nearly 90 degrees.

The basal cavity is obscured on the studied specimen, but it is low and has its apex directed anteriorly at a point just anterior to the midline. The growth axis is only slightly recurved, but it is inclined more steeply than is the cusp itself, so that at the point where the cusp is broken (somewhat less than half its length) the axis is posterior to the cusp midline.

OCCURRENCE-Samples SD/280-320, 380, 400, and 440.

NUMBER OF SPECIMENS-39.

REPOSITORY-UMC 1063-7.

Scandodus n. sp. 2 s.f. P1.20, fig. 12

Scandodus sp. Ethington and Clark, 1964, p. 698, pl. 114, fig. 20.

In this specimen the hyaline cusp is erect to slightly recurved above a shallow base whose margin is laterally flared posteriorly. The anterior margin of the cusp is rounded and the posterior edge of the cusp is sharply keeled. A shallow longitudinal concavity, located approximately medially on each lateral face of the cusp, separates a rounded anterior and a thinner, posteriorly tapering posterior part of the cusp. The cusp is twisted relative to the base so that the base opens somewhat laterally. The anteroaboral angle is nearly 90 degrees; the posteroaboral angle is about 45 degrees.

The base is low and the basal margin flares laterally toward the posterior, hence that part of the base is widest. In plan view, the basal margin is rounded anteriorly and posteriorly and has relatively straight lateral segments; the margin is widest near the posterior end. The basal cavity is expansive but shallow; the cavity profile is asymmetrical and the posterior side is much longer than the anterior side. The cavity apex is directed anteriorly and is located close to the anterior margin. Above the cavity tip, the growth axis is recurved slightly; recurvature of the growth axis is less than the degree of recurvature of the cusp.

DISCUSSION- *Scandodus* n. sp. 2 s.f. resembles both *S. furnishi* s.f. and *Drepanodus toomeyi* s.f. However, both of these latter species possess straight growth axes and each has a sharp anterior edge. The basal cavity of *S.* n. sp. 2 s.f. is more shallow than the cavity of these other species. Ethington and Clark (1964) figured a basally damaged specimen of this species, also from the El Paso, as *Scandodus* sp.

OCCURRENCE-Sample SD/580.

NUMBER OF SPECIMENS-1.

REPOSITORY-UMC 1066-7.

Scandodus n. sp. *3* s.f.
P1.20, fig. 10

Characteristic of this form species is a cusp with a lanceolate cross section. The cusp is slightly proclined, situated above a nonexpanded base having a tall triangular cavity. The base is oval in cross section and the anterior and posterior margins of the base are keeled. The oral margin of the base is straight in profile and meets the aboral margin nearly at right angles. The anterobasal angle is approximately 90 degrees. The basal extent of the anterior margin is straight to very slightly concave in profile; at about half the height of the base, the anterior keel broadens anteroposteriorly and the anterior margin is convex distally. The basal cavity is deep and approximates an equilateral triangle in profile; the posterior edge of the cavity in profile is slightly concave, but the anterior edge is straight. The cavity apex is directed anteriorly and is situated just forward of the midline in the basal part of the cusp. The outer face of the unit is more strongly convex than the inner face.

DISCUSSION-The distinctive feature of this scandodiform element is the straight or barely concave segment along the basal part of the anterior margin. This morphology is the result of the decrease in anteroposterior width of the anterior keel as it approaches the base.

OCCURRENCE-Samples SD/600, 640, and 760.

NUMBER OF SPECIMENS-7.

REPOSITORY-UMC 1066-4.

Scandodus n. sp. 4 s.f.
P1. 21, fig. 2

The element has a lanceolate cusp recurved above a slightly expanded base. The anterior and posterior edges of the cusp are sharp, and the keeled edges continue basally to the basal margin. The base is drawn out anteriorly to a sharp anteroaboral angle; the posteroaboral angle is acute also, at approximately 60 degrees. The basal margin is lachrymiform and the anterior end is pointed, while the posterior end is rounded. The inner lateral edge of the margin is gently convex anteriorly and strongly so posteriorly; the outer margin is strongly convex because of flaring of that side. The basal margin is widest laterally just anterior of the midline; anterior of the widest point the outer side is deflected inwards at nearly a right angle to the inner lateral margin. The anterior keel of the element is strongly deflected inward basally. Above the basal margin, on the base and the lowest portion of the cusp, a linear concavity lies just posterior to the deflected anterior keel. The cusp arises at about 90 degrees above the oral edge of the base and is twisted slightly, its anterior edge inward. At the cusp-base juncture, the anterior edge is deflected posteriorly about 30 degrees behind the line of the anterior edge of the cusp until the anterobasal angle is reached.

The basal cavity is thin walled and conical and the apex is directed anteriorly and located very close to the anterior margin. In profile the posterior side of the cavity is straight to slightly concave near the apex, and the anterior side is slightly concave.

OCCURRENCE-Samples SD/621,660-760, and 821.

NUMBER OF SPECIMENS-17.

REPOSITORY —UMC 1066-10.

GENUS *SCOLOPODUS* Pander, 1856
TYPE SPECIES: *Scolopodus sublaevis* Pander, 1856

DISCUSSION-In his redefinition of *Scolopodus,* Lindström (1971) stated that the genus consists of hyaline elements, even though Pander (1856) referred to the white color of his *Scolopodus* elements. As Lindström (1971, p. 41) pointed out, the white color of Pander's specimens could be due to the elements having been weathered. Still, the significance of the presence or absence of white matter to the taxonomy of conodonts, at least in regard to scolopodan elements, is not yet fully understood. In the collection at hand, several form species conform to Lindström's generic description for *Scolopodus* except that they contain white matter (for example, *S. abruptus, S. carlae).* In another species *(S. gracilis),* the elements have a hyaline appearance in some samples, and in other samples they contain white matter. Possibly diagenetic alteration could change the appearance of previously hyaline conodonts (or even previously albid conodonts?). Until the albid versus hyaline problem for *Scolopodus-like* elements is resolved, I am assigning to *Scolopodus* those hyaline and albid elements that otherwise satisfy Lindström's (1971) generic description.

Scolopodus abruptus n. sp. s.f.
Pl. 21, figs. 1, 3

Scolopodus cornutiformis Branson and Mehl. Ethington and Clark, 1964, in part, p. 698-699, pl. 114, fig. 23 only; Barnes and Tuke, 1970, p. 91, pl. 18, figs. 1, 4; text fig. 6B.

The element's cusp is suberect to erect above a posteriorly expanded base. The cusp tapers rapidly to an apex and may be extremely short and stubby; it consists of white matter beginning abruptly at the base-cusp juncture. The cusp bears numerous strong, evenly spaced, posteriorly directed costae. On stubby specimens, the costae merge distally. Costae diverge on the expanded base and die out before reaching the basal margin. The base is hyaline and expands posteriorly. The postero-oral angle is about 45 degrees and the basal margin is straight in profile. The anterobasal angle is a right angle or slightly obtuse. The basal cross section is oval; the cusp cross section is suboval basally and circular distally. The anterior face of the cusp is more sharply rounded than is the posterior face. The basal cavity is asymmetrically conical and the anterior face of the cavity is parallel with, and extremely near, the anterior margin of the base. The posterior wall of the cavity is long and straight in profile, running from the tip and adjacent to the anterior margin of the base, to the postero-oral angle.

DISCUSSION-Specimens of *S. abruptus* s.f. that have long cusps resemble *S. rex* s.f. The basal cavities of these two species are very different, as is the structure of the cusp-S. *rex* s.f. is hyaline, whereas the cusp of *S. abruptus* s.f. is white matter. The short specimens of *S. abruptus* s.f. are distinctive in their rapidly tapering cusps and in their distally merged costae.

DERIVATION OF NAME-Moore (1970) chose the specific name *abruptus,* in his unpublished manuscript, to refer to the rapid tapering of the cusp that is distinctive of the species. As the name has not been published, there is no problem of priority in my use of that name here.

OCCURRENCE-This form species is present in green shale above and within the Jefferson City Dolomite of Missouri (Moore, 1970) and in the St. George Formation of Newfoundland (Barnes and Tuke, 1970). The El Paso specimens are in samples SD/560-1,020, 1,060, 1,140, 1,180, and 1,260-1,332.

NUMBER OF SPECIMENS-365.

REPOSITORY -UMC 1065-11, 12 (holotype).

Scolopodus acontiodiformis n. sp.
P1.21, figs. 5, 8

Acontiodus iowensis Furnish. Ethington and Clark, 1964, p. 687, pl. 113, fig. 3.

cf. *Scolopodus staufferi* (Furnish). Druce and Jones, 1971, p. 94-95, pl. 18, figs. 8, 9; Jones, 1971, p. 67, pl. 6, figs. 7a-c.

The element has a proclined cone with two prominent posterolateral, longitudinal grooves and a posterior plication between them. The basal margin is oval (nearly circular) and its longest dimension is lateral; the margin is extended aborally very slightly anteriorly and posteriorly. The base is expanded slightly on the lateral and posterior faces. Posterolateral grooves are deep along the cusp but shallow on the base; the grooves diverge outward as the base expands and they die out as the basal margin is reached. The anterior of the cusp is rounded smoothly to sharply; the posterior plication may have a shallow posterior groove above the base, dividing the plication into two rounded costae. The basal cavity's apex is pointed anteriorly near the anterior margin of the element. The surface appears to be ornamented with fine longitudinal striations; these striations are only barely perceptible in the region of the base-cusp juncture.

DISCUSSION-The form of *S. acontiodiformis* s.f. which has a posterior, as well as two posterolateral grooves, appears similar to *S. variabilis* s.f. However, the posterior groove of the former does not extend onto the base as it does on *S. variabilis* s.f. In addition, *S. variabilis* s.f. has a more nearly equal development of its three grooves, whereas the two posterolateral grooves of *S. acontiodiformis* are much deeper than is the posterior one.

The posterior plication of *S. acontiodiformis* s.f. may be more sharply rounded than that on *Acontiodus iowensis* s.f., that on the latter element is nearly straight. The cusp of *S. acontiodiformis* s.f. is proclined at least 45 degrees above the axis of the base.

DERIVATION OF *NAME-acontiodiformis-the* cusp cross section of the form species is similar to that of an acontiodi form element.

OCCURRENCE-Elements with two grooves: SD/180, 220-260, 300, 440, 480, 520, 560-640, 680-720, 760-800, 839-880, 920, 960, 1,060, 1,180, and 1,260-1,332. Elements with three grooves: SD/240, 300, 640, and 700.

NUMBER OF SPECIMENS-Elements with two grooves-110; elements with three grooves-5.

REPOSITORY -UMC 1060-6, 7 (holotype).

Scolopodus acontiodiformis angularis n. subsp. s.f.
Pl. 21, fig. 7

Elements are identical to those of *S. acontiodiformis* n. sp. s.f. except that the posterior plication of *S. acontiodiformis angularis* s.f. is sharper posteriorly.

DISCUSSION-The reader is referred to *S. acontiodiformis* s.f. for a complete description of the species.

DERIVATION OF *NAME-angularis* [L. = angular] referring to the sharp-edged posterior plication of this element.

OCCURRENCE-Samples SD/360-440, 520, and 700.

NUMBER OF SPECIMENS-14.

REPOSITORY -UMC 1064-6 (holotype)

Scolopodus bolites n. sp.
Pl. 21, figs. 9-11

The elements are long, gently curved, proclined cones with robust, wide anterolateral costae. The anterior face is broad and gently convex. Lateral costae are thick and blunt; the anterior part of the costae forms lateral parts of the anterior face. The posterior part of each lateral costa forms a deep, anteriorly directed groove on each side of the main part of the cusp. The posterior part of the cusp is rounded to rounded-quadrate in cross section above the level of the base-cusp juncture; on the basal part the cusp is expanded laterally and especially posteriorly. The cusp is a smoothly tapered continuation of the base. The basal margin is constricted slightly; the lateral costae end at or just above the basal margin. The aboral basal cavity cross section is quadrate-elliptical with the long axis anteroposterior. The basal cavity has its apex directed anteriorly and is only moderately deep. Above the basal margin the unit is marked with fine longitudinal striations that are most prominent on the base. Units are usually bilaterally symmetrical but may be asymmetrical. The posterior part of the cusp may be rounded or it may possess a longitudinal groove that arises just above the basal margin, becomes deepest in the region of maximum cusp curvature, and continues distally along the cusp.

DISCUSSION-Scolopodus *bolites* differs from *Acontiodus staufferi* s.f. and *A. iowensis* s.f. by having wider, more robust lateral costae, by not having a base that is expanded as abruptly as these others, and by being finely striated.

The shortened T-shaped cross section serves to distinguish this from other species of *Scolopodus* s.f.

DERIVATION OF *NAME-bolites* [Gr. = mushroom]. The cusp cross section of this species of *Scolopodus* resembles

OCCURRENCE-Scolopodus *bolites* has a rather short range in the El Paso. It was recovered in samples SD/ 300-340.

NUMBER OF SPECIMENS-96.

REPOSITORY-UMC 1063-5 (holotype), 6, 1083-17.

Scolopodus cornutiformis Branson and Mehl s.f.
P1. 21, figs. 4, 6

Scolopodus cornutiformis Branson and Mehl, 1933, p. 62, pl. 4, fig. 23.

non Scolopodus cornutiformis Branson and Mehl. Ethington and Clark, 1964, p. 698-699, pl. 114, figs. 16, 23 [fig. 16 = *Scolopodus parabruptus* s.f.; fig. 23 = *Scolopodus abruptus* s.f.]; Ethington and Clark, 1965, p. 200, pl. 1, figs. 10, 12 [= *Scolopodus rex* s.f.]; Barnes and Tuke, 1970, p. 91, pl. 18, figs. 1, 4; text fig. 6B [= *lopodus abruptus* s.f.]; Ethington and Clark, 1971, p. 73, pl. 2, fig. 21 [= *Scolopodus rex* s.f.].

?Scolopodus cornutiformis Branson and Mehl. Mound, 1968, p. 418, pl. 5, figs. 14, 15, 17-19, 22-24, 26, 27, 32, 66, 67, 69, 70; Ethington and Clark, 1971, p. 73, pl. 2, fig. 22.

non Scolopodus aff. *S. cornutiformis* Branson and Mehl. Barnes and Poplawski, 1973, p. 786, pl. 1, figs. 9, 10 [= *Scolopodus rex* s.f.]. *? Scolopodus* cf. *S. cornutiformis* Branson and Mehl. Cooper and Druce, 1975, fig. 33.

DISCUSSION-As reflected in the synonymy, there is a need for study of this form and its relation to *Scolopodus rex* s.f. The cotypes of *S. cornutiformis* s.f. are broken and two of them have been rejuvenated. Study of large numbers of specimens from the Jefferson City Dolomite is needed to document the range of variation within the form species.

S. cornutiformis s.f. is distinguished from *S. rex* s.f. by the more expansive basal cavity and more laterally compressed base of the former. Both features are the result of the posterior expansion of the base.

OCCURRENCE-S. *cornutiformis* s.f. is present in the Jefferson City Dolomite of Missouri (Branson and Mehl, 1933) and in the El Paso. Other possible occurrences are in the Joins Formation of Oklahoma (McHargue, 1974), the Cool Creek Formation of Oklahoma (Mound, 1968), and the Fillmore Formation of Utah (Ethington and Clark, 1971). The El Paso specimens are in samples SD/700, 720, 760, 800, and 1,102.

NUMBER OF SPECIMENS-1 16.

REPOSITORY-UMC 1066-20, 1067-1.

Scolopodus emarginatus Barnes and Tuke s.f.
P1. 22, fig. 3

Paltodus n. sp. Mehl and Ryan, 1944, pl. 7, figs. 17, 18.

Scolopodus emarginatus Barnes and Tuke, 1970, p. 91-92, pl. 18, figs. 2, 6-8; text fig. 6C.

DISCUSSION-Barnes and Tuke (1970) gave an excellent description of *S. emarginatus* s.f. Most of the El Paso specimens of this distinctive form are slightly asymmetrical bilaterally.

OCCURRENCE-S. *emarginatus* is present in the Jefferson City Dolomite (Mehl and Ryan, 1944), the St. George Formation of Newfoundland (Barnes and Tuke, 1970), the upper West Spring Creek Formation (Potter, 1975), and the El Paso. The Scenic Drive specimens are in samples SD/720-861, 900-940, 980, 1,180, and 1,300-1,332.

NUMBER OF SPECIMENS-43.

REPOSITORY -UMC 1067-14.

Scolopodus filosus Ethington and Clark s.f.
Pl. 22, fig. 2

Scolopodus filosus Ethington and Clark, 1964, p. 699, pl. 114, figs. 12, 17-19; text fig. 2E; Ethington and Clark, 1965, p. 200; Jones, 1971, p. 63, pl. 5, figs. 9-11; pl. 6, fig. 1.

?Scolopodus filosus Ethington and Clark. Mound, 1968, in part, p. 418, pl. 5, figs. 16, 20, 25, 28, 33, 39, 59 [*non* pl. 5, figs. 45, 46, =*S. gracilis*].

non Scolopodus filosus Ethington and Clark. Mound, 1965, p. 34, pl. 4, figs. 27, 32 [= *S. gracilis*].

?Scolopodus cf. *S. filosus* Ethington and Clark. Cooper and Druce, 1975, p. 576, fig. 32.

DISCUSSION-The original description of this form species is more than adequate. The size of the costae of *S. filosus* s.f. shows a range of variation. Most specimens have the hairlike costae described by Ethington and Clark (1964), but some have costae that are much larger. Even on those specimens that have larger costae, the costae are still only about half as large as the costae on, for example, *Scolopodus rex* s.f., which is somewhat similar in overall morphology to *S. filosus* s.f.

The specimen figured by Cooper and Druce (1975, fig. 32) has a stronger degree of basal curvature than do typical representatives of *S. filosus* s.f. Also, the New Zealand specimen does not have a circular cross section; rather, it is compressed laterally.

OCCURRENCE-S. *filosus* s.f. has been recorded from Texas (Ethington and Clark, 1964; this paper), Alberta (Ethington and Clark, 1965), northwestern Australia (Jones, 1971), Missouri (Moore, 1970), possibly Oklahoma (Mound, 1968), and New Zealand (Cooper and Druce, 1975). The Scenic Drive specimens are in samples SD/240, 280-440, 480-520, 580-700, 740-920, 980, 1,000, 1,140, 1,220, 1,279, 1,315, and 1,342.

NUMBER OF SPECIMENS-502.

REPOSITORY-UMC 1061-20.

Scolopodus filosus xyron n. subsp. s.f.
Pl. 22, figs. 1, 6

DISCUSSION-These elements of *S. filosus* s.f. are laterally compressed posteriorly so that they have a sharp posterior margin. They also may be laterally twisted somewhat, analogous to the twisting of *S. rex paltodiformis* s.f. The cross section above the base is a broad comma shape, with a round anterior margin, tapering posteriorly along convex lateral faces to the sharp posterior edge.

DERIVATION OF *NAME-xyron* [Gr. (n.) = razor], referring to the sharp posterior margin of this form.

OCCURRENCE-Samples SD/440 and 480.

NUMBER OF SPECIMENS-29.

REPOSITORY-UMC 1065-14 (holotype), 15.

Scolopodus floweri n. sp.
Pl. 24, figs. 7, 9, 10; pl. 25, figs. 1, 4

Elements of this species are robust costate hyaline cones having two to four major costae and usually other minor costae. The cusp is reclined to erect, sharply bent in the region of the cusp-base junction, and then only gently recurved distally. The base is somewhat flared posteriorly and the basal margin forms a smooth rim as the costae arise just above the margin. The basal cross section is ovoid to comma shaped; if comma shaped, then the basal margin is widest at the rounded posterior and the apex is located on the inner anterior corner where the largest costa reaches the base. The basal cavity is directed anteriorly and has its apex near the anterior margin. The basal margin is convex in side view.

The symmetry-transition series includes scandodiform elements possessing only two major costae, multicostate elements having four major costae (two anterolateral and two posterolateral) and bilateral symmetry, and forms intermediate between these end members. Above the basal region, the anterior or anterolateral face (outer lateral face of scandodiform elements) is convex; all other intercostal areas are concave. Major costae have their sharp edges directed posteriorly or posterolaterally. Minor costae may be present, but these are confined to the basal region and to the proximal part of the cusp. The inner anterolateral costa is developed most strongly; most specimens show a thickening of the basal rim immediately anterior to the point where this costa meets the basal rim.

DISCUSSION-This species of *Scolopodus* shows the same symmetry-transition series as that shown by *S. rex paltodiformis*. *S. floweri* is more robust than the latter, and the costae on any element of *S. floweri* are more unequal in size. These two species are otherwise very similar, although whether this similarity is because of a close relationship or to homeomorphy between species is unknown at this time.

DERIVATION OF NAME-After R. H. Flower, who has contributed so much to our knowledge of the El Paso Group.

OCCURRENCE-Present in samples SD/100, 360-440.
NUMBER OF SPECIMENS-134.

REPOSITORY -UMC 1060-16, 18 (holotype), 19, 1061-2, 4.

Scolopodus gracilis Ethington and Clark
Pl. 22, figs. 5, 8-11

GRACILIFORM element:

Scolopodus gracilis Ethington and Clark, 1964, p. 699, pl. 115, figs. 2-4, 8, 9; text fig. 2D, G; Ethington and Clark, 1965, p. 200; Mound, 1968, in part, p. 418, pl. 5, figs. 52, 53 (? pl. 5, figs. 29-31, 34-38, 40, 42-44); Barnes and Tuke, 1970, p. 92, pl. 18, figs. 11, 12; text fig. 6E; Uyeno and Barnes, 1970, p. 116, pl. 22, figs. 9, 10; Ethington and Clark, 1971; pl. 2, figs. 3, 9; Ethington, 1972, p. 20, table 1; Barnes and Poplawski, 1973, in part, p. 786-787, pl. 3, figs. 6, 7; text fig. 2G; Barnes, 1974, p. 226-228, pl. 1, fig. 2.

?*Scolopodus gracilis* Ethington and Clark. Druce and Jones, 1971, p. 92, pl. 17, figs. 5a-7d; pl. 18, fig. 5a-d; text fig. 30C; Jones, 1971, p. 63-64, pl. 6, fig. 2; Barnes and Poplawski, 1973, in part, p. 786787, pl. 3, fig. 8; text fig. 2H.

Scolopodus striolatus Harris and Harris, 1965, p. 38-39, p1. 1, fig. 6.

Scolopodus filosus Ethington and Clark. Mound, 1965, p. 34, pl. 4, figs. 27, 32; Mound, 1968, in part, p. 418, pl. 5, figs. 45, 46 (? pl. 5, figs. 16, 20, 25, 28, 33, 39, 59).

TRIANGULARIFORM element:

Scolopodus triangularis Ethington and Clark, 1964, p. 700, pl. 115, figs. 6, 11, 13, 17; text fig. 2-I; Ethington and Clark, 1965, p. 201; Mound, 1968, p. 420, pl. 6, figs. 30-38, 40.

? *Scolopodus triangularis* Ethington and Clark. Abaimova, 1975, p. 104-105, pl. 9, fig. 16; text fig. 8 (20).

ASYMMETRICAL TRIANGULARIFORM element:

The element is laterally compressed. One side is flat or has a narrow groove immediately adjacent to a slightly swollen, round anterior edge. Along the midline on the opposite side is a sharp, or sharply rounded, posterolaterally directed costa, posterior to which is a deep, sharp groove. Along this side also may be a thin groove just posterior to the rounded anterior edge. The posterior edge of the cusp is sharp. The basal margin is compressed laterally and is widest anteriorly. The basal cavity is low and has its apex near the anterior margin.

DISCUSSION-In essence, the asymmetrical triangulariform element is a laterally flattened *Scolopodus triangularis* s.f. One of the posteriorly directed costae, instead of being in a posterolateral position, is, on this element, located on one side almost at the midline.

The form species *S. gracilis* s.f. and *S. triangularis* s. f. have been described adequately by Ethington and Clark (1964). Barnes and Poplawski (1973) felt that *S. gracilis* s.f. is gradational into, and conspecific with, *S. triangularis* s.f. After studying hundreds of specimens of each form, I agree that the two forms are intergradational. However, I have continued to identify the two forms separately in order to compare relative ranges and ratios. In addition, I think that the above described asymmetrical triangulariform is an element of this grouping.

OCCURRENCE-This species is widespread in the Lower Ordovician of North America. Its distribution in the El Paso is as follows: graciliform elements-SD/240, 260, 300-440, 480-800, 861-1,020, 1,140, 1,180, 1,220, and 1,260-1,342; triangulariform elements-SD/180-420, 480, 520, 560-621, 680-1,000, 1,140-1,180, 1,260- 1,315, and 1,342; asymmetrical triangulariform elements-SD/240, 300, 320, 400, 760, and 821.

NUMBER OF SPECIMENS -Graciliform elements-811; triangulariform elements-560; asymmetrical triangulariform elements-44.

REPOSITORY -UMC 1061-10 through 14.

Scolopodus kelpi n. sp. s.f.
Pl. 22, fig. 12

These elements are smoothly recurved, laterally compressed cones having a short base and several prominent costae on each lateral face. The cusp and base cross section is scandodiform and is sharp anteriorly and posteriorly. The base is short and low; the anterior end is drawn out somewhat so that the anterobasal angle is acute. Two to at least six prominent, evenly spaced, posteriorly pointing costae run up each lateral face, arising just above the basal margin. The basal cavity is quite low; the cavity profile is asymmetric, with long posterior stretch, and with the tip near the anterior margin. The cusp is smoothly but not strongly recurved except for the basal part of the anterior margin, which is drawn out anteroaborally.

DISCUSSION-S. *kelpi* s.f. resembles *S. rex* s.f. and *S. cornutiformis* s.f. in its overall shape and costation, but *S. kelpi* s.f. has a scandodiform, rather than circular or oval, cross section. *Walliserodus* Serpagli (1974) has more prominent costae and also a rounded cross section. *Scolopodus* n. sp. 1 s.f. has a higher basal cavity. *Scolopodus kelpi* s.f. is placed in that form genus because of its costation and anteriorly directed basal cavity.

DERIVATION OF *NAME-kelpi*, from television station KELP, whose management granted me access to their road, and under whose transmission tower the Scenic Drive section is located.

OCCURRENCE-Samples SD/340 and 360.

NUMBER OF SPECIMENS-3.

REPOSITORY —UMC 1065-1 (holotype).

Scolopodus parabruptus n. sp. s.f. P1. 22, figs. 4, 7

Scolopodus cornutiformis Branson and Mehl. Ethington and Clark, 1964, in part, p. 698-699, pl. 114, fig. 16 only.

Scolopodus filosus Ethington and Clark, 1964, in part, p. 699, pl. 114, fig. 18 only.

The element's cusp is proclined to erect above a posteriorly expanded base. The cusp is subcircular in cross section and bears two strong longitudinal, posteriorly directed, lateral costae running from the basal margin to the distal end of the cusp. These two costae may be located symmetrically or slightly asymmetrically bilaterally on the lateral faces, and one costa may be developed more strongly than the other. The anterior face of the unit may bear several costae which may be nearly as prominent as the lateral costae on the base but which die out on the basal part of the cusp; the medial and distal part of the cusp therefore has a smooth convex anterior face. The posterior face of the unit is convex and is ornamented with fine striae or fine costae which extend to the distal end of the cusp.

The base is slightly expanded posteriorly. The basal margin is thin and has an oval to circular cross section. The postero-oral angle is 90 degrees or less; the antero-oral angle is 90 degrees to slightly obtuse. The basal cavity is deep and conical; in profile, the cavity sides are straight and the posterior side is longer than the anterior one. The cavity tip is near the anterior margin at the base-cusp juncture. Above this juncture, the cusp is white matter.

Some elements have a cusp that is lanceolate in cross section, the long dimension being lateral. These forms have a smooth anterior face.

DISCUSSION-The strong lateral costae and the cusp being albid above a hyaline base are the distinctive features of *S. parabruptus* s.f. This form is similar to *S. rex* s.f. in shape and is distinguished from the latter by the white cusp and by the strongly developed lateral costae on *S. parabruptus* s.f. In the abrupt development of white matter above the cusp, *S. parabruptus* s.f. is similar to *S. abruptus* s.f. The two forms differ in costation and basal cavity shape, *S. parabruptus* s.f. having a more symmetrically conical cavity than does *S. abruptus* s f.

DERIVATION OF *NAME parabruptus* (para [Gk.] = akin to), referring to the similarity of this form to *S. abruptus* s.f. This specific name was used in a manuscript by Moore (1970).

OCCURRENCE-*S. parabruptus* s.f. was recovered from shale associated with the Jefferson City Dolomite of Missouri (Moore, 1970). Ethington and Clark (1964) figured two specimens of this species, identified as *S. cornutiformis* and *S. filosus* s.f. The specimens recovered in this study are in samples SD/300, 320, 580, 600, 640-720, 760-1,020, 1,060, 1,140-1,180, 1,260, and 1, 315.

NUMBER OF SPECIMENS —Subcircular cusp elements-210; lanceolate cusp elements-32.

REPOSITORY —UMC 1063-17 (holotype), 18.

Scolopodus aff. S. parabruptus n. sp. s.f. Pl. 23, fig. 3

This element consists of a smoothly recurved cusp having an asymmetrical cross section above a tall base. The element is characterized by a prominent laterally directed costa running along the inner anterolateral edge. The costa arises at the basal margin and is most prominent in the region of greatest curvature of the unit. A narrow groove is immediately posterior to this costa. A second costa runs along the outer postero-lateral edge of the unit. This costa is directed posteriorly and may be nearly as large as the anterolateral costa or it may be only weakly developed and restricted to the cusp above the basal region. The cusp cross section is rounded across the anterior face, outer anterolateral, and inner posterolateral faces. The base is rather tall and has an ovoid cross section modified by the presence of the costae. Aborally, the base is slightly expanded posteriorly. The basal margin is straight in profile. In cross section, the basal margin is oval in most specimens; costae modify the basal cross section on robust specimens. The basal cavity is tall and expansive, and its apex is near the anterior margin. The basal region is striated longitudinally. The cusp is made of white matter.

DISCUSSION-This form is quite similar to *Scolopodus parabruptus* s.f. The latter form species differs in that it is bilaterally symmetrical. Except for its marked asymmetry and gentle recurvature, *S.* aff. *S. parabruptus* s.f. is similar also to *Protopanderodus leonardii* as found in this collection. The overall morphology of this new form resembles that of *Paltodus bassleri* s.f., except that elements of the former are striated basally and bear longer cusps.

OCCURRENCE-Samples SD/700, 800-880, 940, 1, 140, and 1,300.

NUMBER OF SPECIMENS-42.

REPOSITORY -UMC 1129-3 .

Scolopodus carlae n. sp. s.f. Pl. 23, figs. 1, 2

The element's cusp is lanceolate and compressed anteroposteriorly above a small circular base. The basal rim is circular in cross section; the basal cavity is conical and its tip is directed orally. The cusp is reclined or slightly recurved above the basal rim. Lateral width increases rapidly above the base so that the base of the cusp is one and a half to two times wider than the basal rim. Above the widest point, the cusp tapers gently to the distal tip. In posterior view, the lateral edges of the cusp are strongly convex basally in the region of greatest expansion of width and are gently convex from the widest point to the tip. The anterior face is smoothly convex. The lateral edges are directed slightly postero-laterally. The posterior face is nearly flat, with very low median carina and very shallow grooves flanking the carina. The cusp consists of white matter above the widest point and is hyaline basally. The cusp is finely and evenly striated longitudinally; striae on the posterior face are coarser than those on the anterior.

DISCUSSION-I have placed this new distinctive form in *Scolopodus* because of its longitudinal striation, circular basal margin, and conical basal cavity whose apex is near the anterior margin. *S. carlae* s.f. is unusual in its constricted base and in being compressed anteroposteriorly; it differs from *Protopanderodus asymmetricus* in being bilaterally symmetrical.

DERIVATION OF NAME-After Carla Wilson Potter who recovered specimens of *S. carlae* s.f. in Oklahoma.

OCCURRENCE-*S. carlae* s.f. occurs in the Jefferson City Dolomite of Missouri (collection of Arthur Moore, unreported), the Ninemile Formation of Nevada (R. L. Ethington, personal communication, 1975), the West Spring Creek Formation of Oklahoma (Potter, 1975), and the El Paso at Scenic Drive, in samples SD/720821, 861, 880, 1,158, 1,260, 1,300, 1,332, and 1,342.

NUMBER OF SPECIMENS-32.

REPOSITORY -UMC 1067-5, 6 (holotype).

Scolopodus pseudoquadratus Branson and Mehl s.f. P1. 23, fig. 7

Scolopodus pseudoquadratus Branson and Mehl, 1933, p. 63, p1. 4, fig. 19; Graves and Ellison, 1941, p. 4, pl. 1, fig. 14; Lee, 1970, p. 333, pl. 8, figs. 10a, b.

non Scandodus pseudoquadratus (Branson and Mehl). Abaimova, 1975, p. 97-98, pl. 9, figs. 8-10; text figs. 8 (5, 7, 8, 9, 11).

DISCUSSION-The El Paso specimens assigned here compare very well with the holotype of *S. pseudoquadratus* s.f.

The forms illustrated as *Scandodus pseudoquadratus* (Branson and Mehl) by Abaimova (1975) are too strongly recurved, and it appears that their lateral costae do not extend to the basal margin as they do on *Scolopodus pseudoquadratus.*

OCCURRENCE-This form species has been reported from Missouri (Branson and Mehl, 1933), Korea (Lee, 1970), and Texas (Graves and Ellison, 1941; this report). The El Paso Group specimens are in samples SD/ 621, 740, 760, 821, 839, 940-980, 1,180, 1,220, and 1, 260-1,300.

NUMBER OF SPECIMENS-17.

REPOSITORY -UMC 1066-5.

Scolopodus aff. S. pseudoquadratus Branson and Mehl s.f. Pl. 23, fig. 9

aff. *Scolopodus pseudoquadratus* Branson and Mehl, 1933, p. 63, pl. 4, fig. 19.

This element is identical with *S. pseudoquadratus* s. f. except that it lacks one posterolateral costa. That posterolateral region lacking a costa is smooth and rounded.

DISCUSSION-S. aff. *S. pseudoquadratus* s.f. is probably involved in a symmetry-transition series with *S. pseudoquadratus* s.f., but both forms are too rare in my collections to document such a series.

OCCURRENCE-Samples SD/760, 821, 839, and 1, 140.

NUMBER OF SPECIMENS-5.

REPOSITORY -UMC 1068-13.

Scolopodus quadraplicatus Branson and Mehl s.f. P1. 23, figs. 4, 5

Scolopodus quadraplicatus Branson and Mehl, 1933, p. 63, pl. 4, figs. 14-15; Barnes and Tuke, 1970, p. 93, pl. 18, figs. 13-14, 17, text fig. 6F [synonymy through 1968]; Moskalenko, 1967, p. 114-115, pl. 25, figs. 3-5; Ethington and Clark, 1971, p. 73, pl. 2, fig. 5; Greggs and Bond, 1971, p. 1,468-1,469, pl. 2, figs. 3-6b; Moskalenko, 1973, pl. 15, fig. 13; Repetski and Ethington, 1977, p. 96-97, 100, pl. 2, fig. 15.

non Scolopodus quadraplicatus Branson and Mehl. Druce and Jones, 1971, p. 93-94, pl. 18, figs. 6a-7c; text fig. 30f; Jones, 1971; p. 65, pl. 6, fig. 6.

Scolopodus variabilis Ethington and Clark, 1964, in part, p. 701, pl. 115, fig. 16 only.

? *Scolopodus* cf. *S. quadraplicatus* Branson and Mehl. Cooper and Druce, 1975, p. 578, fig. 25.

? *Scolopodus quadraplicatus* Branson and Mehl. Abaimova, 1975, p. 103-104, pl. 9, figs. 11, 14; text fig. 8 (16, 21, 23).

DISCUSSION-Scolopodus *quadraplicatus* s.f. is one of the most common forms in the Scenic Drive section above the lowermost beds.

The specimen figured by Cooper and Druce (1975, fig. 25) as *S.* cf. *S. quadraplicatus* is probably not conspecific with *S. quadraplicatus* s.f. The authors pointed out that their specimens have an offset posterior groove and their illustrated specimen is smoothly recurved, whereas typical *S. quadraplicatus* s.f. specimens are rather strongly recurved at the cusp-base junction and are only slightly curved distally.

The published illustrations do not show whether Abaimova's (1975) specimens are conspecific with *S. quadraplicatus* s.f. One specimen (pl. 9, fig. 11) has a smaller base and another (pl. 9, fig. 14) has a more expanded base than that of typical *S. quadraplicatus* s.f.

OCCURRENCE-S. *quadraplicatus* s.f. is found in many Lower Ordovician sections in North America as well as being present in Siberia (distribution summarized in Ethington and Clark, 1971). It is in my samples SD/180, 240, 260, 320, 360, 400, 420, 480-1,000, 1, 060, and 1,102.

NUMBER OF SPECIMENS-624.

REPOSITORY -UMC 1060-14, 15.

Scolopodus rex Lindström s.f. Pl. 23, fig. 6

Scolopodus rex Lindström, 1955, p. 595-596, pl. 3, fig. 32; Lee, 1970, p. 334, pl. 8, figs. 8, 9; Bergström and others, 1972, p. D38, pl. 1, fig. b; ? Ethington, 1972, p. 22, pl. 1, fig. 17; Serpagli, 1974, p. 86-87, pl. 17, figs. la-3b; pl. 28, fig. 10; Lee, 1975a, p. 89, pl. 2, fig. 13; text fig. 4-I.

Scolopodus cornutiformis Branson and Mehl. Ethington and Clark, 1965, p. 200, pl. 1, fig. 10 (?), 12; Ethington and Clark, 1971, p. 73, pl. 2, figs. 21, 22.

Scolopodus aff. *S. cornutiformis* Branson and Mehl. Barnes and Poplawski, 1973, p. 786, pl. 1, figs. 9-10.

? *Scolopodus rex* Lindström. Abaimova, 1975, p. 104, pl. 9, figs. 12, 15, 17, 20, 21; text figs. 8 (22, 26).

? *Scolopodus* sp. Abaimova, 1975, p. 106, 107, pl. 9, figs. 13, 18; text figs. 8 (32, 33).

DISCUSSION-This form species has been well described by Lindström (1955) and by Serpagli (1974).

S. rex s.f. is very similar to, and may be related to, *S. cornutiformis* Branson and Mehl. Both are hyaline forms, have similar costation patterns, and have a similar stratigraphic range. *S. cornutiformis* is recurved somewhat more strongly than is *S. rex*, and the costae of the former die out about halfway up the cusp. Unfortunately, none of the three cotypes of *S. cornutiformis* s.f. is well preserved; they all have broken basal margins and possibly have been partially resorbed distally. Two of the three also appear to have been broken and partially rejuvenated.

The distinguishing features between these two forms are: 1) *S. cornutiformis* s.f. is more strongly recurved than is *S. rex* s.f.; 2) the costae of *S. rex* s.f. continue to the apex of the cusp; 3) the base of *S. rex* s.f. usually shows a slight constriction at the basal margin, whereas *S. cornutiformis* s.f. does not appear to have this constriction; and 4) the basal cavity of *S. cornutiformis* s.f. appears to be larger and deeper than that of *S. rex* s.f., although the details of the cavity cannot be seen well in most of my specimens.

S. rex s.f. may be part of a symmetry-transition series involving *S. rex paltodiformis.* This transition series is discussed under the latter form subspecies.

OCCURRENCE-S. *rex* s.f. has a widespread distribudon, having been reported from Sweden (Lindström, 1955), Pennsylvania (Bergstrom and others, 1972), Nevada(?) (Ethington, 1972), Argentina (Serpagli, 1974), Utah and Arizona (Ethington and Clark, 1971), Korea (Lee, 1975a), possibly Siberia (Abaimova, 1975), and Canada (Ethington and Clark, 1965). The Scenic Drive specimens are in samples SD/180, 260-360, 400, 621, 700-740, 800, 861-900.

NUMBER OF SPECIMENS-136.

REPOSITORY-UMC 1061-9.

Scolopodus rex paltochformis Lindström s.f., emended herein

Pl. 23, figs. 8, **10, 11;** pl. 24, fig. 2

Scolopodus rex paltodiformis Lindstrom, 1955, p. 596, pl. 3, figs. 33, 34; Ethington, 1972, p. 22, pl. 1, fig. 18.

This is a symmetry-transition series consisting of costate simple cones whose cusp cross sections range from subcircular to lanceolate. The lanceolate end members are scandodiform in appearance. They have a slightly twisted bladelike cusp above a base whose aboral margin is bluntly biconvex. The aboral margin is widest near or at midlength. The inner face of the cusp is only slightly convex, but the outer face is markedly so. The bladelike cusp has anterior and posterior keels. Immediately posterior from the anterior keel on the outer face is a costa that may be very faint on the most distinctly scandodiform specimens. Most of these forms, however, have a sharp costa in that position, and others have one or more faint costae on the inner face of the cusp. Still other elements possess as many as three costae on the outer cusp face in an anterolateral position.

The other elements (paltodiform) have subcircular basal cross sections. In general, this form has an asymmetrical cusp that is twisted above the base, very much like the scandodiform elements. The cusp of this form is keeled along its posterior margin, but it has a rounded anterior margin. The anterior part of the cusp is costate; two or three sharp costae are on each face of this anterior part. The most anterior of these costae are the most strongly developed, and they decrease in size posteriorly. As it is on the scandodiform elements, the cusp of these asymmetrical costate forms is much more strongly convex on the outer face.

DISCUSSION-These two end members (scandodiform and paltodiform) grade into each other, and the form with the rounded basal section *(S. rex paltodiformis sensu* Lindström) appears to be transitional into *S. rex* s. f. If this lateral transition is indeed real, then there is no need to distinguish these more asymmetrical elements from *S. rex* s.f. However, I choose to distinguish all three forms until more is known of their stratigraphic ranges and geographic distribution.

OCCURRENCE-S. *rex paltodiformis* is known only from Sweden (Lindström, 1955), Nevada (Ethington, 1972), and Texas. The El Paso specimens were found in samples SD/180, 240-340, 400, 480-520, 580-621, 660, 700-760, 800, 839, 861, 900, 940, 980, and 1,180.

NUMBER OF SPECIMENS -Scandodiform elements-83; paltodiform elements-137.

REPOSITORY-UMC 1061-5 through 8.

Scolopodus sexplicatus Jones s.f.

P1. 24, fig. 3

Scolopodus sexplicatus Jones, 1971, p. 65-66, pl. 5, figs. 4, 5, 7, 8; pl. 9, figs. 4a-c; text figs. 16a-c.
? Scolopodus sexplicatus Jones. Cooper and Druce, 1975, p. 578, fig. 29.
? Paltodus sexplicatus (Jones). Abaimova, 1975, p. 91-92, pl. 8, figs. 1, 2; text figs. 7-31, 39.

DISCUSSION-This form species possibly is a member of the symmetry-transition series which also includes *Acodus oneotensis* s.f. and *Scolopodus sulcatus* s.f. *S. sexplicatus* s.f. may be ancestral to forms here identified as *S. rex* s . f. and *S. rex paltodiformis* s . f.

The specimen illustrated by Cooper and Druce (1975, fig. 29) appears to be more drawn out at its anterobasal and posterobasal angles than are the specimens illustrated by Jones (1971). The Siberian specimens figured by Abaimova (1975) as *Paltodus sexplicatus* appear to have too large a base to be *S. sexplicatus.*

OCCURRENCE-The element is rare in the Pander Greensand and the Jinduckin Formation of northwestern Australia (Jones, 1971). El Paso representatives were recovered in samples SD/60, 80, and 100.

NUMBER OF SPECIMENS-13 .

REPOSITORY --UMC 1059-13.

Scolopodus sulcatus Furnish s.f.

Pl. 24, figs. 6, 8

Scolopodus sulcatus Furnish, 1938, p. 334, pl. 41, figs. 14, 15; text fig. II.

DISCUSSION-Several specimens in the El Paso collection conform with Furnish's (1938) description of *Scolopodus sulcatus* s.f. This form species probably is a member of the symmetry-transition series that includes *Acodus oneotensis* s.f. and probably also *Scolopodus sexplicatus* Jones s.f. (Jones, 1971).

OCCURRENCE-S. *sulcatus* has been reported previously only from the Blue Earth beds in Minnesota

(Furnish, 1938). The El Paso specimens are in samples SD/40, 60, 100, 180, and 260.

NUMBER OF SPECIMENS-48.

REPOSITORY-UMC 1060-9, 10.

Scolopodus triplicatus Ethington and Clark s.f. Pl. 24, figs. 1, 4

Scolopodus triplicatus Ethington and Clark, 1964, p. 700-701, pl. 115, figs. 20, 22-24; text fig. 2c; Mound, 1968, p. 420, pl. 6, figs. 39, 41-60, 63-65; Druce and Jones, 1971, p. 96, pl. 18, figs. la-4d; text fig. 30i, j; Greggs and Bond, 1971, p. 1,469, pl. 2, figs. 7-9.
non Scolopodus triplicatus Ethington and Clark. Jones, 1971, p. 68, pl. 7, figs. la-3b; pl. 9, fig. 7.
non Scolopodus aff. *triplicatus* Ethington and Clark. Abaimova, 1975, p. 105-106, pl. 10, figs. 1, 2, 4, 5; text fig. 8 (24, 25).

DISCUSSION-This form species may yet prove to be part of the apparatus that includes *S. quadraplicatus* s.f., although the latter has been recorded from several localities that apparently do not yield *S. triplicatus* s.f. Because many elements of *S. triplicatus* s.f. from the El Paso have a slight flattening of the cusp along the non-grooved side, sometimes even becoming a very shallow groove distally, I suspect that these two forms are transitional with each other.

The figured specimens of Jones (1971), identified as *S. triplicatus* s.f., have grooves which extend to the basal margin, and they lack a subcircular basal margin. *S. triplicatus* s.f. has a circular basal cross section, and its grooves die out proximally. The specimens compared with *S. triplicatus* s.f. by Abaimova (1975) have bases which are too large for that form species.

OCCURRENCE-S. *triplicatus* s.f. occurs in the Cool Creek Formation of Oklahoma (Mound, 1968), in Queensland (Druce and Jones, 1971), in the March Formation in southeast Ontario (Greggs and Bond, 1971), and in the El Paso (Ethington and Clark, 1964; this report). My specimens are in samples SD/180, 240, 480640, 680-1,000, 1,040, 1,060, and 1,260.

NUMBER OF SPECIMENS-370.

REPOSITORY-UMC 1061-16, 17.

Scolopodus variabilis Ethington and Clark s.f. P1. 24, fig. 5

Scolopodus variabilis Ethington and Clark, 1964, in part, p. 701, pl. 115, figs. 14, 15, 19 (*non* pl. 115, fig. 16, = *S. quadraplicatus* s.f.).
Scolopodus robustus Ethington and Clark, 1964, p. 700, pl. 113, fig. 7; pl. 115, figs. 18, 21; text fig. 2A.

DISCUSSION-S. *variabilis* s.f. is quite similar to *S. quadraplicatus* s.f. in all respects except that the two posterolateral costae of the former species are smaller than are the anterolateral costae. *S. variabilis* s.f. might be a variety of *S. quadraplicatus* s.f. This form has been recognized only in the El Paso (Ethington and Clark, 1964; this report).

Scolopodus robustus s.f. appears to be within the range of variability of *S. variabilis* s.f. and I have placed it in synonymy with the latter. I chose *S. variabilis* s.f. as the name for this species because *S. robustus* s.f. is near the extreme in the range of variation seen in the studied specimens.

OCCURRENCE-S. *variabilis* s.f. has been reported only from the El Paso (Ethington and Clark, 1964; this report). I recovered the form species in samples SD/580, 600, 640-760, 800-960, 1,000, 1,020, 1,060, 1, 180, 1,260, and 1,279.

NUMBER OF SPECIMENS-191.

REPOSITORY-UMC 1066-8.

Scolopodus n. sp. 1 s.f. P1. 25, fig. 3

The element has an erect cusp that is not compressed above a short, aborally flared base. The cusp possesses six costae; three sharp costae, one each at the anterolateral corners and one located posteriorly, that are slightly larger than the other three costae. Two additional sharp costae are located posterolaterally between the posterior and anterolateral costae. The anterior face possesses a rounded median costa. The cusp cross section is bilaterally symmetrical. The base is flared at the margin and this basal margin is rounded-triangular in cross section, with one rounded apex anterior, a second lateral, and the third posterolateral. The basal cavity has its apex anterior of the midpoint in the basal part of the cusp; in lateral view, the cavity sides are concave upward because of flaring toward the basal margin.

OCCURRENCE-One specimen, in sample SD/260.

NUMBER OF SPECIMENS-1.

REPOSITORY -UMC 1062-15 .

Scolopodus n. sp. 2 s.f. P1.25, fig. 2

The element has an anteroposteriorly compressed blade with a posterior median costa and is recurved above a low base that has a circular cross section. The basal cavity is conical and directed anteriorly; the apex is near the anterior margin of the lower part of the cusp. The base is expanded somewhat near the aboral margin. The anterior face of the cusp is smoothly convex. A lateral costa runs from the base to the tip on each side of the element and the costae are directed posterolaterally. Along the lower half of the cusp, each costa has an adjacent (posteriorly) costa that is thin and sharp and that merges with the cusp edge about two-thirds of the way up the cusp. The posterior face possesses a strong median carina above the base. The carina is flanked on either side by a rather deep groove, which is deepest in the region of greatest curvature of the element. The unit is finely striated longitudinally.

DISCUSSION-S. n. sp. 2 s.f. differs from the lanceolate form of *S. parabruptus* s.f. in that the posterior face of the former is grooved and much more prominently carinate. *S.* n. sp. 2 s.f. has distinctive double or split lateral costae at least along a part of the cusp. *Acontiodus propinquus* s.f. has the same general morphology, but *S.* n. sp. 2 s.f. has a more gentle distal tapering, longitudinal striations, a taller base, and a deeper basal cavity.

OCCURRENCE-Samples SD/740 and 861.
NUMBER OF SPECIMENS-2. REPOSITORY -UMC 1067-4.

GENUS *SPATHOGNATHODUS* Branson and Mehl, 1941
TYPE SPECIES: *Ctenognathus murchisoni* Pander, 1856

"?*Spathognathodus* sp." Ethington and Clark s.f. Pl. 25, figs. 8-10

?*Spathognathodus* sp. Ethington and Clark, 1965, p. 201, pl. 2, fig. 5.
New Genus B Sweet and others, 1971, p. 168, pl. 1, fig. 34; Barnes, 1974, p. 229-230, pl. 1, fig. 9.
? *Loxodus asiaticus* Abaimova, 1972, text fig. 1-64; Abaimova, 1975, p. 114-115, pl. 10, figs. 14, 17; text figs. 8 (38, 39).
Spathognathodus sp. Serpagli, 1974, p. 87-88, pl. 19, fig. 11; pl. 29, fig. 16.

These bladelike elements consist of a series of erect to slightly proclined, basally fused denticles. The units possess three to eight denticles and the denticles at midlength are largest. Denticles anterior of midlength are proclined slightly; the anteriormost denticle is wide and tonguelike anteriorly. The basal cavity is a small pit just anterior of the midlength. A shallow basal groove includes the pit and runs to the posterior end. The groove flares slightly laterally but becomes constricted laterally toward the posterior end. At the position of the basal pit, the basal groove splits; one side flares laterally, the other extends anterolaterally as a constricted groove. The anterior part of the base is formed by the edge of the anterior denticle.

DISCUSSION-This element shows morphological affinities with species of the genus *Cristodus*. The major difference between "?*Spathognathodus* sp." and *C. loxoides* is that the anterior edge of the former forms the anterior part of the basal edge; on *C. loxoides* this edge is erect. Other than this, and the difference in denticle inclination, the basal pit and groove of the two species are very similar.

Ethington and Clark (1965) and Serpagli (1974) have described this bladelike form. The anteroposterior orientation that I have used, based chiefly on morphology of the base, is opposite that used by these authors; that is, I believe that the denticles of "?*Spathognathodus* sp." are proclined, not reclined.

Loxodus asiaticus Abaimova (1975), from the upper part of the Chun'sk Stage in southeastern Siberia, may well be the same as, or at least related to, "?*Spathognathodus* sp.," but direct comparison of specimens is necessary before a firm determination is made.

OCCURRENCE-"?*Spathognathodus* sp." has been recovered from the Columbia Ice Fields section of Alberta, Canada (Ethington and Clark, 1965), the Wah Wah and Juab Formations of the Great Basin (Ethington and Clark, 1965; Sweet and others, 1971), high Arenig strata in Scandinavia (Lindström, 1960), the upper part of the Ship Point Formation in the Canadian Arctic (Barnes, 1974), and high in the West Spring Creek Formation of southern Oklahoma (Potter, 1975). The El Paso Group specimens are in samples SD/1,140 and 1,300-1,332.

NUMBER OF SPECIMENS-9.
REPOSITORY -UMC 1070-9, 10, 1083-18.

GENUS *TRIANGULODUS* van Wamel, 1974
TYPE SPECIES: *Paltodus volchovensis* Sergeeva, 1963

Triangulodus cf. *T. brevibasis* (Sergeeva) P1.25, figs. 5-7; pl. 26, figs. 1-4

cf. *Oistodus brevibasis* Sergeeva, 1963, p. 95, pl. 7, figs. 4, 5.
cf. *Triangulodus brevibasis* (Sergeeva). Van Wamel, 1974, p. 96-97, pl. 5, figs. 1-7.
cf. *Scandodus brevibasis* (Sergeeva). Lindström, 1971, p. 39-40, pl. 1, figs. 24-27; text fig. 3; Serpagli, 1974, p. 82-83, pl. 18, figs. 5-7; pl. 27, figs. 10, 11; pl. 30, figs. 2, 3; text fig. 21 (synonymy to date).

DISCUSSION -Lindström (1971) assigned to *S. brevibasis* "hyaline elements with rather slowly narrowing, curved, erect to recurved cusp, and an almost straight, conical basal cavity; the anterior and posterior margins of which may form an angle of about 60 degrees." Van Wamel (1974) then distinguished the genus *Triangulodus* from *Scandodus* and *Drepanoistodus* by the presence of roundyaform elements in the former.

Elements in the Scenic Drive material closely resemble the illustrations of the elements of *Triangulodus brevibasis* as figured by van Wamel and of *S. brevibasis* as figured by both Lindström (1971) and Serpagli (1974). On the drepanodiform element, the cusp rises above the base slightly more abruptly on the El Paso Group elements than on the figured Baltic and South American forms.

OCCURRENCE-Samples SD/700-940, 1,000, and 1,158-1, 279.

NUMBER OF SPECIMENS -Drepanodiform elements-117; trichonodelliform elements-115; erect scandodiform elements-210; oistodiform elements-301; acodiform elements-18; distacodiform elements-37.

REPOSITORY-UMC 1067-7 through 13.

GENUS *ULRICHODINA* Furnish, 1938 TYPE SPECIES: *Acontiodus abnormalis* Branson and Mehl, 1933

Ulrichodina abnormalis (Branson and Mehl) s.f. P1.26, fig. 9

Acontiodus abnormalis Branson and Mehl, 1933, p. 57, pl. 4, figs. 24-25.
Ulrichodina prima Furnish, 1938, p. 335, pl. 41, figs. 21, 22; text fig. 1A; Barnes and Tuke, 1970, p. 94, pl. 20, figs. 5, 6, 12; text fig. 6G; Greggs and Bond, 1971, p. 1,469-1,470, pl. 2, fig. 11.
Ulrichodina cristata Harris and Harris, 1965, p. 40-41, pl. 1, figs. 5a-d.
?*Ulrichodina prima* Furnish. Mound, 1968, p. 421, pl. 6, figs. 67, 68, 72.
Ulrichodina sp. Ethington and Clark, 1971, p. 76, pl. 2, fig. 18 only.

DISCUSSION-Comparison of the types of *U. abnormalis* s.f., *U. prima* s.f., and *U. cristata* s.f. indicates that these three forms are conspecific. The Jefferson City types do show indentation of the medial part of the anteroaboral margin, and although these specimens appear to have been abraded, they indicate that at least some of the specimens possess an anterior medial costa, as does the type of *U. cristata* s.f. This anterior costa, when present, may or may not die out before reaching the anterobasal margin; if it does reach this margin, the costa is less strongly developed there than it is distally.

OCCURRENCE-*U. abnormalis* s.f. has been reported from the Lower Ordovician of Missouri (Branson and

FIGURE 8-A-F- *Triangulodus cf. T. brevibasis* (Sergeeva). All x 58. A) Oistodiform element, lateral view. UMC 1067-7; **B)** Drepanodiform element, lateral view. UMC 1067-12; C) Acodiform element, outer lateral view. UMC 1067-9; D) Erect scandodiform element, lateral view. UMC 1067-13; E) Distacodiform element, lateral view. UMC 1067-8; F) Trichonodelliform element, posterior view. UMC 1067-10. *G-Ulrichodina* n. sp. 1 s.f. Lateral view, x 45. UMC 1060-11. *H-Ulrichodina* n. sp. 3 s.f. Lateral view, x 55. UMC 106811. **I, J-New** Genus A, n. sp. A. Posterolateral views, x 44. **I)** UMC 1058-18; J) UMC 1058-20. **K,** *L-Reutterodus andinus?* Serpagli. Inner lateral views. K) Conelike element, x 51. UMC 1071-7; L) Unibranched element, x 29. UMC 1071-6. *M-Oistodus* sp. s. f. Lateral view, x 29. UMC 1072-1. **N-New** Genus **B,** n. sp. s.f. Lateral view, x 60. UMC 1070-3. **0, P,** *R-Oepikodus?* n. sp. **0)** Oepikodiform element, x 59. UMC 1071-4; P) Trichonodelliform element, x 55. 1071-3; R) Oistodiform element, x 42. UMC 1071-1. *Q-Oistodus* cf. *0. pseudoramis* Serpagli s.f. Lateral view, x 55. UMC 1071-19. ***S-Scolopodus** sulcatus* Furnish s.f. Outer lateral view, x 58. UMC 1060-10. *T-Ulrichodina wisconsinensis* Furnish s.f. Lateral view, x 63. UMC 1065-9. *U-Scolopodus variabilis* Ethington and Clark s.f. Lateral view, x 64. UMC 1066-8. *V-Scolopodus* n. sp. 1 s.f. Anterior view, x 42. UMC 1062-15. *W-Scolopodus* n. sp. 2 s.f. Posterior view, x 55. UMC 1067-4. *X-Ulrichodina deflexa* Furnish s.f. Lateral view, x 43. UMC 1065-7.

Mehl, 1933), Wisconsin (Furnish, 1938), Newfoundland (Barnes and Tuke, 1970), Nevada (Longwell and Mound, 1967), Oklahoma (Harris and Harris, 1965; Mound, 1968; Potter, 1975), southeast Ontario (Greggs and Bond, 1971), and Utah (Ethington and Clark, 1971). The El Paso specimens are in samples SD/760, 800, 839-900, 940, 980, 1,279, 1,315, and 1,342.

NUMBER OF SPECIMENS-34.

REPOSITORY -UMC 1068-16.

Ulrichodina deflexa Furnish s.f. P1.26, fig. 10

Ulrichodina? deflexus Furnish, 1938, p. 335-336, pl. 41, figs. 23-24; text fig. 1-C.
Ulrichodina costata Mound, 1968, p. 421, pl. 6, figs. 61-62, 69. ?
Ulrichodina ? sp. cf. *U.? deflexus* Furnish. Mound, 1968, p. 421, pl. 6, fig. 66.
?Ulrichodina sp. Ethington and Clark, 1971, in part, p. 76, pl. 2, fig. 25 only *(non* fig. 18, = *U. abnormalis).*
non Ulrichodina sp. cf. *U. deflexus* Furnish. Jones, 1971, p. 70-71, pl. 7, figs. 9, 10.

DISCUSSION-I would add to Furnish's (1938) description of the holotype that *U. deflexa* s.f. possesses a posterior groove which is shallow on the base but well developed along the cusp. The presence of this posterior groove on the holotype infers that *U. costata* Mound (1968) is a junior synonym of *U. deflexa* s.f. because presence or absence of that feature was used as the distinguishing feature between the two species.

The illustrations of *U.?* sp. cf. *U.? deflexus* Mound (1968) and of *U.* sp. Ethington and Clark (1971; pl. 2, fig. 25) do not show the respective forms adequately for comparison, but both these forms may be conspecific with *U. deflexa* s. f.

The cusp of *U. deflexa* s.f. is very similar to that of *Scolopodus quadraplicatus* s.f.; indeed, the cusps of all species of *Ulrichodina* are *Scolopodus-like* in their hyaline structure and overall external morphology. Possibly the two form genera may be related.

U. sp. cf. *U.? deflexus* of Jones (1971) cannot be conspecific with *U. deflexa* s.f. because the former element is described as having a sharp posterior edge and no lateral grooves.

OCCURRENCE-*U. deflexa* s.f. is a rare conodont in collections that contain it. Furnish (1938) found only one specimen in the Shakopee Dolomite in Minnesota. It is probably also in the Fillmore Formation in western Utah and the Kindblade Formation in Oklahoma (Ethington and Clark, 1971), and it is in the Cool Creek Formation of Oklahoma (Mound, 1968). The Scenic Drive specimens are in samples SD/480, 520-560, and 680.

NUMBER OF SPECIMENS-5.

REPOSITORY-UMC 1065-7.

Ulrichodina wisconsinensis Furnish s.f. P1. 26, fig. 8

Ulrichodina wisconsinensis Furnish, 1938, p. 335, pl. 41, figs. 19, 20; text fig. 1-B.
non Ulrichodina wisconsinensis Furnish. Ethington and Clark, 1964, in part, p. 702, hypotype BYU 914.
?Ulrichodina wisconsinensis Furnish. Mound, 1968, p. 421, pl. 6, figs. 71, 74, 75.
cf. *Ulrichodina wisconsinensis* Furnish. Jones, 1971, p. 71, pl. 7, figs. 11, 12.

REMARKS-*U. wisconsinensis* s.f. may have a slightly inflated anterior margin marked by a shallow longitudinal groove on the lateral faces just anterior to the midline. It differs from *U.* n. sp. 1 s.f. by having a triangular basal cross section. The anterior face of *U. abnormalis* s.f. is flatter and may be keeled, and basal anterolateral parts of *U. abnormalis* s.f. are straight, whereas the anterior part of *U. wisconsinensis* s.f. is recurved slightly at the base-cusp juncture.

The specimen of *U. wisconsinensis* s.f. reported by Ethington and Clark (1964) has extensive white matter and sharp anterolateral costae, features not found on that species. Mound's (1968) illustrations of specimens identified as *U. wisconsinensis* s.f. are unintelligible. Jones' (1971) specimens may be conspecific with *U. wisconsinensis* s.f. if they have triangular basal cross sections. If they have ovoid basal cross sections, then these are probably *U.* n. sp. 1 s.f.

OCCURRENCE-This form occurs in the Shakopee Dolomite of Wisconsin (Furnish, 1938) and probably in the Pander Greensand of northwestern Australia (Jones, 1971). El Paso Group specimens are in samples SD/502, 520, 580, 760, 800, 821, 880, 940, 960, and 1,000.

NUMBER OF SPECIMENS-34.

REPOSITORY-UMC 1065-9.

Ulrichodina n. sp. 1 s.f. Pl. 26, fig. 5

The unit is broad anteroposteriorly, straight but reclined slightly, and has a wide basal margin. The anterior of the element is wide laterally and broadly rounded across the anterior face. Just anterior to the midline the cusp is constricted longitudinally; this constriction forms a groove running nearly parallel to the anterior margin. The posterior part of the cusp thins (laterally) to a keeled posterior margin. The basal margin is flared outward along the posterior part but continues aborally as a short aborally directed rim of the anterior face. The basal margin is subround in cross section. The basal cavity is wide and extremely shallow, having an apical pit centrally situated under the point of lateral constriction of the cusp.

DISCUSSION-This form is very similar to *Ulrichodina abnormalis* (Branson and Mehl). In the latter species, though, the basal cross section is triangular, and the anterior part of this basal margin is either indented or thickened centrally. *U.* n. sp. 1 could be ancestral to the ulrichodinans, which first appear somewhat higher in the section.

OCCURRENCE-Rare in sample SD/180, 360-400, 480, and 502.

NUMBER OF SPECIMENS-11.

REPOSITORY -UMC 1060-11.

Ulrichodina n. sp. 2 s.f. Pl. 26, fig. 6

The element's cusp is bilaterally symmetrical, with an anterior keel, posterior groove, and anterolateral and posterolateral rounded costae on each side. A shallow groove lies between the anterolateral and posterolateral costa on each lateral face of the cusp. Lateral grooves do not extend onto the base. The anterior face of the cusp carries a sharp median keel from the tip of the cusp to the basal margin. The basal margin is flared outward except at the anterior; the anterior portion of the margin is strongly depressed and indented under the base. The cross section of the basal margin is subcircular except for an anterior indentation. The basal cavity is extremely shallow; the apex of the cavity is pitlike and is located anterior to the midpoint just posterior to indentation of the basal margin.

The cusp is straight and the posterior face of the cusp carries a deep medial groove that does not reach the basal margin.

DISCUSSION-Harris and Harris (1965, p. 40) erected a new species of *Ulrichodina, U. cristata* s.f., that has an anterior keel, as does *U.* n. sp. 2 s.f. However, I believe that *U. cristata* s.f. is conspecific with *U. abnormalis* (Branson and Mehl) s.f. for reasons discussed under the latter species. Although *U.* n. sp. 2 s.f. has an anterior keel, as does *U. abnormalis* s.f., the latter has a posterior keel and a pointed posterior to its basal cross section.

U. deflexa s.f. has a posterior groove but it does not have an anterior keel as does *U.* n. sp. 2.

OCCURRENCE-Sample SD/580.

NUMBER OF SPECIMENS-1.

REPOSITORY -UMC 1066-12.

Ulrichodina n. sp. 3 s.f.
P1. 26, fig. 7

The element has a laterally compressed lanceolate cusp that is keeled sharply anteriorly and posteriorly. The basal margin flares outward slightly along lateral margins and orally slightly on either side of the anterior keel. The blade is broken shortly above the base but the cusp appears to be reclined somewhat. In profile, the basal margin is convex; in cross section, the basal margin is biconvex. Aborally, the anterior end of the margin is less sharp than the posterior and the anterior part of the basal rim is thickened. The basal facet is a straight-sided groove running anteroposteriorly, with the basal pit just posterior to the thickened anterior part of the rim.

DISCUSSION-This form is distinctive in its lanceolate cross section. The other forms of *Ulrichodina* have either a rounded anterior face or rounded costae on their cusp.

OCCURRENCE-Samples SD/780, 800, 861, and 1, 332.

NUMBER OF SPECIMENS-5.

REPOSITORY-UMC 1068-11.

New Genus A of Sweet and others, 1971
P1.27, figs. 1-6

Oistodus sp. B. Ethington and Clark, 1965, p. 196, p1. 2, fig. 11.
New Genus and Species, Ethington and Clark, 1965, p. 203, pl. 2, fig. 17.
New Genus A Sweet and others, 1971, p. 168, pl. 1, figs. 19, 22; Barnes, 1974, p. 229-230, p1. 1, figs. 4, 5.

This new multielement species contains ramiform, oistodiform, and platform elements. All elements are characterized by a ledgelike carina parallel to and slightly above the basal margin. The oistodiform and ramiform elements have been described by Ethington and Clark (1965) as *Oistodus* sp. B and New Genus and species, respectively. These same elements have been illustrated (Ethington and Clark, 1965; Sweet and others, 1971). In addition, a platform element is probably a constituent of the species. This element has a keellike blade, which makes a sharp bend of 45-90 degrees about at midlength. Along the inner side runs a shelf, and a short bladelike process may protrude outward from the point of the bend. The basal cavity is a narrow groove bordered by a thin flaring sheath.

DISCUSSION-This apparatus is under further study by R. L. Ethington (personal communication, 1975). The species is distinctive and may prove to be important stratigraphically.

OCCURRENCE-New Genus A is present in Alberta, Canada (Ethington and Clark, 1965), in the Juab Limestone of Utah (Sweet and others, 1971), in the upper part of the Eleanor River and Ship Point Formations in the Canadian Arctic (Barnes, 1974), in the uppermost West Spring Creek Formation of Oklahoma (Potter, 1975), in an Ordovician sequence at Mt. Arrowsmith, New South Wales, Australia (Kennedy, 1975), and in northern Tasmania (Kennedy, 1974). The El Paso specimens are in samples SD/1,300-1,342.

NUMBER OF SPECIMENS-Ramiform elements-37; oistodiform elements-108; platform elements-12.

REPOSITORY-UMC 1071-10 through 15.

NEW GENUS A

DIAGNOSIS-As only one species of this genus is known, the species description serves for the genus as well.

New Genus A, n. sp. A
P1. 28, figs. 1-4

Acodus oneotensis Furnish. Jones, 1971, in part, p. 44, pl. 1, figs. 6, 7 only; pl. 8, fig. 1; Druce and Jones, 1971, p. 56-57, pl. 12, figs. 3a-7c; text fig. 20; Müller, 1973, p. 26-27, pl. 7, figs. 1, 3-8.
? Acodus aliformis Abaimova, 1971, p. 76-77, pl. 10, fig. 5; Abaimova, 1972, text figs. 1 (53a, b); Abaimova, 1975, p. 41-42, pl. 2, figs. 1-3.
? Scandodus? n. sp. A. Viira, 1974, p. 122, text fig. 158.
New Genus Repetski and Ethington, 1977, p. 95, pl. 1, fig. 6.

This is a symmetry-transition series of proclined elements having pronounced anterior and posterior rounded carinae and a concavoconvex bladelike cusp that lies out of the anteroposterior vertical plane that symmetrically divides the laterally flattened, anteriorly leaning basal cavity. The basal cavity is relatively shallow in specimens having a wide, keeled cusp. Specimens having less prominent keels have a deep basal cavity that is nearly circular in cross section. The blade widens aborally and may extend aborally as two short processes, situated anterolaterally and posterolaterally, or laterally on bilaterally symmetrical (acontiodiform) elements. The posterior carina ends at the level of the tip of the basal cavity, which is also the region of greatest curvature of the element. The anterior carina is more pronounced than the posterior one and extends distally along the blade. On some specimens this anterior carina may rival the lateral keels in size in the basal region; on these specimens, this anterior carina is developed aborally as a short bosslike process. The entire unit may be twisted slightly above the basal region.

The symmetry transition results from the range shown by the angle of departure of the blade from the anteroposterior plane. Specimens in which this angle is very small (10 degrees or less) resemble drepanodiform elements. On these elements, the posterior carina may not be expressed because it is essentially coincident with the posterior keel; however, the anterior carina, though subdued, is still present. Bilaterally symmetrical elements have an acontiodiform cross section. The cusp is albid above the base.

DISCUSSION-Juanognathus variabilis Serpagli most closely resembles this new genus and species, the former also having lateral costae extending aborally as short processes. However, the basal cavity of *J. variabilis* is much more deeply excavated, the entire anterior (or anterolateral) face is uniformly rounded, and the rounded posterior carina extends the length of the element.

This new form was identified by Jones (1971), Druce and Jones (1971), and Müller (1973) as *Acodus oneotensis* s.f. However, the basal cross section of *A. oneotensis* is circular to subcircular, and the lateral costae of *A. oneotensis* are not continued aborally as short processes; as Müller noted (1973, p. 27), the basal cavity of *A. oneotensis* is larger than that of this new form.

New Genus A, n. sp. A may be conspecific with *Acodus aliformis* Abaimova (1971, 1972, 1975) from the southeast part of the Siberian Platform, but this cannot be determined from the published illustrations. If these two forms are indeed the same, then the latter is the senior synonym, although this conodont does not belong in the genus *Acodus* Pander.

Hundreds of excellently preserved specimens from the Manitou Formation (R. L. Ethington, undescribed collections) were studied in addition to the El Paso Group material. Ethington and this author are continuing to investigate this new genus.

OCCURRENCE-New Genus A, n. sp. A is now known to occur in the Shirgesht Formation of northern Iran (Müller, 1973), the Manitou Formation of Colorado (R. L. Ethington, undescribed collections), the Lower Ordovician of Australia (Jones, 1971; Druce and Jones, 1971), the Collier Shale of Arkansas (Repetski and Ethington, 1977), and the lowermost El Paso Group in the Franklin Mountains of Texas. Samples containing this form are SD/0-100.

NUMBER OF SPECIMENS-126.

REPOSITORY —UMC 1058-18 through 20, 1059-1.

New Genus B, n. sp. s.f.
Pl.28, fig. 5

The unit consists of a small erect cusp above a large, laterally compressed base. The anterior margin is rounded basally but acquires a shallow groove at the base-cusp juncture. The unit is constricted longitudinally just posterior to the rounded anterior margin. The posterior margin of the cusp and oral edge of the base is continuous and consists of two sharp, thin, posteriorly directed costae separated by a narrow posterior groove. The posterobasal angle is broken but appears to be approximately a right angle. The oral edge of the base is short; the aboral margin is straight in profile and is parallel to the cusp. The aboral margin is a laterally compressed oval in cross section. The anterobasal angle is acute but is nearly a right angle. The basal cavity is deep and triangular in profile; the sides of the cavity are straight, but the apex is deflected orally very slightly. The anterior side of the cavity is slightly longer than the posterior side.

DISCUSSION-This specimen somewhat resembles *Macerodus dianae,* but the former has a much shorter base and has a posterior groove.

OCCURRENCE-Sample SD/960.

NUMBER OF SPECIMENS-1.

REPOSITORY —UMC 1070-3.

References

Abaimova, G. P., 1971, New Early Ordovician conodonts from the southeastern part of the Siberian Platform (translated from Novyye ranneordovikskiye konodonty yugo-vostoka Sibirskoy platformy, Paleontologicheskiy Zhurnal, no. 4, p. 74-81): Paleontological Journal, v. 5, no. 4, p. 486-493

———, 1972, Subdivision and correlation of Ordovician deposits from the southeastern part of the Siberian Platform based on conodonts: Novosibirsk, Trudy Sibirskogo nauchno-issledovatel'skogo instituta geologii, geofiziki i mineral'nogo syr'ya, no. 146, p. 65-67, 1 pl., in Russian

———, 1975, Early Ordovician conodonts from the middle reaches of the Lena River (Ranneordovikskie konodonty srednego techeniya r. Lena): Novosibirsk, Trudy Sibirskogo nauchno-issledovatel'skogo instituta geologii, geofiziki i mineral'nogo syr'ya, no. 207, 130 p., 10 pls., in Russian

Barnes, C. R., 1974, Ordovician conodont biostratigraphy of the Canadian Arctic, *in* Canadian arctic geology, J. D. Aitken and D. J. Glass, eds., Geological Association of Canada and Canadian Society of Petroleum Geologists, Spec. v., p. 221-240, 1 pl.

Barnes, C. R., and Poplawski, M. L. S., 1973, Lower and Middle Ordovician conodonts from the Mystic Formation, Quebec, Canada: Journal of Paleontology, v. 47, p. 760-790, 5 pls.

Barnes, C. R., and Tuke, M. F., 1970, Conodonts from the St. George Formation (Ordovician), northern Newfoundland: Geological Survey of Canada, Bull., v. 187, p. 79-97, 3 pls.

Barnett, S. G., 1965, Conodonts of the Jacksonburg Limestone (Middle Ordovician) of northwestern New Jersey and eastern Pennsylvania: Micropaleontology, v. 11, p. 59-80, 2 pls.

Bergström, S. M., 1968, Biostratigraphy of the Lower Ordovician sequence at Skattungbyn, Dalarna (abs.), *in* VIII—Nordiska Geologiska Vintermötet, Abstracts: Geologiska Föreningens i Stockholm Förhandlingar, v. 90, p. 454

———, 1971, Conodont biostratigraphy of the Middle and Upper Ordovician of Europe and eastern North America, *in* Symposium on conodont biostratigraphy, W. C. Sweet and S. M. Bergström, eds.: Geological Society of America, Mem. 127, p. 83-162

Bergström, S. M., and Sweet, W. C., 1966, Conodonts from the Lexington Limestone (Middle Ordovician) of Kentucky and its lateral equivalents in Ohio and Indiana: Bulletins of American Paleontology, v. 50, no. 229, p. 271-441

Bergström, S. M., Epstein, A. G., and Epstein, J. B., 1972, Early Ordovician North Atlantic province conodonts in eastern Pennsylvania: U.S. Geological Survey, Prof. Paper 800-D, p. D37-D44, 1 pl.

Bond, I. J., and Greggs, R. G., 1973, Revision of the March Formation (Tremadocian) in southeastern Ontario: Canadian Journal of Earth Sciences, v. 10, p. 1,140-1,155

Bradshaw, L. E., 1969, Conodonts from the Fort Peña Formation (Middle Ordovician), Marathon Basin, Texas: Journal of Paleontology, v. 43, p. 1,137-1,168, pls. 131-137

Brand, Uwe, and Rust, B. R., 1977, The age and upper boundary of the Nepean Formation in its type section near Ottawa, Ontario: Canadian Journal of Earth Sciences, v. 14, no. 9, p. 2,002-2,006

Branson, E. B., and Mehl, M. G., 1933, Conodont studies: University of Missouri Studies, v. 8, 349 p., 28 pls.

———, 1944, Conodonts, *in* Index fossils of North America, by H. W. Shimer and R. R. Shrock: Cambridge, Massachusetts Institute of Technology Press, p. 235-246, pls. 93-94

Carlson, C. C., 1960, Stratigraphy of the Winnepeg and Deadwood Formations in North Dakota: North Dakota Geological Survey, Bull. 35, 149 p., 2 pls.

Clark, D. L., 1972, Early Permian crisis and its bearing on Permo-Triassic conodont taxonomy: Geologica et Paleontologica, Sonderband 1, p. 147-158

Cloud, P. E., Jr., and Barnes, V. E., 1948, The Ellenburger Group of central Texas: University of Texas, Pub. 4621, 473 p.

Collinson, C., 1963, Collection and preparation of conodonts through mass production techniques: Illinois State Geological Survey, Circ. 343, 16 p., 6 figs.

Cooper, R. A., and Druce, E. C., 1975, Lower Ordovician sequence and conodonts, Mount Patriarch, northwest Nelson, New Zealand: New Zealand Journal of Geology and Geophysics, v. 18, no. 4, p. 551-582, 2 pls.

Druce, E. C., and Jones, P. J., 1971, Cambro-Ordovician conodonts from the Burke River structural belt, Queensland: Australia Bureau of Mineral Resources, Bull. 110, 159 p., 20 pls.

Epstein, A. G., Epstein, J. B., and Harris, L. D., 1977, Conodont color alteration—an index to organic metamorphism: U.S. Geological Survey, Prof. Paper 995, 27 p.

Ethington, R. L., 1972, Lower Ordovician (Arenigian) conodonts from the Pogonip Group, central Nevada: Geologica et Paleontologica, Sonderband 1, p. 17-28, 1 pl.

Ethington, R. L., and Clark, D. L., 1964, Conodonts from the El Paso Formation (Ordovician) of Texas and Arizona: Journal of Paleontology, v. 38, p. 685-704, pls. 113-115

———, 1965, Lower Ordovician conodonts and other microfossils from the Columbia Ice Fields section, Alberta, Canada: Brigham Young University, Geology Studies, v. 12, p. 185-205, 2 pls.

———, 1971, Lower Ordovician conodonts in North America, *in* Symposium on conodont biostratigraphy, W. C. Sweet and S. M. Bergström, eds.: Geological Society of America, Mem. 127, p. 63-82, pls. 1, 2

Fahraeus, L. E., 1966, Lower Viruan (Middle Ordovician) conodonts from the Gullhögen Quarry, southern central Sweden: Sveriges Geologiska Undersökning, Series C, no. 610, Arsbok 60, no. 5, 40 p., 4 pls.

Fahraeus, L. E., and Nowlan, G. S., 1978, Franconian (Late Cambrian) to early Champlainian (Middle Ordovician) conodonts from the Cow Head Group, western Newfoundland: Journal of Paleontology, v. 52, no. 2, p. 444-471, 3 pls.

Flower, R. H., 1964, Early Paleozoic in New Mexico: New Mexico Geological Society, Guidebook 16th field conference, p. 112-131

———, 1969, Early Paleozoic of New Mexico and El Paso region, *in* The Ordovician Symposium, D. V. LeMone, ed.: El Paso Geological Society and Permian Basin Society of Economic Paleontologists and Mineralogists, p. 31-103

Furnish, W. M., 1938, Conodonts from the Prairie du Chien beds of the upper Mississippi Valley: Journal of Paleontology, v. 12, p. 318-340, pls. 41, 42

Glenister, A. T., 1957, Conodonts of the Ordovician Maquoketa Formation in Iowa: Journal of Paleontology, v. 31, p. 715-736, pls. 85-88

Goodwin, P. W., 1965, Early Ordovician conodonts from Wyoming, Montana, and South Dakota (abs.): Geological Society of America, Spec. Paper 82, p. 75

Graves, R. W., and Ellison, S. P., Jr., 1941, Ordovician conodonts of the Marathon Basin, Texas: University of Missouri School of Mining and Metallurgy, Bull., Technical Series, v. 14, no. 2, 26 p., 3 pls.

Greggs, R. G., and Bond, I. J., 1971, Conodonts from the March and Oxford Formations in the Brockville area, Ontario: Canadian Journal of Earth Sciences, v. 8, no. 11, p. 1,455-1,471, 2 pls.

Hamar, György, 1964, Conodonts from the lower Middle Ordovician of Ringerike: Norsk Geologisk Tidsskrift, v. 44, pt. 2, p. 243-292, 6 pls.

———, 1966, Preliminary report on conodonts from the Oslo-Asker and Ringerike districts: Norsk Geologisk Tidsskrift, v. 46, pt. 1, p. 27-83, 7 pls.

Harbour, R. L., 1972, Geology of the northern Franklin Mountains, Texas and New Mexico: U.S. Geological Survey, Bull. 1298, 129 p., 3 pls.

Harris, R. W., 1962, New conodonts from the Joins (Ordovician) Formation of Oklahoma: Oklahoma Geological Survey Notes, v. 22, p. 199-211, 1 pl.

Harris, R. W., and Harris, Beth, 1965, Some West Spring Creek (Ordovician Arbuckle) conodonts from Oklahoma: Oklahoma Geological Survey, Notes, v. 25, p. 34-47, 1 pl.

Hayes, P. T., and Cone, G. C., 1975, Cambrian and Ordovician rocks of southern Arizona and New Mexico and westernmost Texas: U.S. Geological Survey, Prof. Paper 873, 98 p.

Hinde, G. J., 1879, On conodonts from the Chazy and Cincinnati group of the Cambro-Silurian and from the Hamilton and Genesee shale division of the Devonian in Canada and the United States: Geological Society of London, Quart. Jour., v. 35, p. 351-369, 3 pls.

Hintze, L. F., 1953, Lower Ordovician trilobites from western Utah and eastern Nevada: Utah Geological and Mineralogical Survey, Bull., v. 48, p. 1-249, 28 pls. (dated 1952)

Igo, Hisayoshi, and Koike, Toshio, 1967, Ordovician and Silurian conodonts from the Langkawi Islands, Malaya: Geology and Palaeontology of Southeast Asia, v. 3, p. 1-29, 3 pls.

International Commission on Zoological Nomenclature, 1964, International code of zoological nomenclature adopted by the XV International Congress of Zoology: London, International Trust on Zoological Nomenclature, 176 p.

Jones, P. J., 1971, Lower Ordovician conodonts from the Bonaparte Gulf Basin and the Daly River basin, northwestern Australia: Australia Bureau of Mineral Resources, Bull. 117, 80 p., 8 pls.

Kelley, V. C., and Silver, C., 1952, Geology of the Caballo Mountains: University of New Mexico, Publications in Geology, no. 4, 286 p.

Kennedy, D. J., 1974, Lower Ordovician conodonts from the Cabbage Tree Formation, northern Tasmania, Australia (abs.): Geological Society of America, Abstracts with Programs, v. 6, no. 6, p. 520-521

———, 1975, Conodonts from a Lower-Middle Ordovician formation, Mt. Arrowsmith, northwest New South Wales, Australia (abs.): Geological Society of America, Abstracts with Programs, v. 7, no. 6, p. 796

———, 1980, A restudy of conodonts described by Branson and Mehl, 1933, from the Jefferson City Formation, Lower Ordovician, Missouri: Geologica et Paleontologica, v. 14, p. 45-76

Kottlowski, F. E., 1963, Paleozoic and Mesozoic strata of southwestern and south-central New Mexico: New Mexico Bureau of Mines and Mineral Resources, Bull. 79, 100 p.

Kottlowski, F. E., Flower, R. H., Thompson, M. L., and Foster, R. W., 1956, Stratigraphic studies of the San Andres Mountains, New Mexico: New Mexico Bureau of Mines and Mineral Resources, Mem. 1, 132 p.

Lamont, Archie, and Lindström, M., 1957, Arenigian and Llandeilian cherts identified in the Southern Uplands of Scotland by means of conodonts, etc.: Edinburgh Geological Society, Trans., v. 17, no. 1, p. 60-70, pl. 1

Landing, Ed, 1976, Early Ordovician (Arenigian) conodont and graptolite biostratigraphy of the Taconic allochthon, eastern New York: Journal of Paleontology, v. 50, no. 4, p. 614-646, 4 pls.

Lee, Ha-Young, 1970, Conodonten aus dem Choson-Gruppe (Unteres Ordovizium) von Korea: Neus Jahrbuch für Geologica und Paläontologica Abhandlungen, 136, p. 303-344, pls. 7, 8

———, 1975a, Conodonts from the Dumugol Formation (Lower Ordovician), South Korea: Journal of the Geological Society of Korea, v. 11, no. 2, p. 75-93, 2 pls.

———, 1975b, Conodonten aus dem Unteren und Mittleren Ordovizium von Nordkorea (Conodonts from the Lower and Middle Ordovician of North Korea): Palaeontographica, v. 150, p. 161-186, 2 pls.

LeMone, D. V., 1969, Cambrian-Ordovician in the El Paso border region, *in* The Ordovician symposium, D. V. LeMone, ed.: El Paso Geological Society and Permian Basin Society of Economic Paleontologists and Mineralogists, p. 145-161

Lindström, Maurits, 1955, Conodonts from the lowermost Ordovician strata of south-central Sweden: Geologiska Föreningens i Stockholm, Förhandlingar 76, p. 517-604, 7 pls.

———, 1960, A Lower-Middle Ordovician succession of conodont faunas: International Geological Con-

gress, 21st Session (Copenhagen), Rept. 7, p. 88-96
———, 1964, Conodonts: Amsterdam, Elsevier, 196 p.
———, 1971, Lower Ordovician conodonts of Europe, p. 21-61, pl. 1, *in* Symposium on conodont biostratigraphy, W. C. Sweet and S. M. Bergström, eds.: Geological Society of America, Mem. 127
———, 1975, *Oepikodus, Protoprioniodus, in* Catalogue of conodonts, W. Ziegler, ed.: Stuttgart, E. Schweizerbart'sche Verlagsbuchhandlung, v. II, p. 237, 238, 333-337
Longwell, C. R., and Mound, M. C., 1967, A new Ordovician formation in Nevada dated by conodonts: Geological Society of America, Bull. 78, p. 405-412, 1 pl.
Lucia, F. J., 1969, Sedimentation and paleogeography of the El Paso Group, *in* The Ordovician symposium, D. V. LeMone, ed.: El Paso Geological Society and Permian Basin Society of Economic Paleontologists and Mineralogists, p. 110-133
McHargue, T. R., 1974, Conodonts of the Joins Formation (Ordovician), Arbuckle Mountains, Oklahoma: M.A. thesis, University of Missouri, 151 p., 8 pls.
McTavish, R. A., 1973, Prioniodontacean conodonts from the Emanuel Formation (Lower Ordovician) of Western Australia: Geologica et Paleontologica, v. 7, p. 27-58, pls. 1-3
Mehl, M. G., and Ryan, R., 1944, *in* The geology of Missouri, by E. B. Branson: University of Missouri Studies, v. 19, no. 3, p. 45, 52
Miller, J. F., 1969, Conodont fauna of the Notch Peak Limestone (Cambro-Ordovician), House Range, Utah: Journal of Paleontology, v. 43, p. 413-439, pls. 63-66
Moore, Arthur, 1970, Conodonts of the Jefferson City Formation of Missouri: M.A. thesis, University of Missouri, 113 p., 4 pls.
Moskalenko, T. A., 1967, Conodonts from the Chunsky Stage (Lower Ordovician) of the rivers Moiero and Podkamennaya Tunguska, *in* New data on the biostratigraphy of the lower Paleozoic deposits of the Siberian platform, A. B. Ivanovskii and B. S. Sokolov, eds.: Akademiya Nauk SSSR, Sibirskoye Otdeleniye, Instituta Geologii i Geofiziki, p. 98-116, 4 pls.
———, 1972, Ordovician conodonts of the Siberian Platform and their bearing on multielement taxonomy: Geologica et Paleontologica, Sonderband 1, p. 47-56
———, 1973, General survey of Ordovician conodonts of the Siberian Platform: Akademiya Nauk USSR, Siberian Branch, Trudy Instituta Geologii i Geofiziki, v. 47, p. 87-135, pls. 15-23 (in Russian)
Mound, M. C., 1965, A conodont fauna from the Joins Formation (Ordovician), Oklahoma: Tulane Studies in Geology and Paleontology, v. 4, p. 1-45, 4 pls.
———, 1968, Conodonts and biostratigraphy of the lower Arbuckle Group (Ordovician), Arbuckle Mountains, Oklahoma: Micropaleontology, v. 14, p. 393-434, 6 pls.
Müller, K. J., 1964, Conodonten aus dem unteren Ordovizium von Sudkorea: Neus Jahrbuch für Geologie Paläontologie, Abhandlungen 119, p. 93-102, 2 pls.
———, 1973, Late Cambrian and early Ordovician conodonts from northern Iran: Geological Survey of Iran, Rept. 30, 77 p., 11 pls.
Pander, C. H., 1856, Monographie der fossilen Fische des silurischen Systems des russisch-baltischen Gouvernements: St. Petersburg, Akademie de Wissenschaften, i-x, p. 1-91
Pantoja-Alor, J., and Robison, R. A., 1967, Paleozoic sedimentary rocks in Oaxaca, Mexico: Science, v. 157, p. 1,033-1,035
Potter, C. W., 1975, Lower Ordovician conodonts of the upper West Spring Creek Formation, Arbuckle Mountains, Oklahoma: M.A. thesis, University of Missouri, 133 p., 4 pls.
Repetski, J. E., 1973, Conodonts from the Middle Ordovician Dutchtown Formation of southeast Missouri (abs.): Geological Society of America, Abstracts with Programs, v. 5, p. 345
———, 1977, Early Ordovician (Canadian) conodonts from New York (abs.): Geological Society of America, Abstracts with Programs, v. 9, no. 5, p. 647
Repetski, J. E., and Ethington, R. L., 1977, Conodonts from graptolite facies in the Ouachita Mountains, Arkansas and Oklahoma, p. 92-106, pls. 1, 2, *in* Symposium on the geology of the Ouachita Mountains, C. G. Stone, ed.: Arkansas Geological Commission.
Rhodes, F. H. T., 1953, Some British Lower Paleozoic conodont faunas: Royal Society of London, Phil. Trans., Series B, no. 647, v. 237, p. 261-334, pls. 20-23
———, 1955, The conodont fauna of the Keisley Limestone: Geological Society of London, Quart. Jour., v. III, p. 117-142, pls. 7-10
Richardson, G. B., 1904, Report of a geologic reconnaissance in Trans-Pecos Texas, north of the Texas and Pacific Railway: University of Texas Mineral Survey, Bull. 9, 119 p.
———, 1909, Description of the El Paso district: U.S. Geological Survey, Geologic Atlas, folio 166, 17 p.
Ross, R. J., Jr., 1951, Stratigraphy of the Garden City Formation in northeastern Utah and its trilobite faunas: Yale University, Peabody Museum of Natural History, Bull. 6, p. 1-161, 36 pls.
Sando, W. J., 1958, Lower Ordovician section near Chambersburg, Pennsylvania: Geological Society of America, Bull. 69, p. 837-854, 2 pls.
Schopf, T. J. M., 1966, Conodonts of the Trenton Group (Ordovician) in New York, southern Ontario, and Quebec: New York State Museum and Science Service, Bull. 405, 105 p., 6 pls.
Sergeeva, S. G., 1963, Conodonti iz Nishnego Ordovika Leningradskoi Oblasti (Conodonts from the Lower Ordovician of the Leningrad region): Paleontologicheskiy Zhurnal 1963(2), p. 93-108, pls. 7, 8
Serpagli, E., 1974, Lower Ordovician conodonts from Precordilleran Argentina (Province of San Juan): Bolletino Societe Paleontologico Italiana, v. 13, p. 17-93, pls. 7-31
Sweet, W. C., and Bergström, S. M., 1972, Multielement taxonomy and Ordovician conodonts: Geologica et Paleontologica, Sonderband 1, p. 29-42
Sweet, W. C., Ethington, R. L., and Barnes, C. R., 1971, North American Middle and Upper Ordovician conodont faunas, *in* Symposium on conodont biostratigraphy, W. C. Sweet and S. M. Bergström, eds.: Geological Society of America, Mem. 127, p. 163-193, pls. 1, 2
Uyeno, T. T., and Barnes, C. R., 1970, Conodonts from the Lévis Formation (zone D1) (Middle Ordovician), Lévis, Quebec: Geological Survey of Canada, Bull. 187, p. 99-123, 4 pls.
van Wamel, W. A., 1974, Conodont biostratigraphy of the Upper Cambrian and Lower Ordovician of northwestern Oland, southeastern Sweden: Utrecht Micropaleontoliska, Bull. 10, 126 p., 8 pls.
Viira, V., 1974, Ordovician conodonts of the east Baltic: Institut Geologii Akademii Nauk Estonskoi SSR, Tallin, 142 p.
Winder, C. G., 1966, Conodonts from the Upper Cobourg Formation (Late Middle Ordovician) at Colborne, Ontario: Journal of Paleontology, v. 40, p. 46-63, pls. 9, 10
Wolska, Z., 1961, Conodonts from Ordovician erratic boulders of Poland: Acta Palaeontologica Polonica, v. 6, no. 4, p. 339-365, pls. 1-6

Plates

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All specimens are metallically coated for SEM photography. Stereo pairs **(PR)** have an 8 degree separation.

Plate 1

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1, 3	*Acanthodus lineatus* (Furnish) s.f.	10
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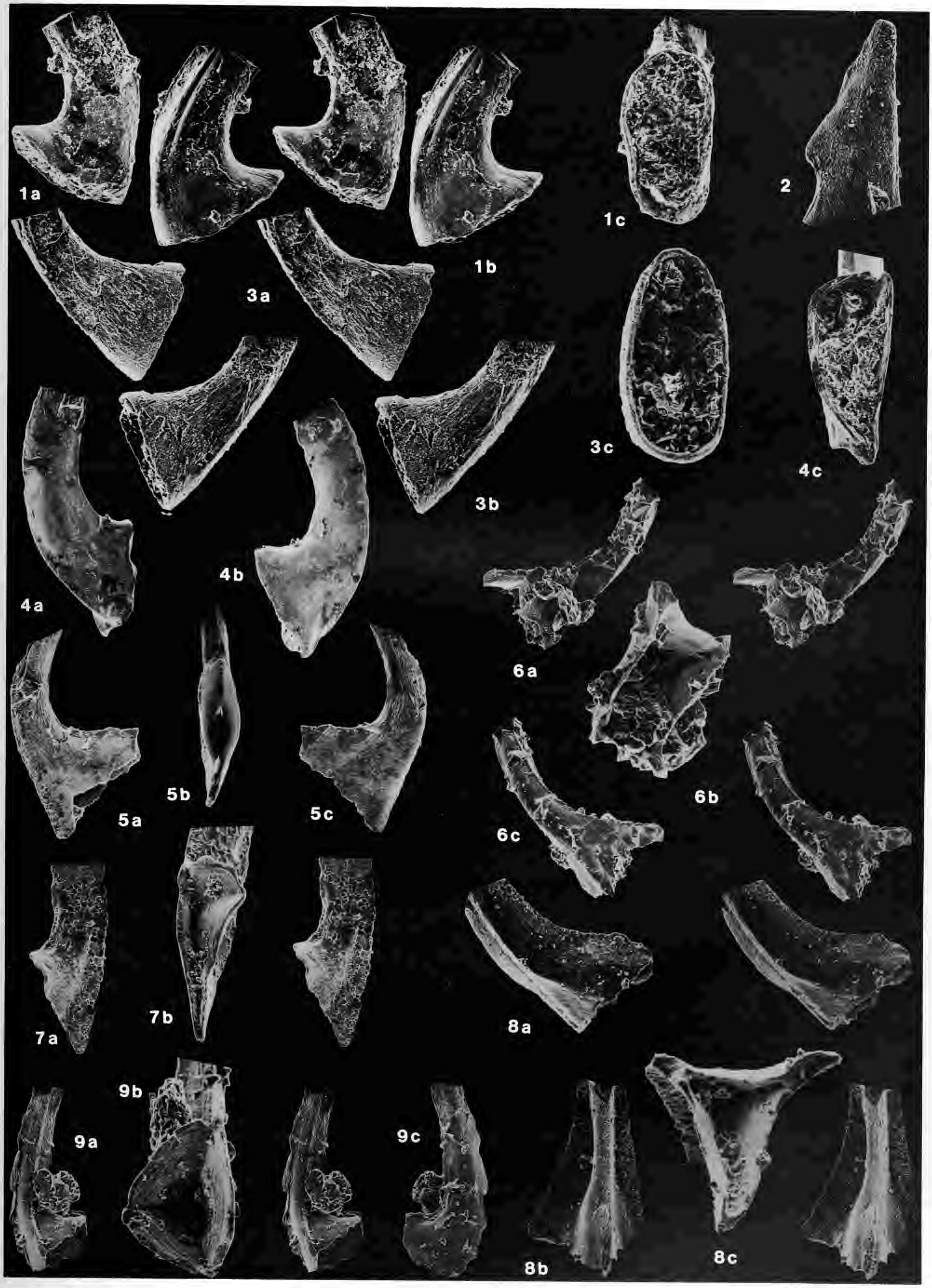
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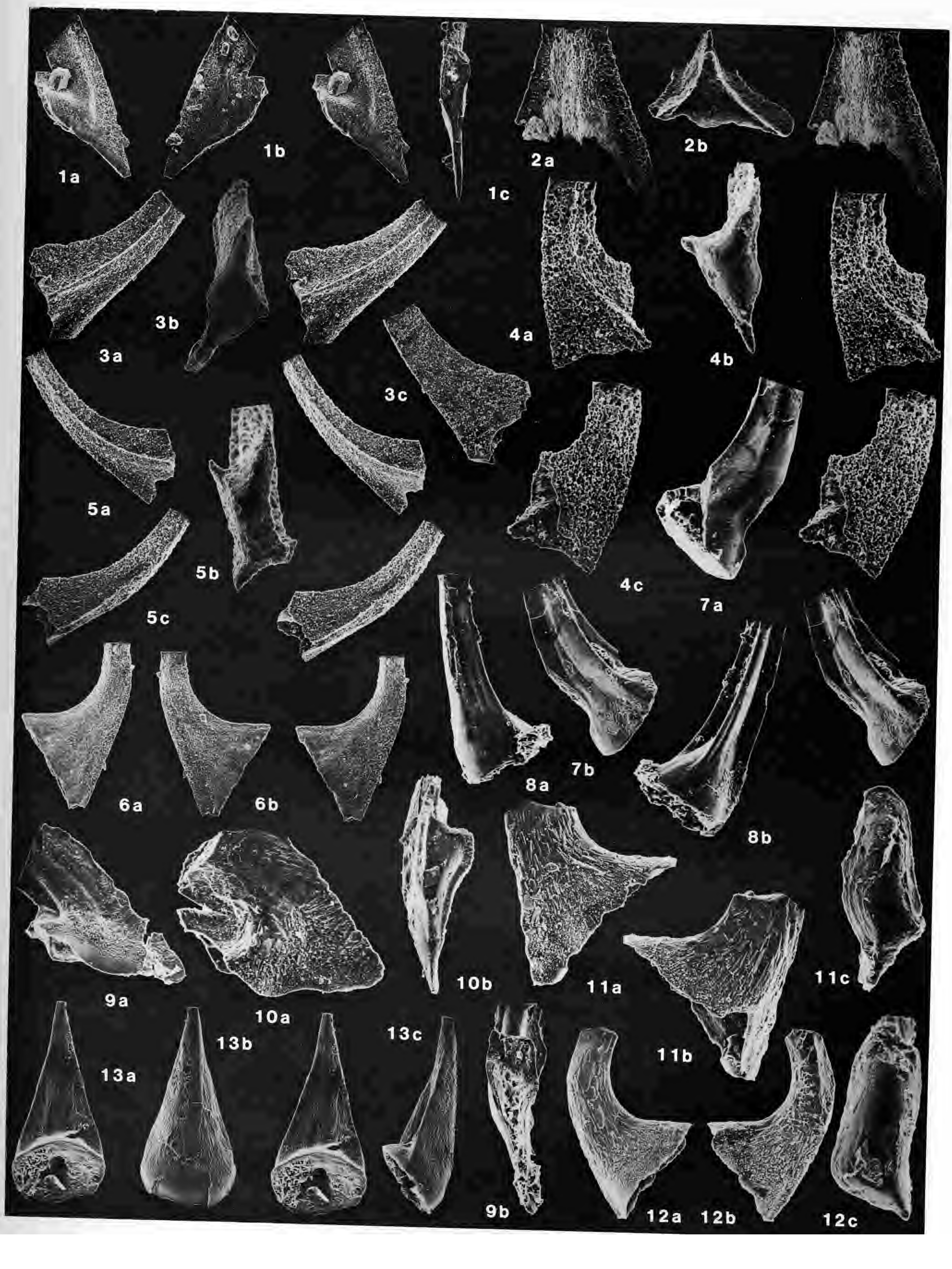
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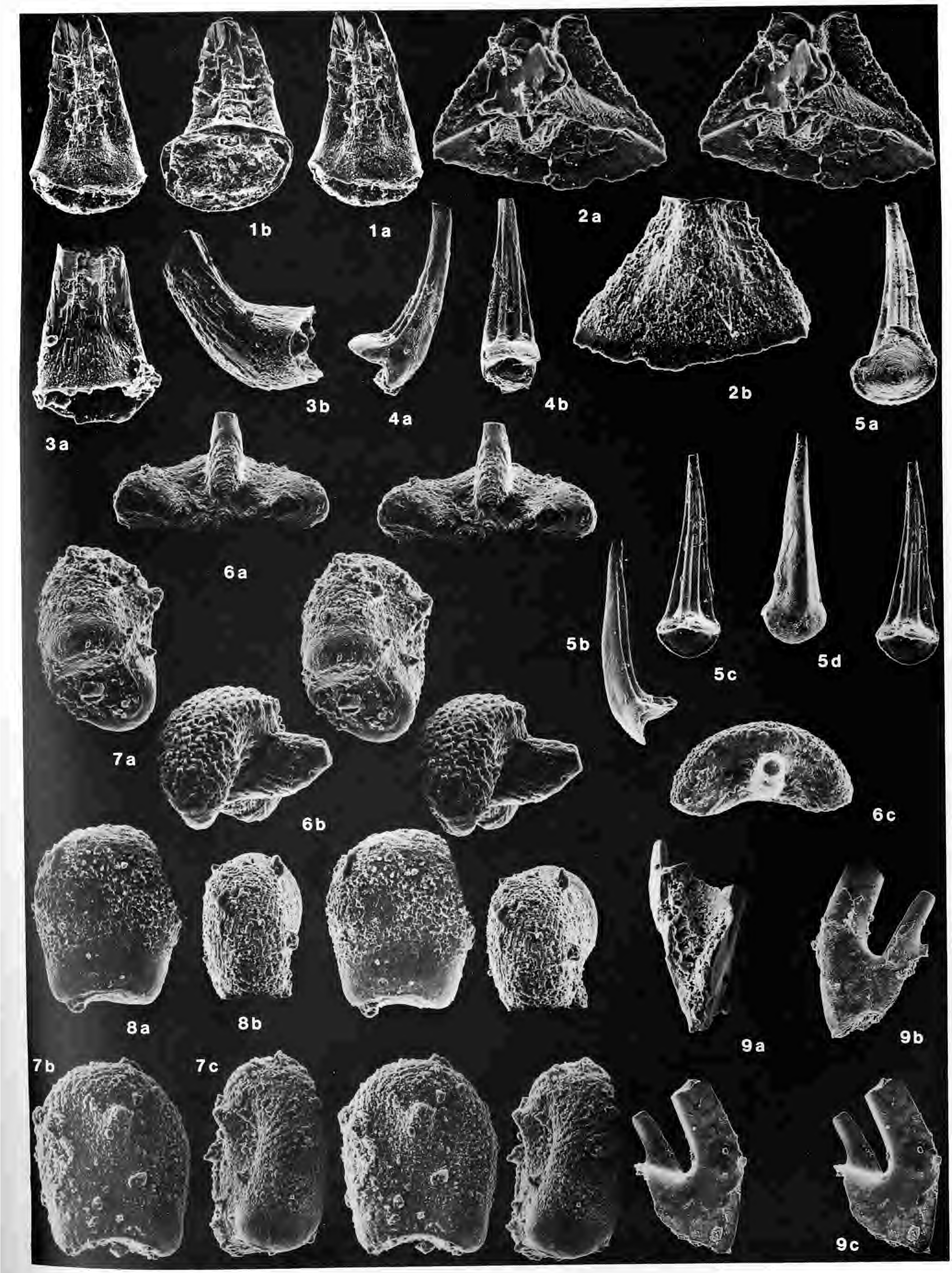
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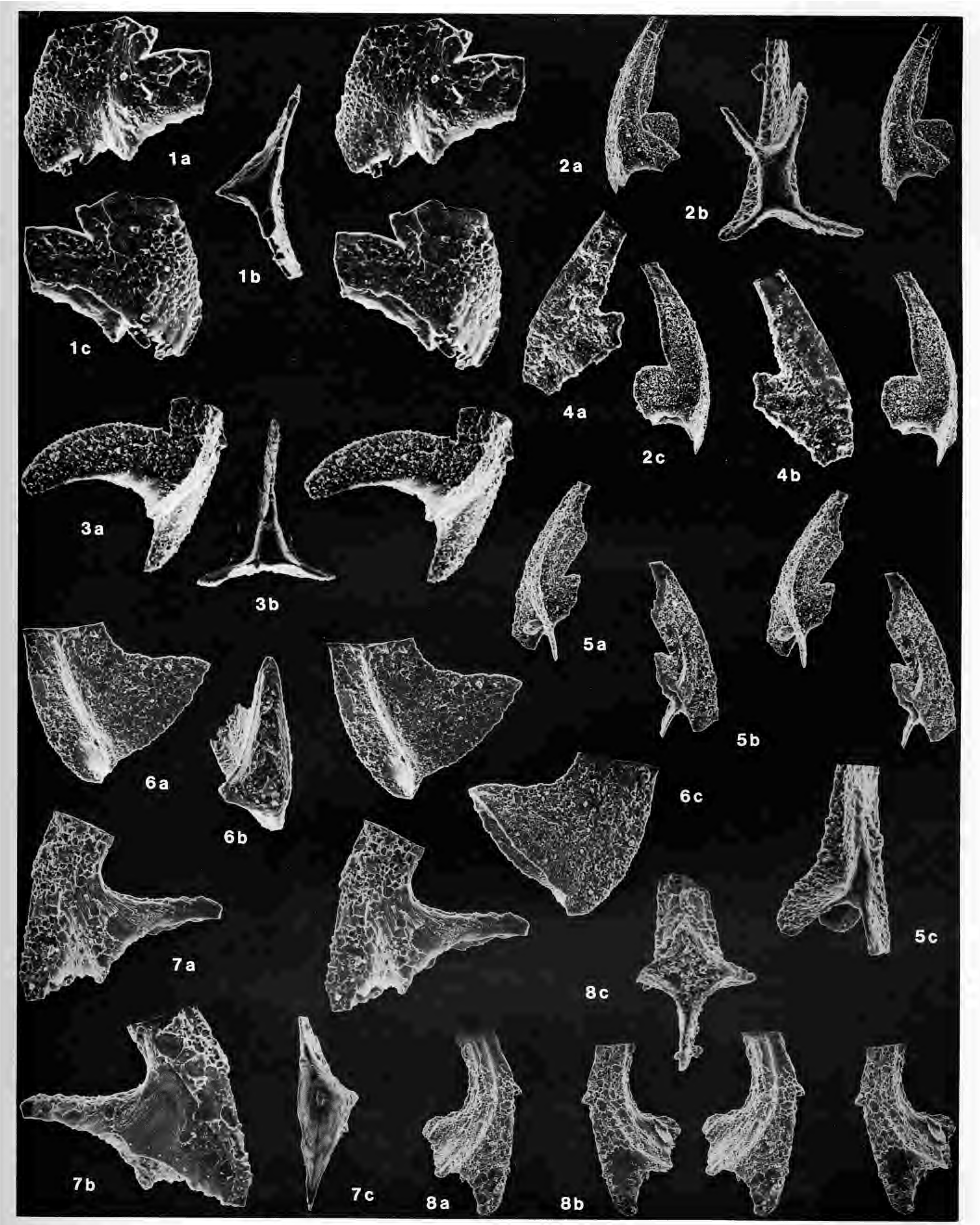
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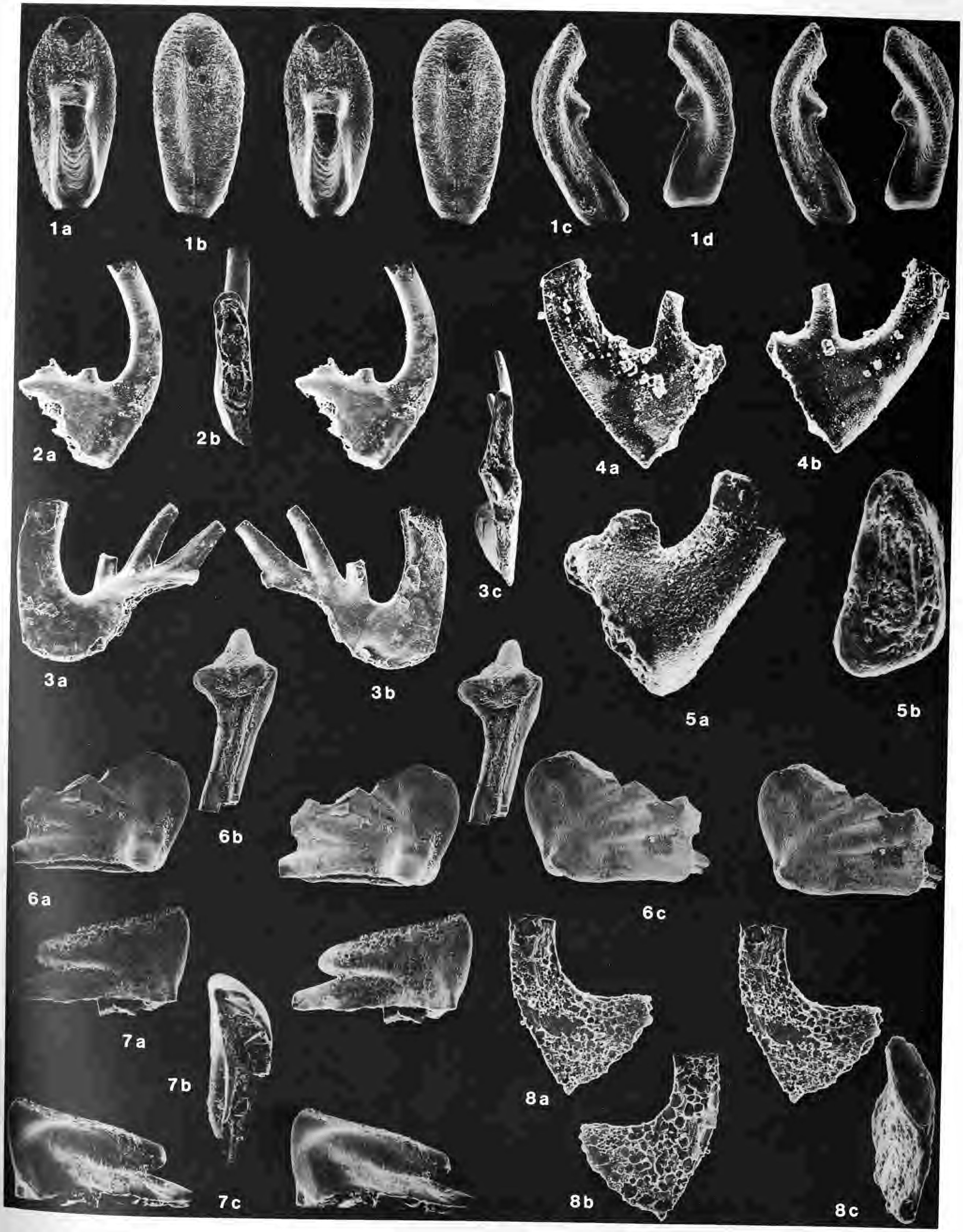
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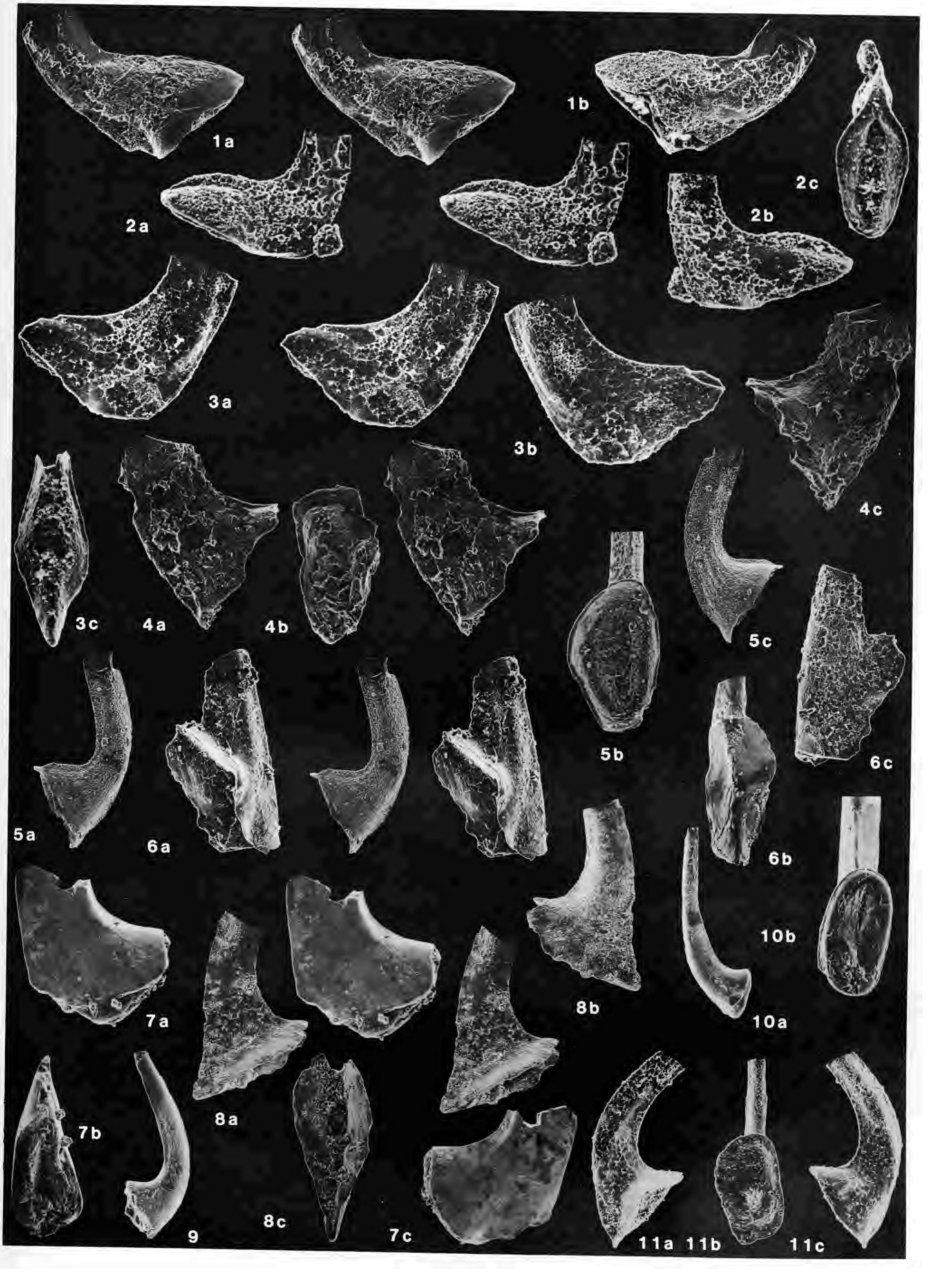
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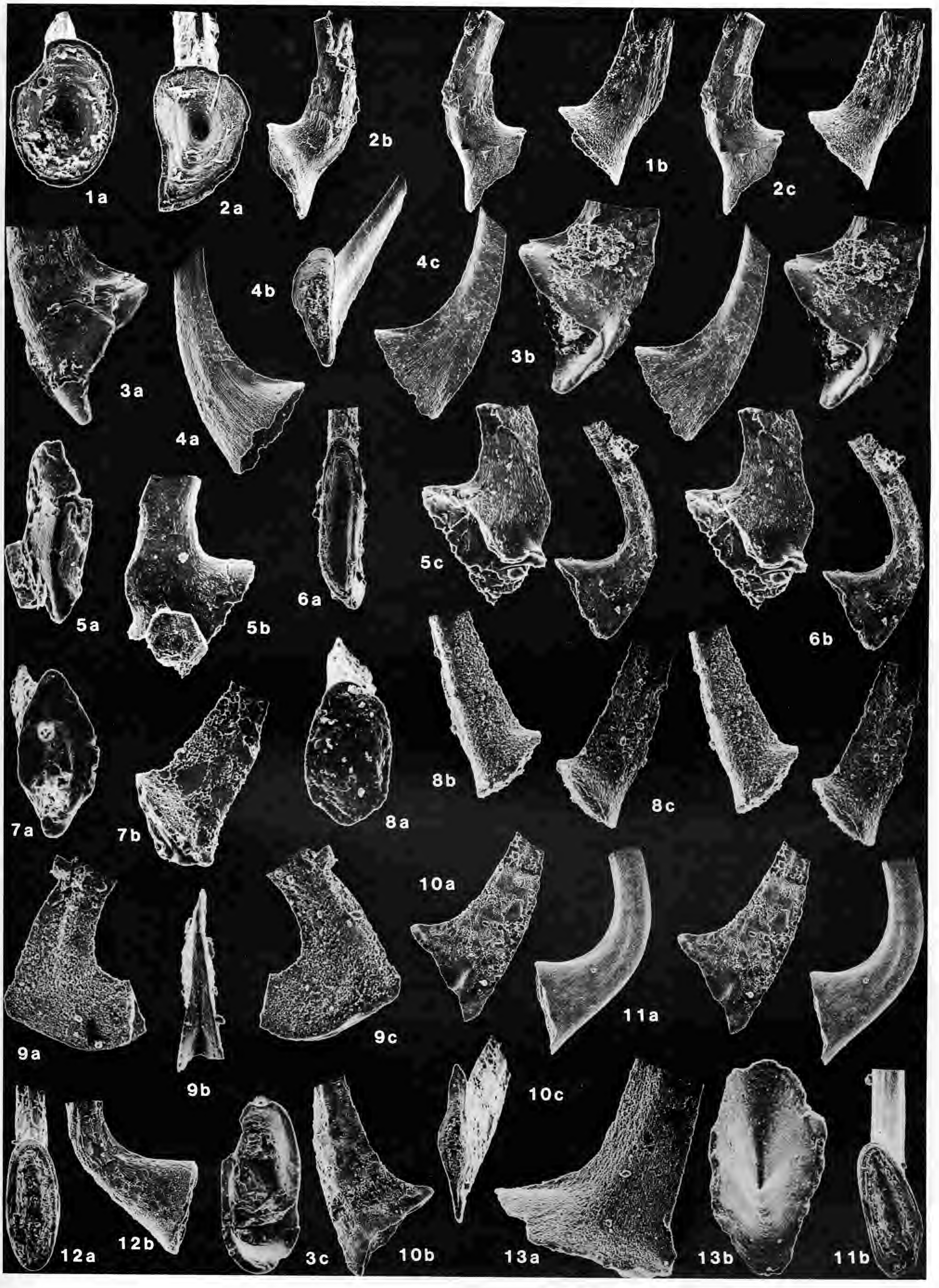
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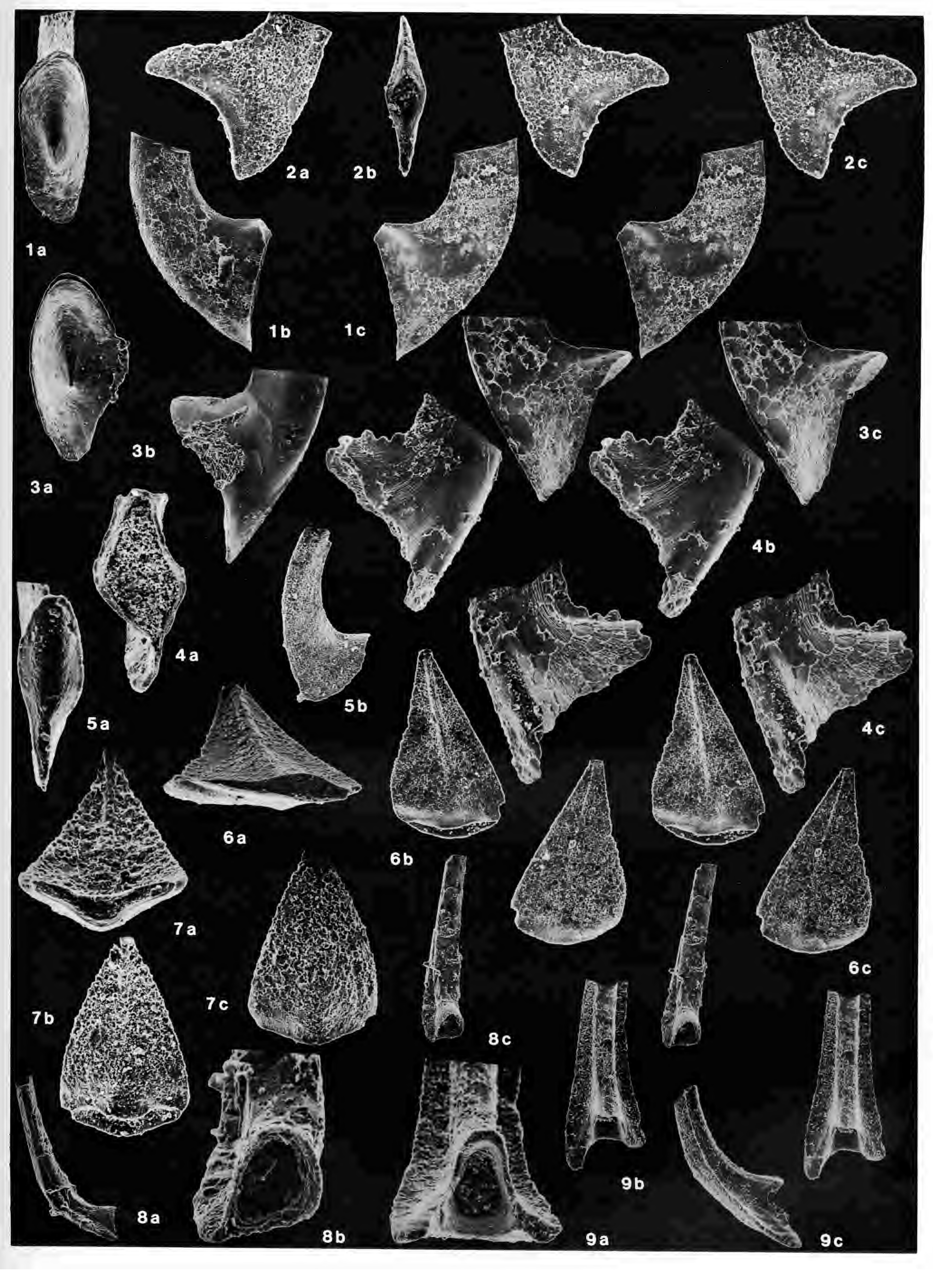
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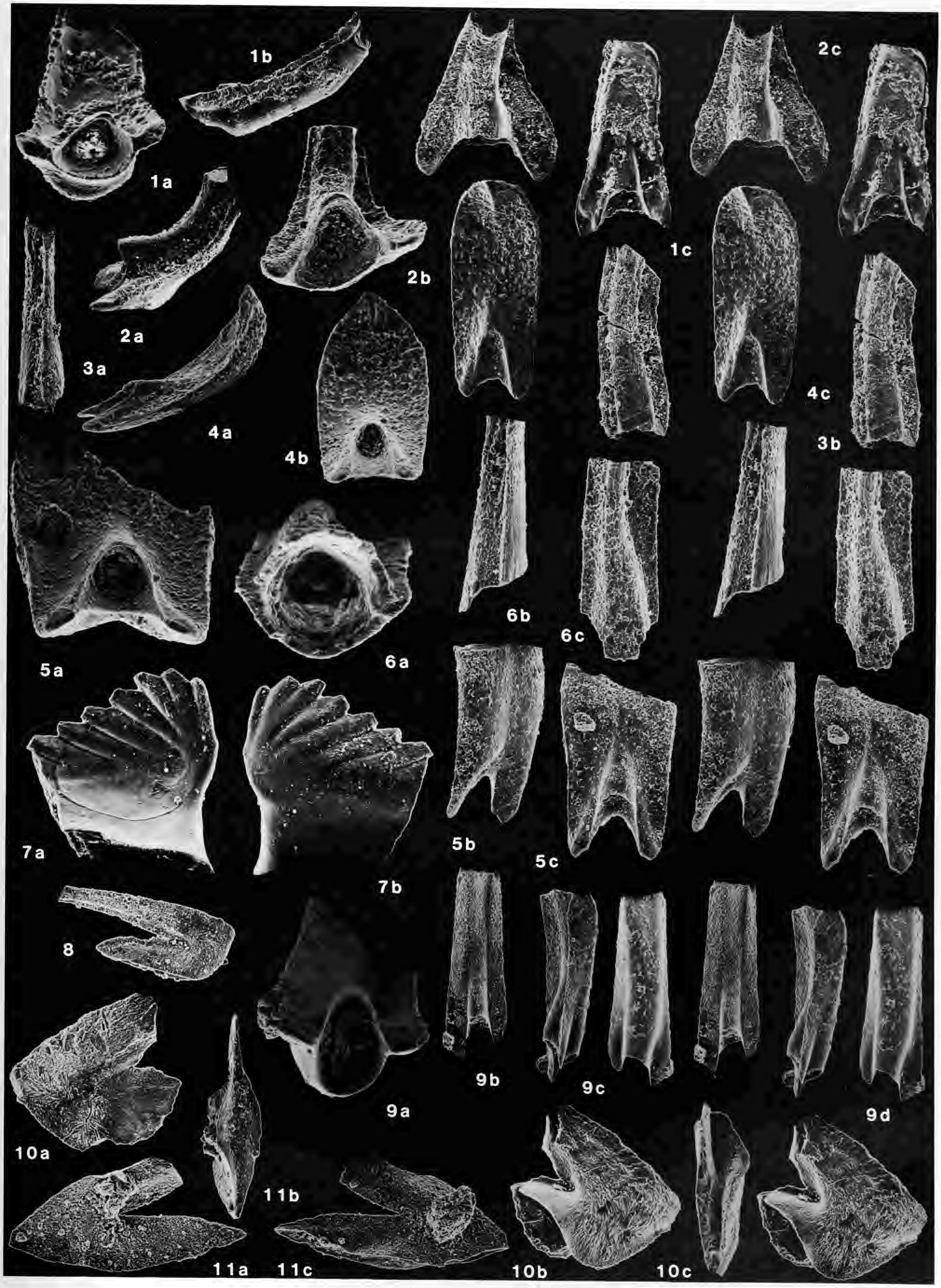
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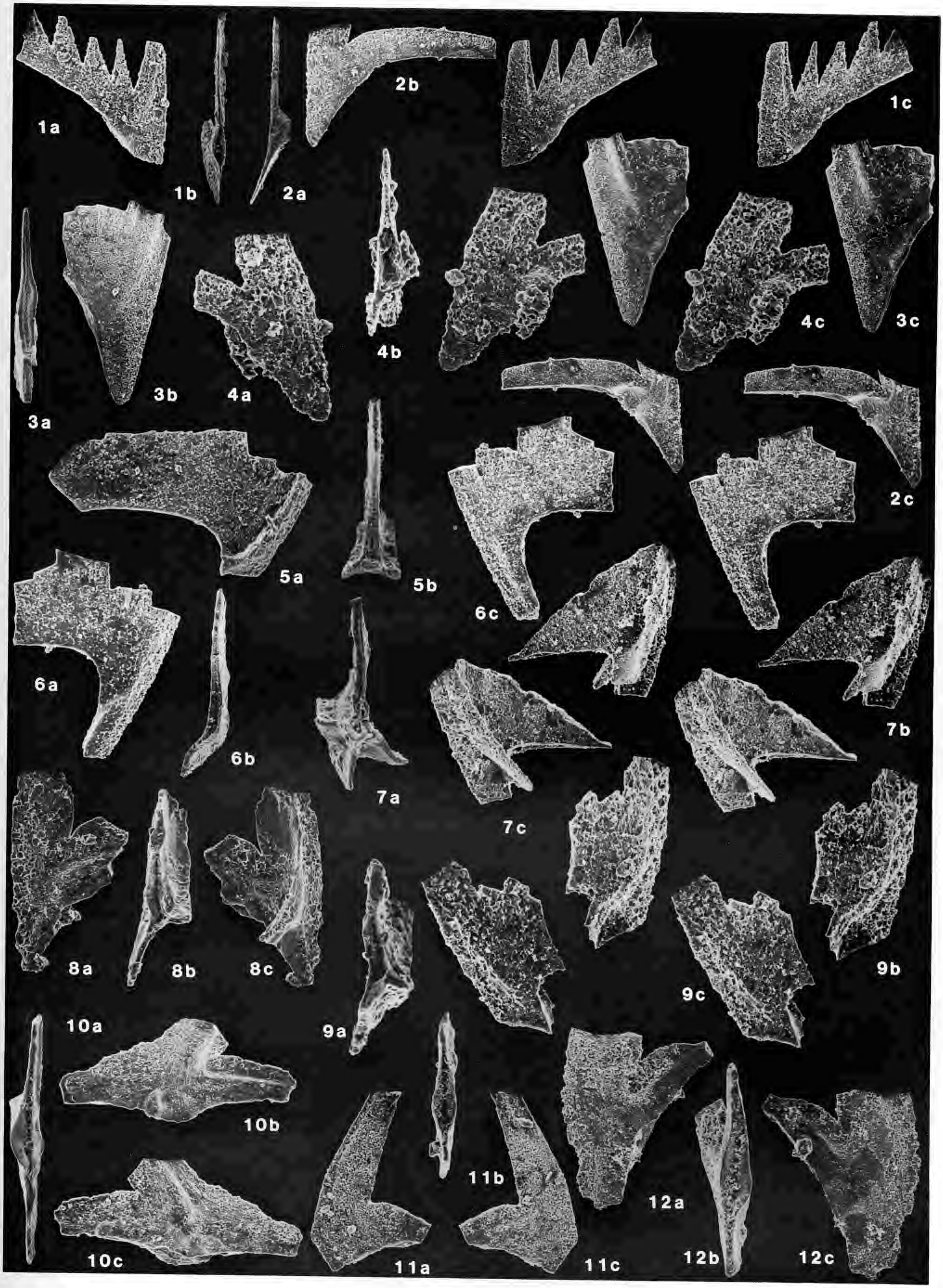
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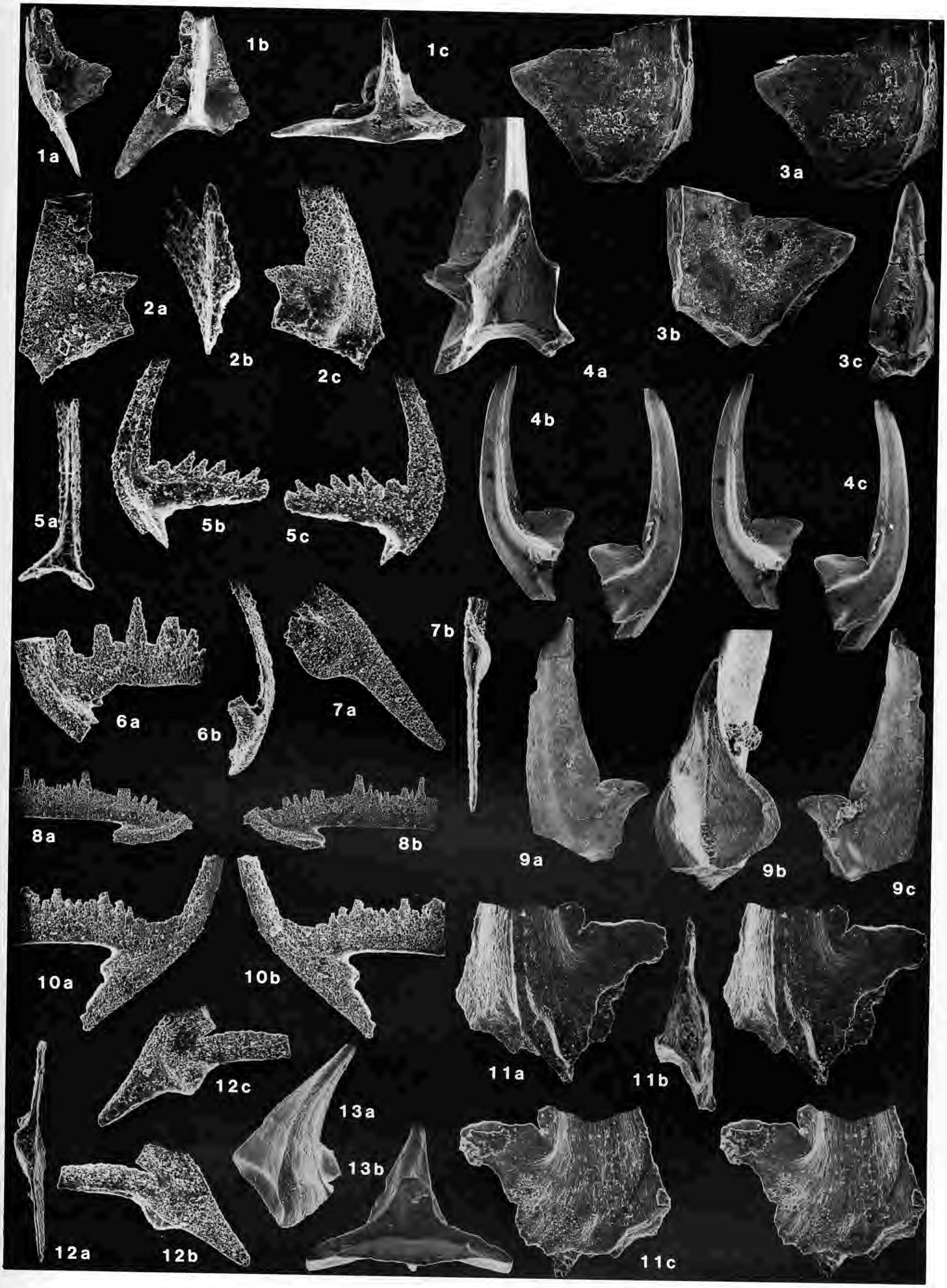
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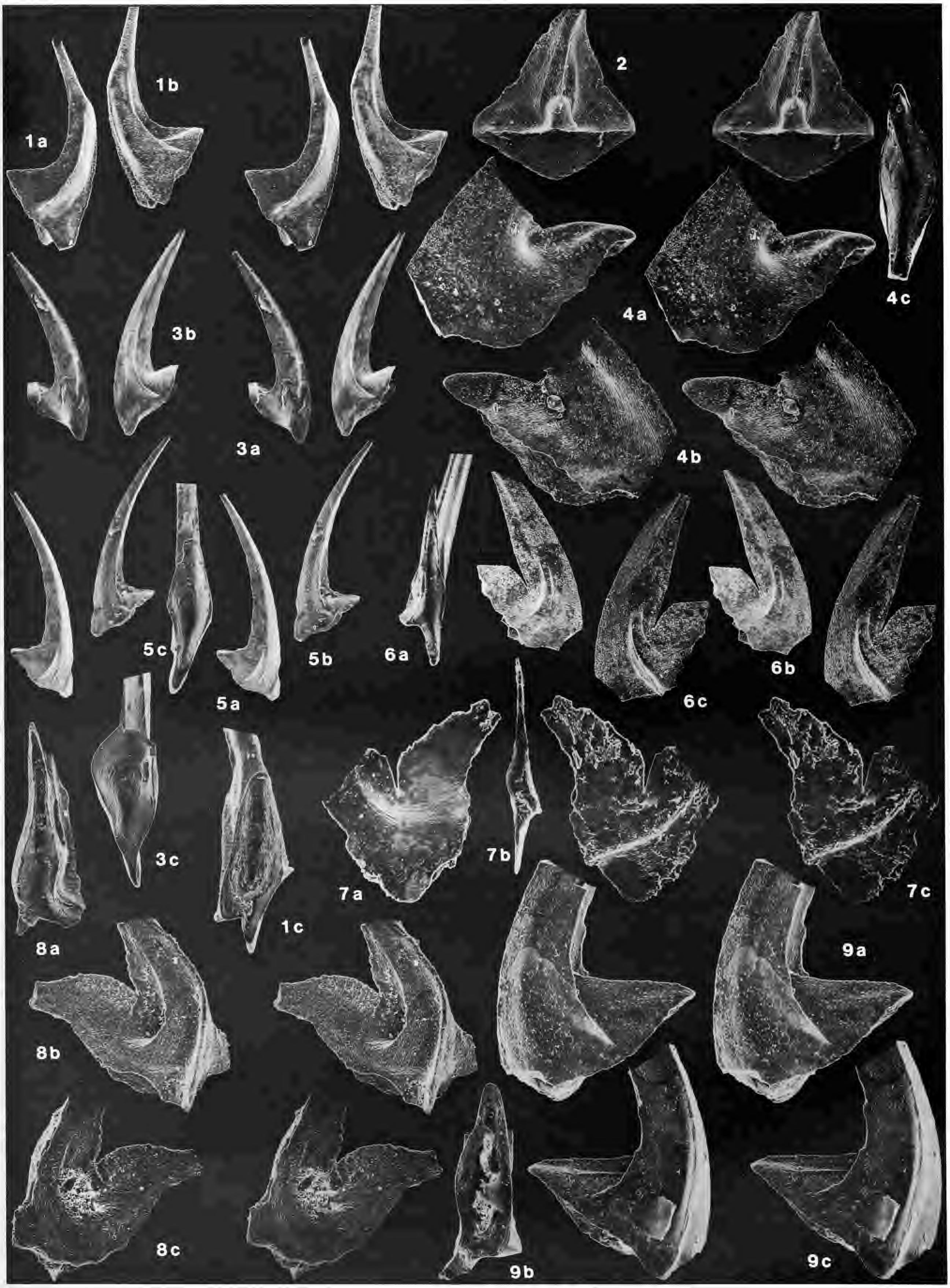
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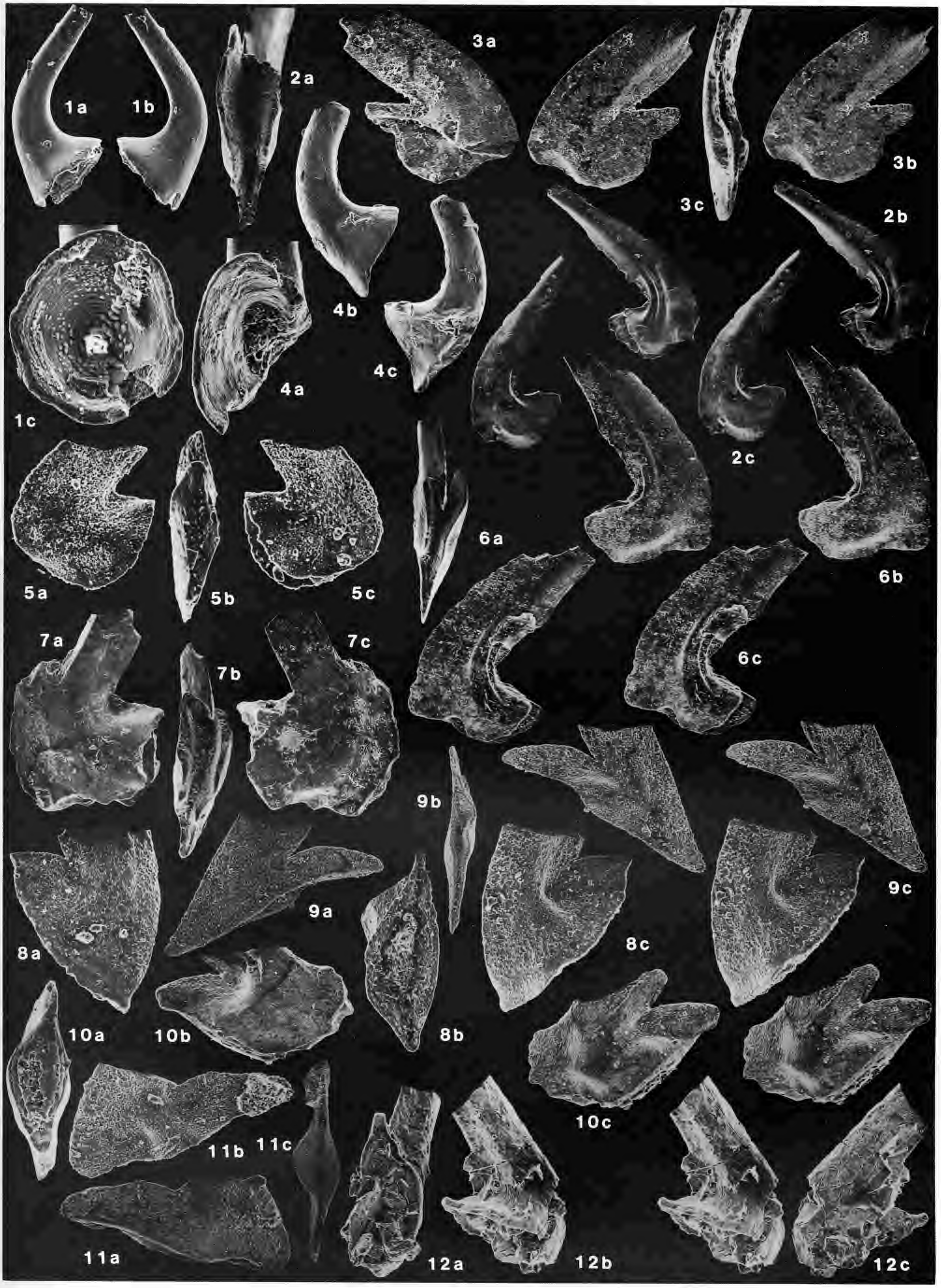
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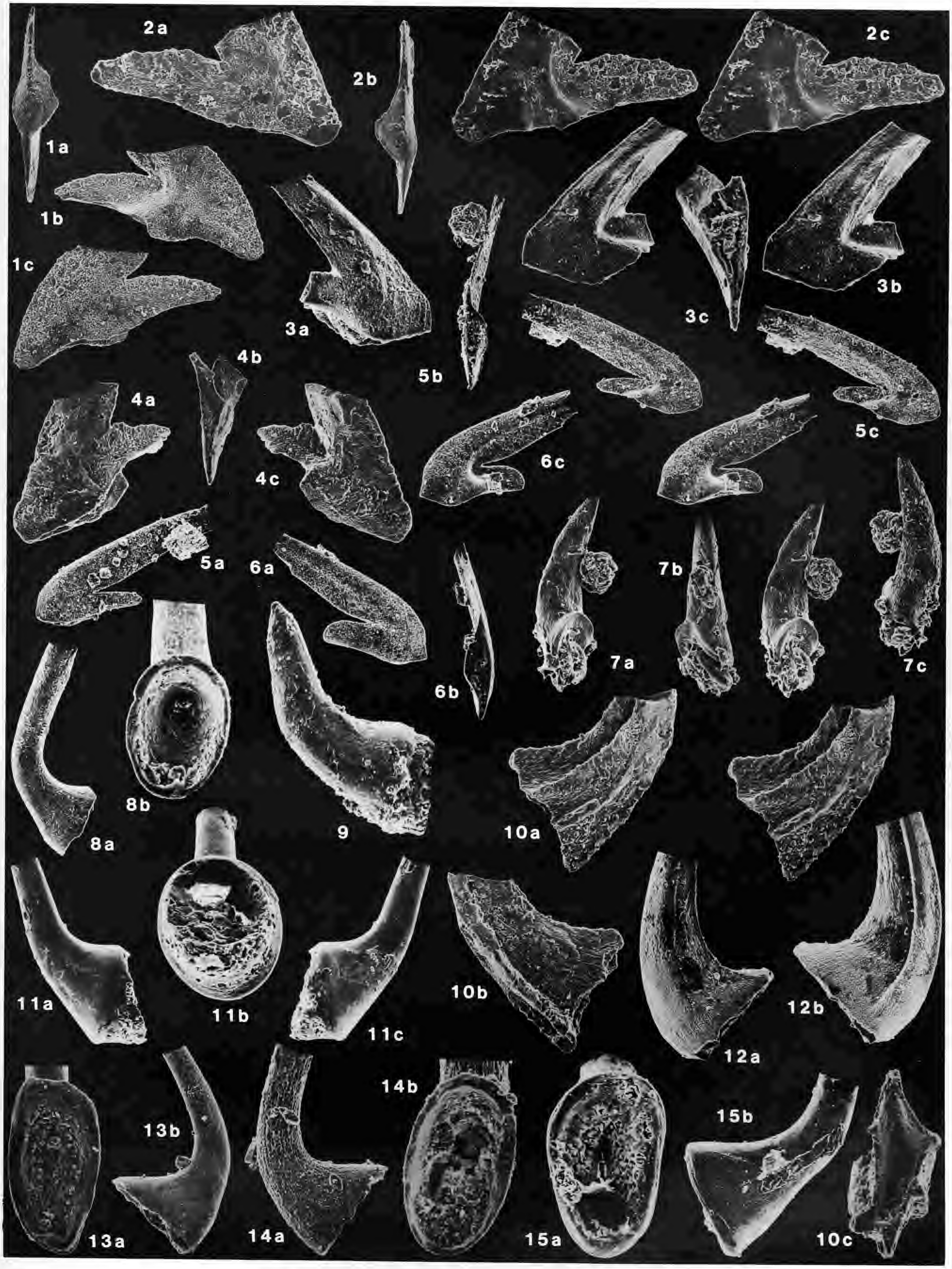
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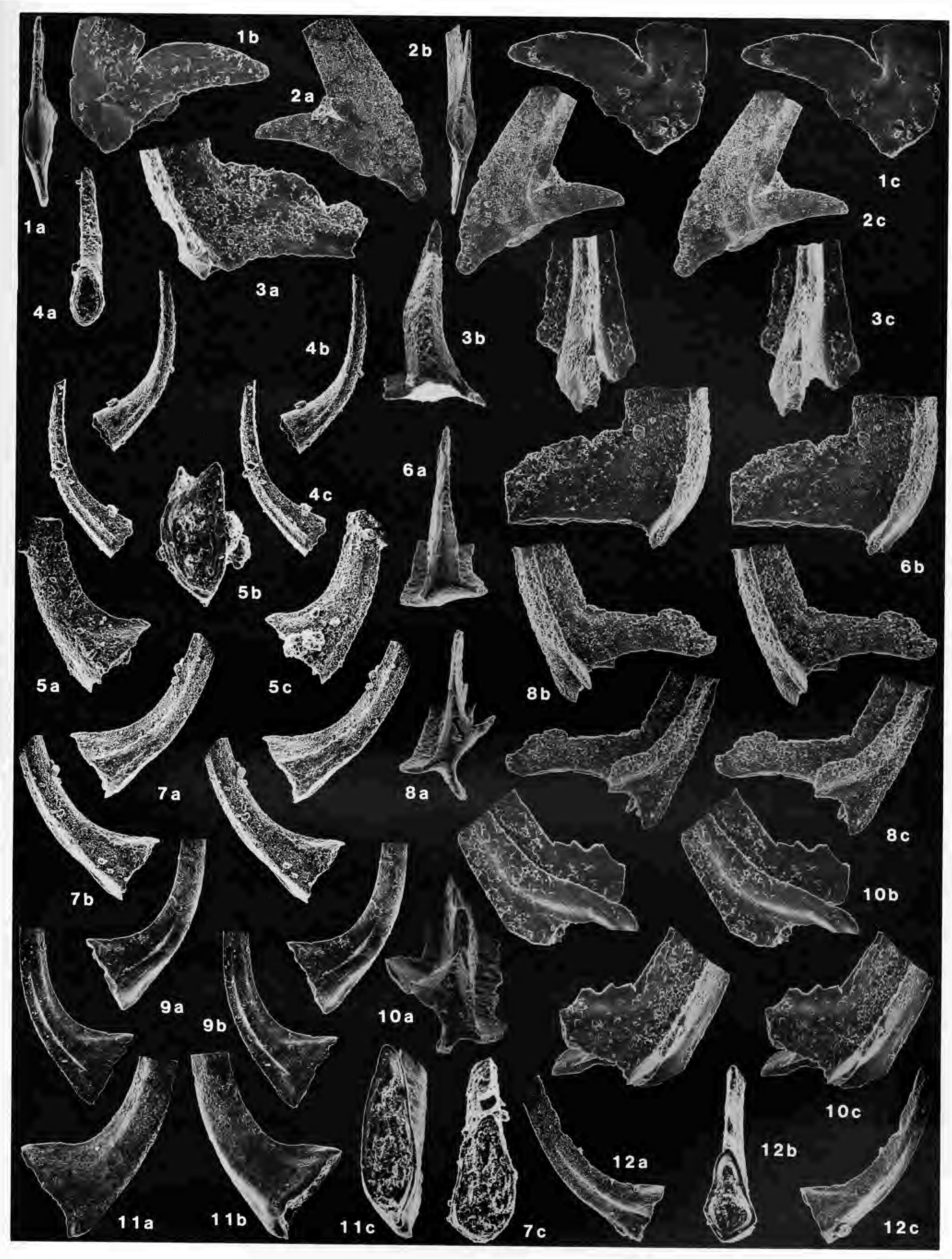
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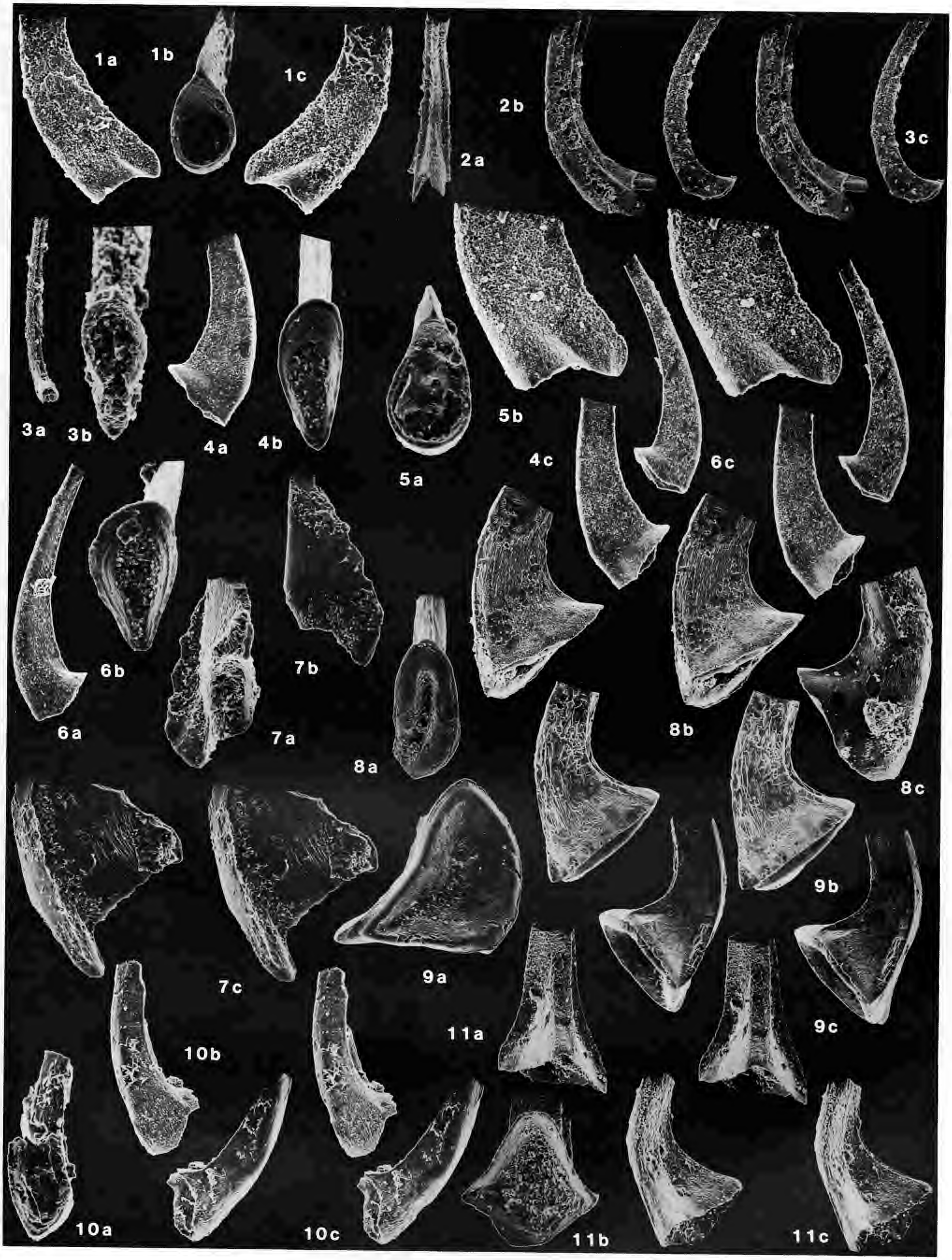
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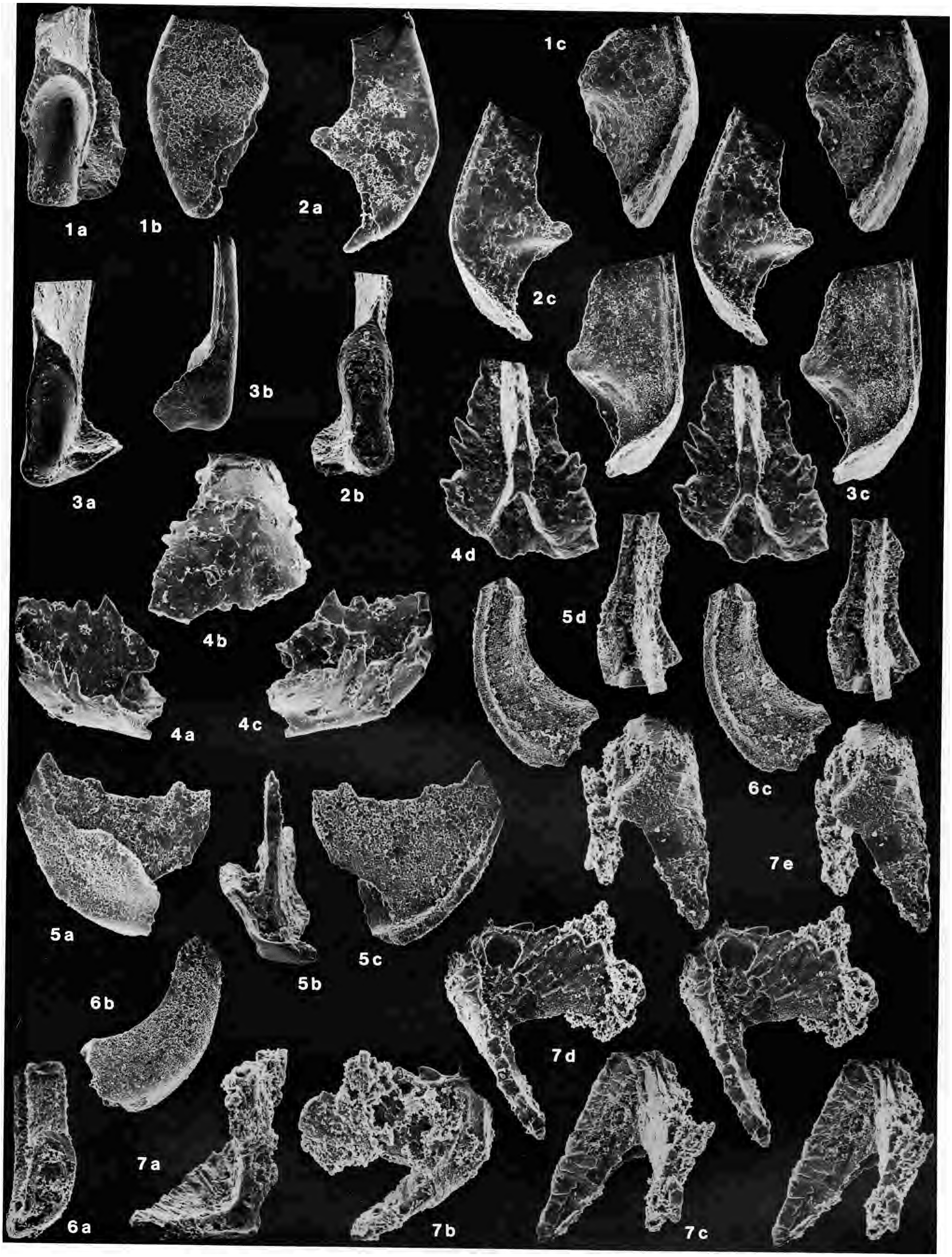
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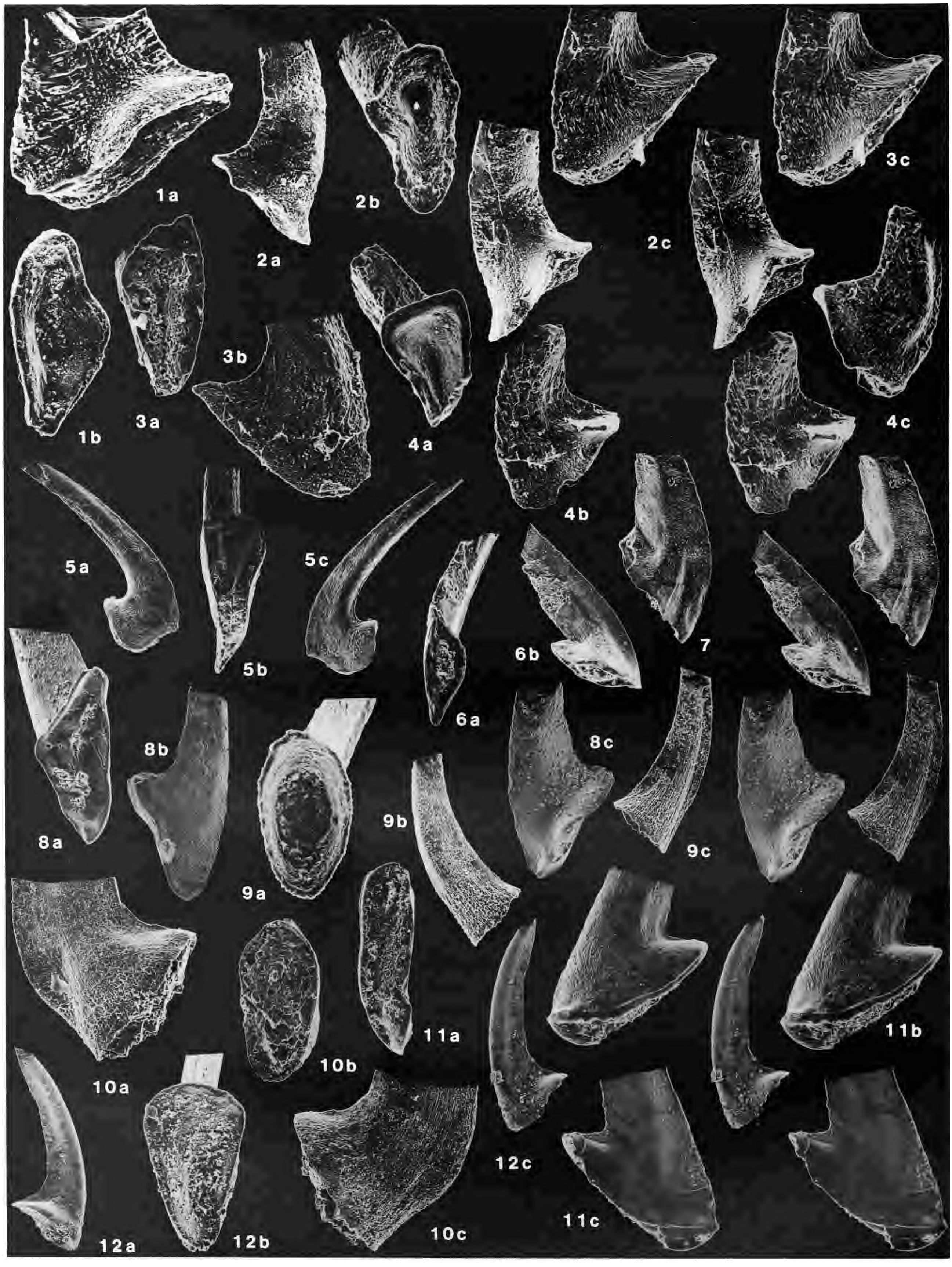
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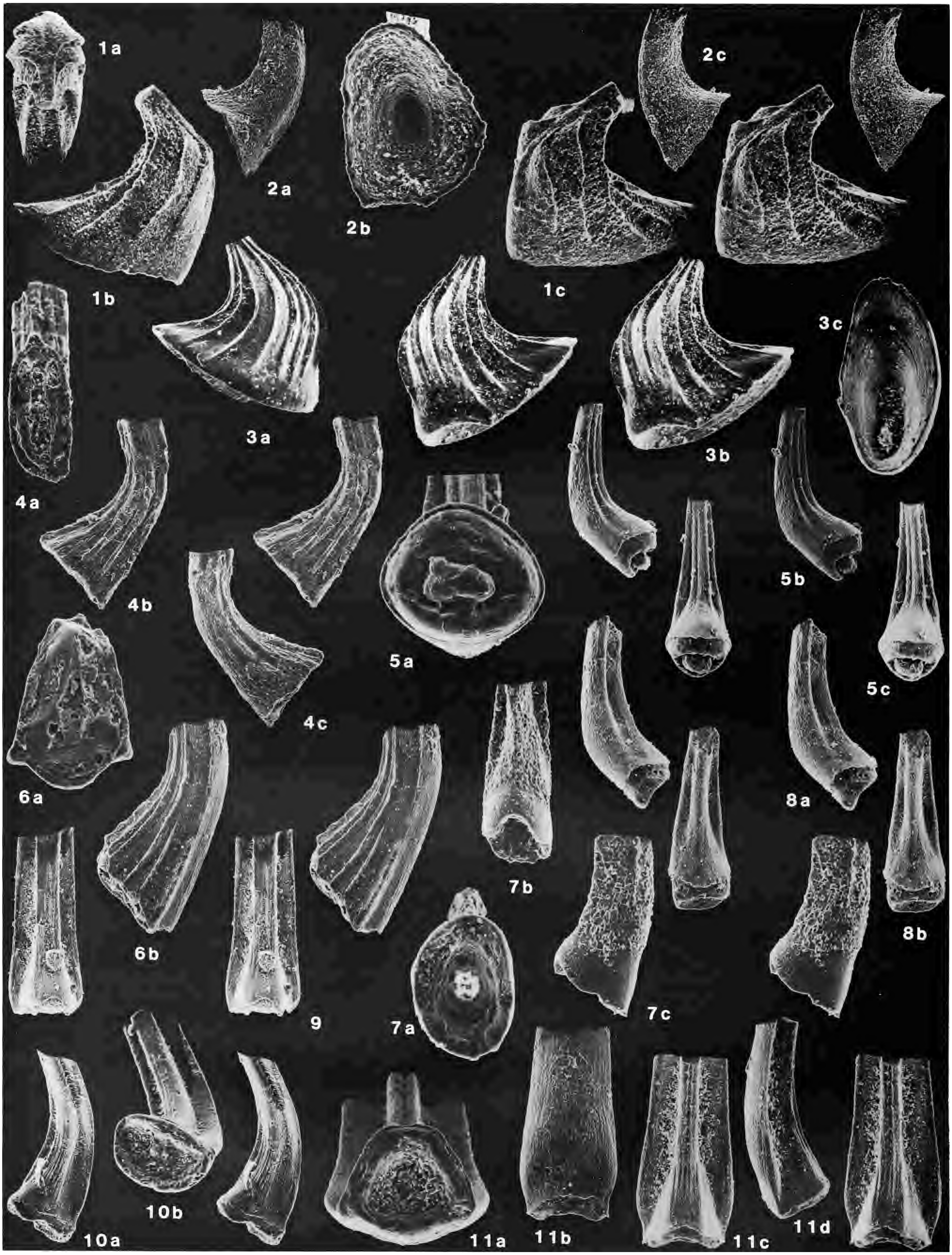
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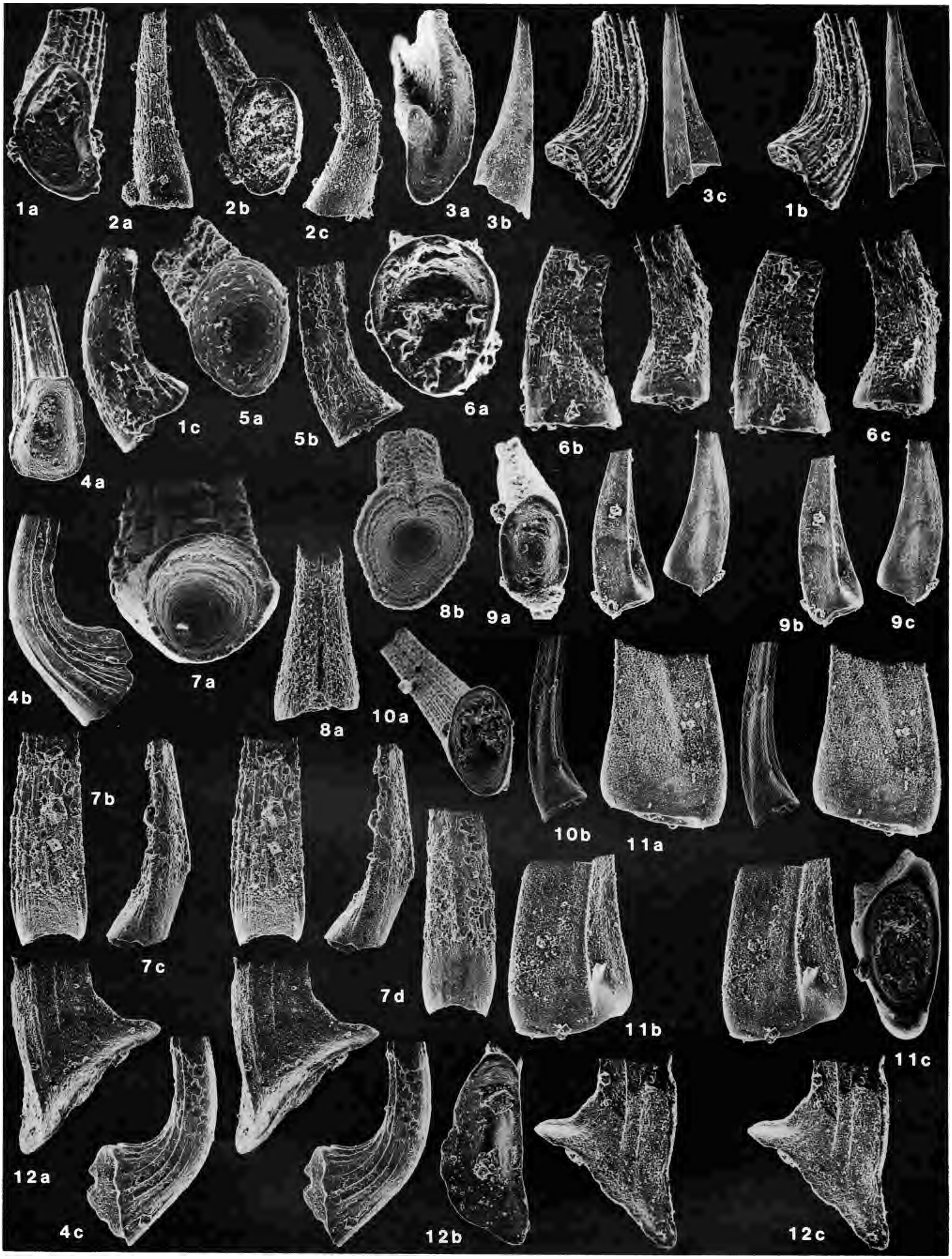
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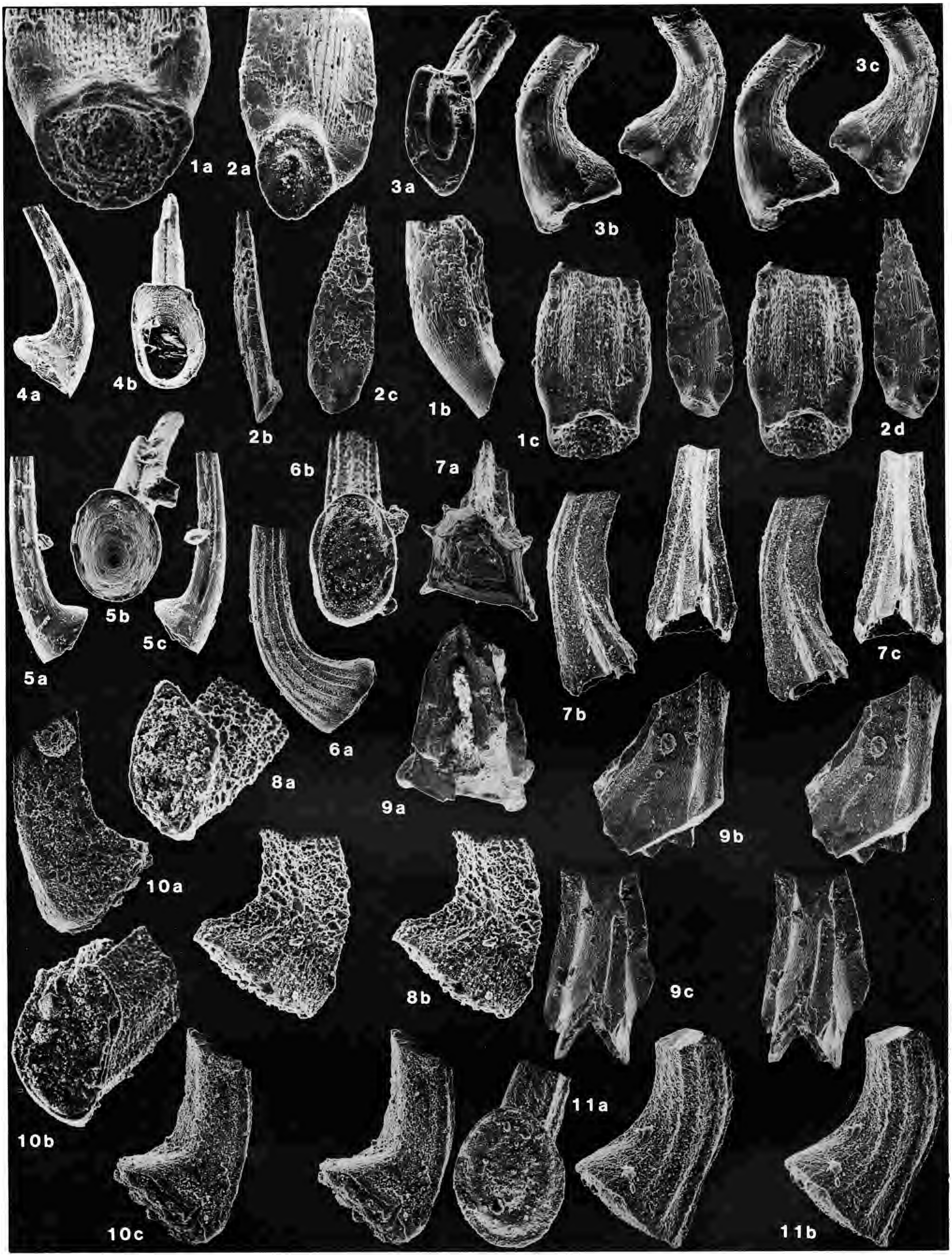
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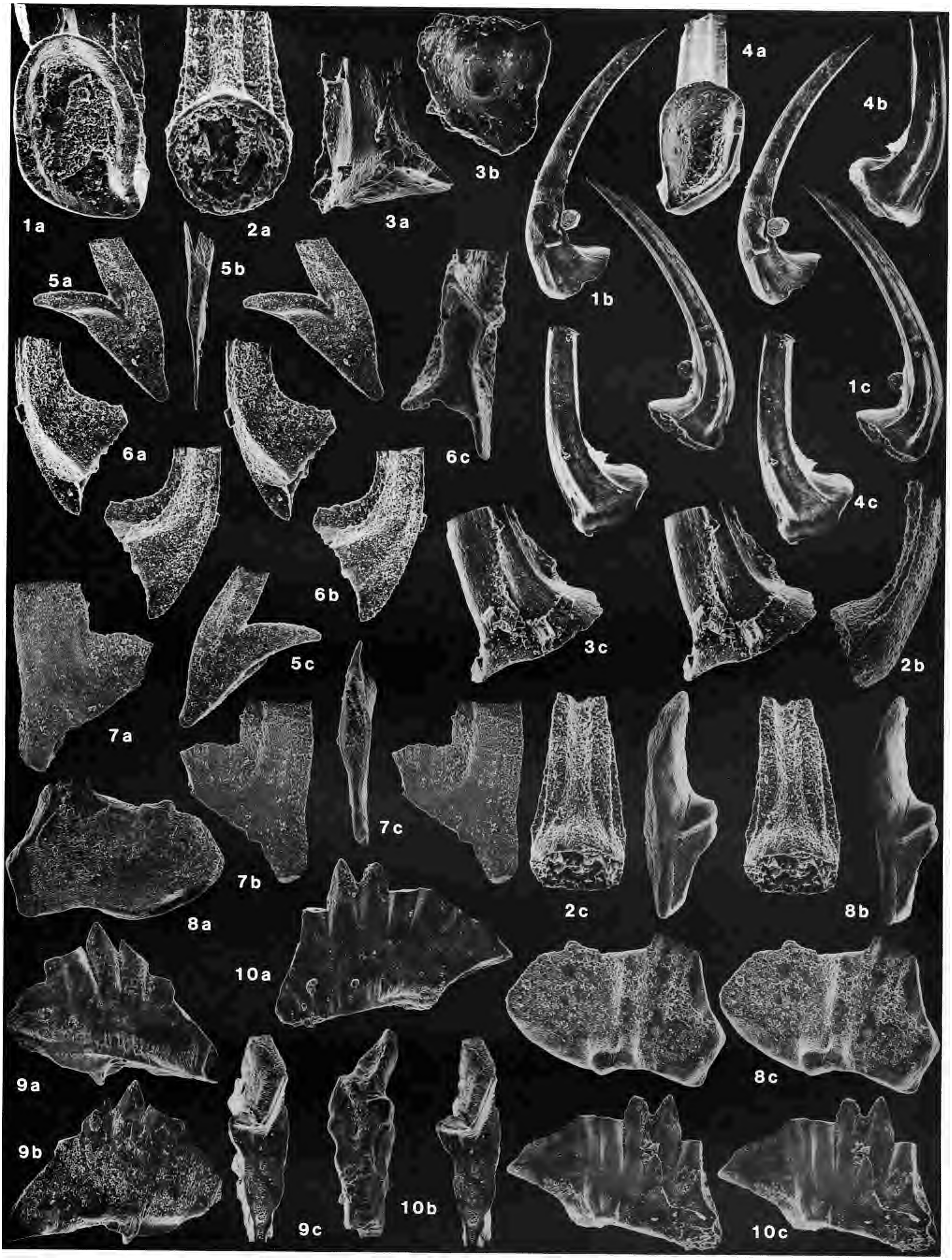
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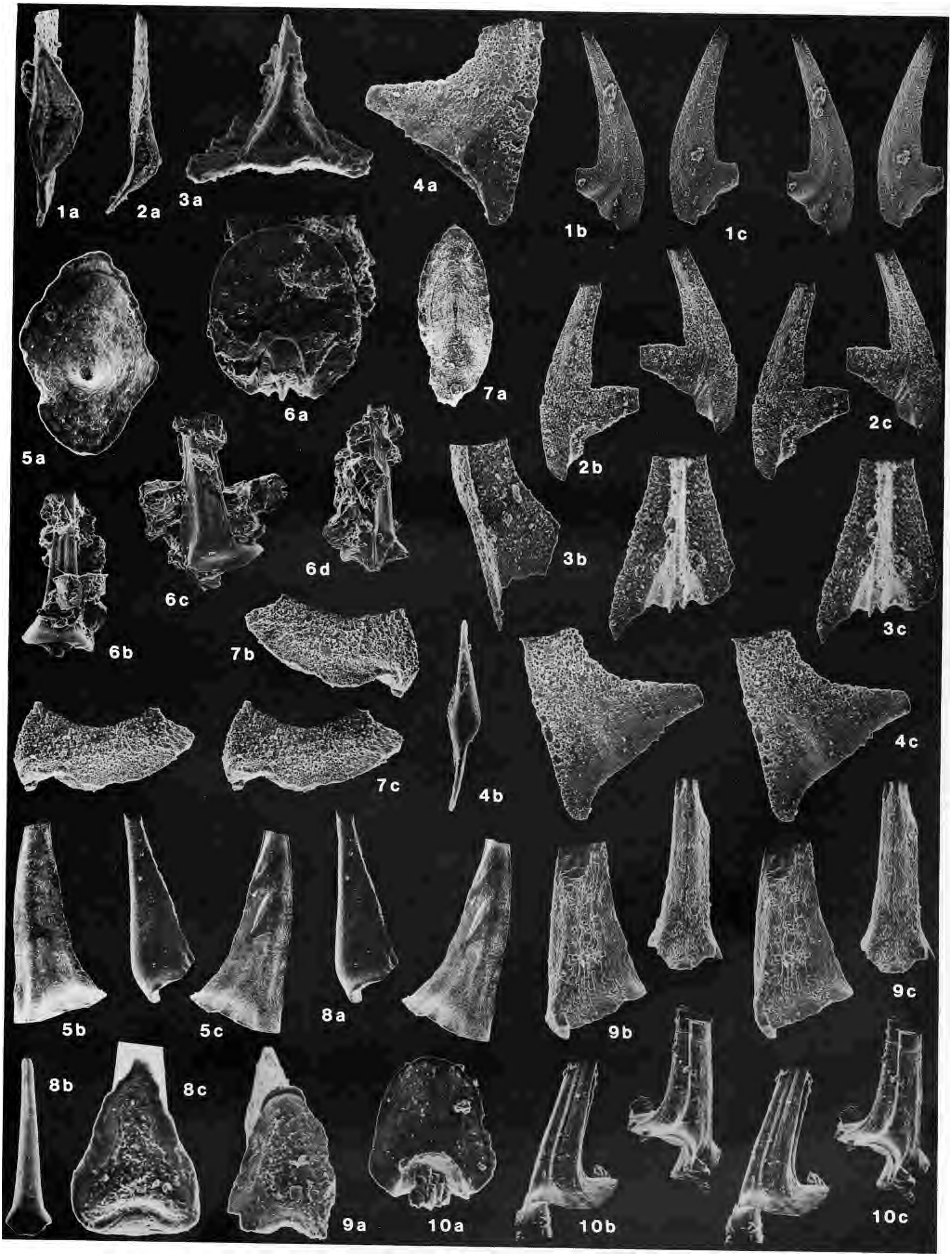
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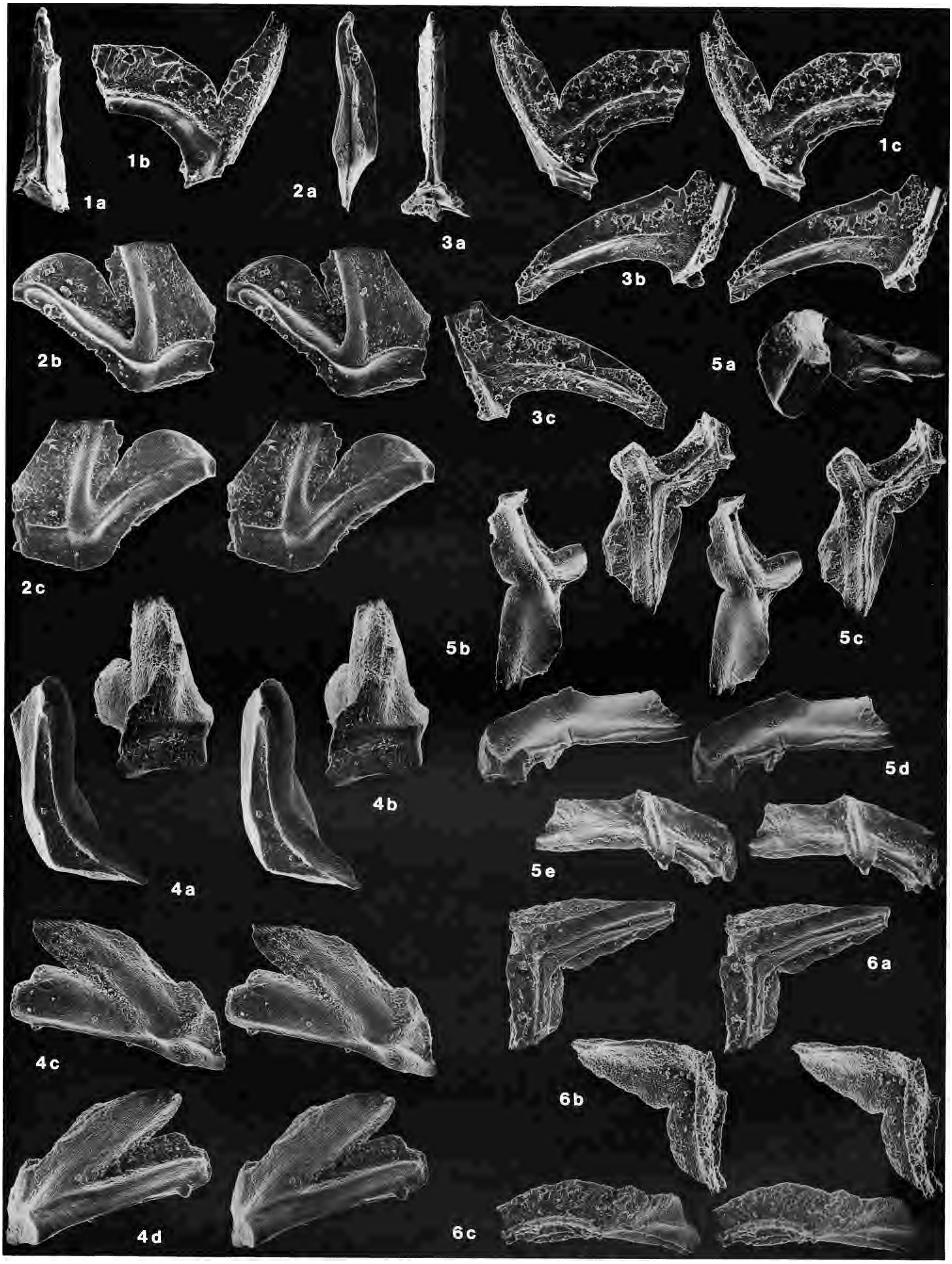
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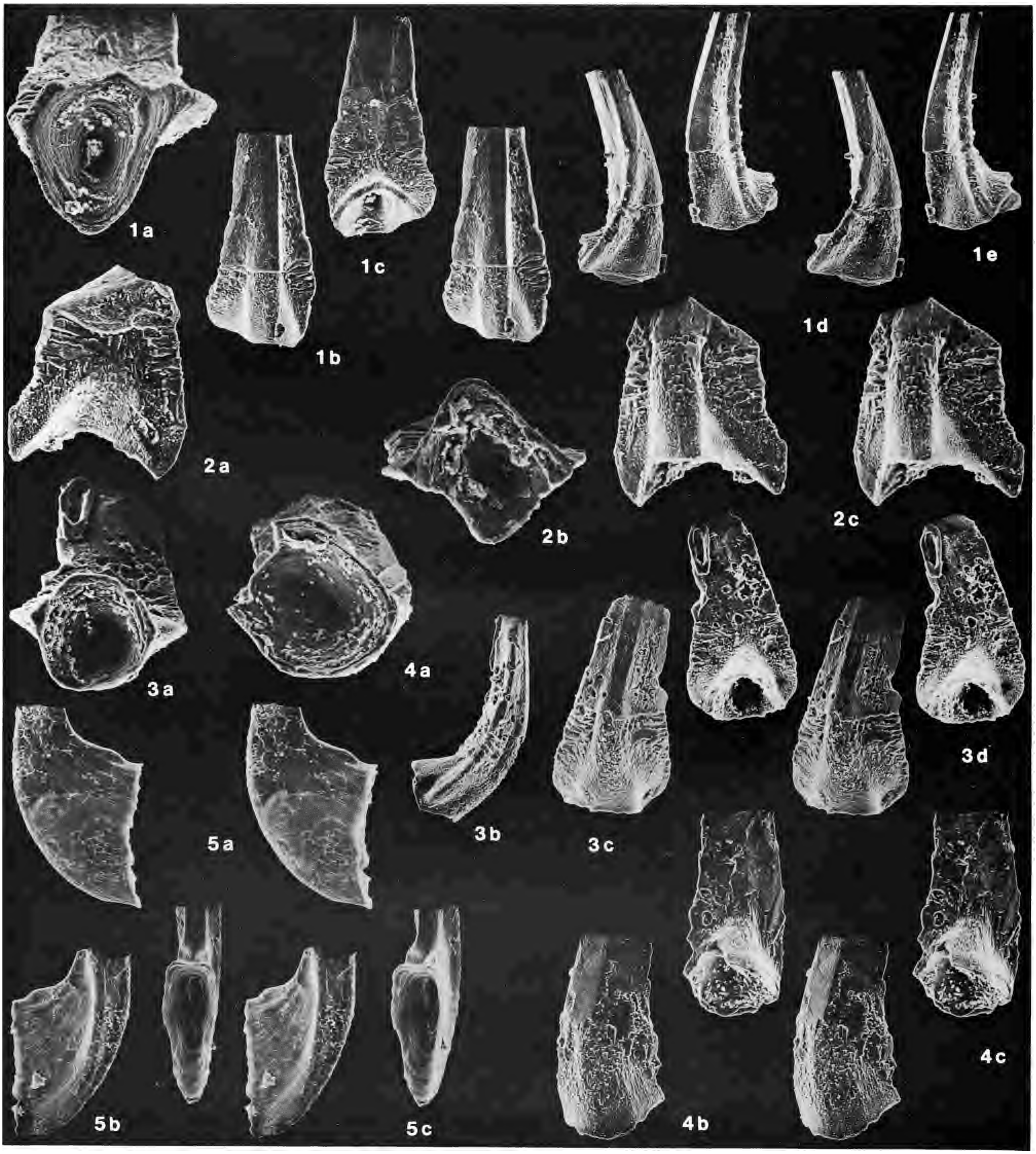
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