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Cambrian and Ordovician Rostroconch Molluscs from Northern Australia

JOHN POJETA, JR.[1], JOYCE GILBERT-TOMLINSON, AND J. H. SHERGOLD

[1] U.S. Geological Survey, Washington, D.C. 20560, U.S.A.

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CONTENTS

FIGURES

TABLES

SUMMARY

Rostroconch molluscs are widespread and abundant in the Cambrian and Ordovician rocks of the Amadeus and Georgina Basins of northern Australia. Because the mollusc faunas of this area are largely unknown, this study concentrates on their systematics and biostratigraphic distribution. The work complements that of Pojeta & Runnegar (1976), who considered the known Cambrian and Ordovician rostroconchs from the rest of the world.

We deal with 32 species, which are placed in 15 genera; 24 of the species are named and 8 are treated with open nomenclature. The 21 named species and 6 genera newly named here are: *Ribeiria csiro* sp. nov., *R. huckitta* sp. nov., *R. jonesi* sp. nov., *R. runnegari* sp. nov., *Apoptopegma dickinsi* gen. nov. et sp. nov., *Cymatopegma semiplicatum* gen. nov. et sp. nov., *Pinnocaris wellsi* sp. nov., *P. robusta* sp. nov., *Ptychopegma burgeri* gen. nov. et sp. nov., *Wanwania drucei* sp. nov., *Technophorus kempae* sp. nov., *T. nicolli* sp. nov., *T. planei* sp. nov., *T. walteri* sp. nov., *Kimopegma pinnatum* gen. nov. et sp. nov., *Pauropegma* gen. nov., *Pleuropegma plicatum* gen. nov. et sp. nov., *Tolmachovia belfordi* sp. nov., *Eopteria struszi* sp. nov., *Euchasma caseyi* sp. nov., *E. skwarkoi* sp. nov., and *Bransonia chapronierei* sp. nov.

Twenty of the species are presently known only from the Georgina Basin, seven are known only from the Amadeus Basin, and five are common to both basins. The specimens were collected from 95 localities. The Australian occurrences are unusual in that 11 of the species are known from Upper Cambrian rocks; elsewhere in the world there are only four known species of rostroconchs in the whole Cambrian System. In the Cambrian rocks of Australia, four species of rostroconchs are known to occur in the Mindyallan Stage, one in the Idamean Stage, and seven in the Payntonian Stage. In the Australian Ordovician, ten species are known to occur in Datsonian rocks, four in Warendian rocks, and five in Arenigian rocks.

Elsewhere in the world, most pre-Silurian rostroconchs occur in carbonate rocks; in Australia 14 of the known species occur in clastic rocks, and the remainder in carbonate rocks.

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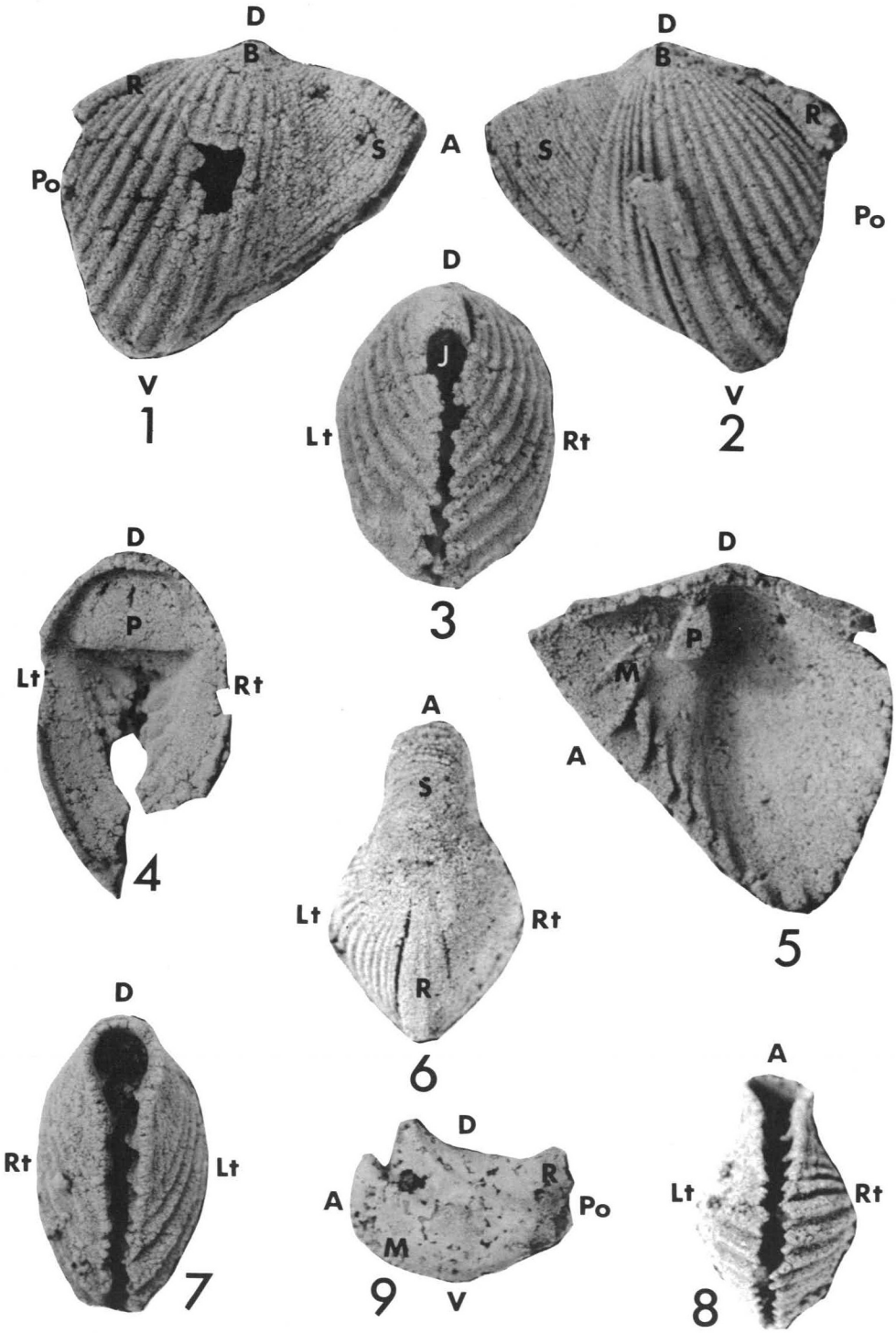
1. INTRODUCTION

This paper is a systematic and biostratigraphic study of the rostroconch molluscs from the Cambrian and Ordovician rocks of the Amadeus and Georgina Basins in the Northern Territory and western Queensland. We recognize 32 species, of which 24 are named and 8 are treated within open nomenclature. Twenty of the species are presently known only from the Georgina Basin, seven occur only in the Amadeus Basin, and five are common to both basins (Table 2). Only three of the named species have been considered previously (Pojeta & Runnegar, 1976); the remaining 21 species are newly named herein. To our knowledge, Tate (1896, p. 110) is the only author to have previously indicated the presence of what are now called rostroconchs in the area of this study; he named '*Conocardium* sp. ind.' His specimen is not well preserved but is a conocardioid. Elsewhere in the Cambrian and Ordovician rocks of Australia, Etheridge (1883, pl. 2, figs. 15a, b) figured a rostroconch from the Ordovician rocks of Tasmania; we could not locate this specimen, but, on the basis of Etheridge's figures, it is probably assignable to the genus *Tolmachovia* Howell and Kobayashi. In the post-Ordovician the only major work on Australian rostroconchs is that of Fletcher (1943). Our work complements that of Pojeta & Runnegar (1976), who dealt with the systematics of all known Cambrian and Ordovician rostroconchs outside of Australia. They have also dealt with the functional and descriptive morphology of the Class Rostroconchia, and we refer readers to their paper for an explanation of the morphological terms and the orientation of rostroconchs used here. We provide a brief introduction to rostroconch morphological terminology in Figure 1. Now that the northern Australian material has been described, all known Cambrian and Ordovician rostroconchs in the world have been considered herein or by Pojeta & Runnegar (1976); we now have a general idea of the diversity of the class through about 140 million years of geologic time in a large part of the world. There still remain extensive areas of Cambrian and Ordovician outcrop in Australia, China, and the USSR which may add significantly to our knowledge of the Rostroconchia.

A considerable part of this study is devoted to the biostratigraphic occurrence and usefulness of rostroconchs in the Cambrian and Ordovician rocks of northern Australia. The basic biostratigraphic data are provided in each species description under the heading *Distribution* and in the Locality Register (pp. 31-51), where the trilobites and conodonts which were used to date the rostroconchs are identified. The Cambrian and Ordovician stages of northern Australia have largely been established on the basis of trilobites and conodonts. The stratigraphic information is brought together in a biostratigraphic summary. As can be seen from Table 1, which gives the stratigraphic ranges of northern Australian rostroconchs, most of the species are known from only one or two stages and thus have potential usefulness as biostratigraphic tools. Moreover, some of the species are exceedingly abundant and occur at many localities.

The specimens upon which this study is based have been accumulating at the Bureau of Mineral Resources (BMR) since 1954. For the most part they were collected by various field parties during the mapping of the 1:250 000 map areas, and they have been maintained intact as a collection by Gilbert-Tomlinson. This collection was supplemented by a month of field work in July-August 1974 by Pojeta and Shergold and by A. T. Wells of BMR. All told, we had several thousand specimens to examine. Most of these are placed in the new genus and species *Cymatopegma semiplicatum;* of the remaining 31 species discussed, we had about 2500 specimens. The number of specimens of each species available to us is given in each species description. The specimens are from 95 localities, of which 15 are in the Amadeus Basin and 80 in the Georgina Basin.

The geology and lithostratigraphy of the Amadeus Basin have been studied in depth by Öpik (1956); Prichard & Quinlan (1962); Ranford, Cook, & Wells (1965); Wells, Forman, & Ranford (1965); Forman (1966); Wells, Stewart, & Skwarko (1966); Wells, Ranford, Stewart, Cook, & Shaw (1967); Forman, Milligan, & McCarthy (1967); Wells, Forman, Ranford, & Cook (1970); and Cook (1972a). In addition, the entire basin has been mapped on a scale of 1:250 000 by BMR. In contrast to this extensive knowledge of the geology of the Amadeus Basin, little has been published about the palaeontology and biostratigraphy of the large Cambrian and Ordovician faunas of the area. Tate (1891, 1896), Etheridge (1891a, b; 1892; 1893; 1894), Teichert (1939), Teichert & Glenister (1952),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Thomas (1960), and Crespin (1943) wrote on the Ordovician fauna, and Öpik (1970a) described some of the Cambrian trilobites. Nieper (1970) worked with the conodonts from the Horn Valley Siltstone while at the University of Queensland; however, her dissertation has not yet been published. The rostroconchs discussed here are, therefore, the first considerable part of the large Cambrian and Ordovician faunas of the Amadeus Basin to be described and analysed biostratigraphically. In this sense, this work is a pioneering study, and we hope it will encourage others to examine the rest of the Amadeus Basin fauna, which is rich in trilobites, cephalopods, pelecypods, archaeocyaths, and trace fossils. Except for the specimens from our locality 8, which occur in limestone, all rostroconchs from the Amadeus Basin which were available to us occur in clastic rock units. They are particularly abundant in sandstones, where they are preserved as moulds and casts.

The lithostratigraphy and geology of the Georgina Basin have been summarized by Smith (1964, 1972), and the entire basin has been mapped on the 1:250 000 scale. The Cambrian and Ordovician faunas and biostratigraphy of the Georgina Basin have been studied by Druce & Jones (1971); Gilbert-Tomlinson (1973); Henderson (1974); Henderson & Shergold (1971); Hill, Playford, & Woods (1969); Jones, Shergold, & Druce (1971); Nieper (1970); Öpik (1958, 1961, 1963, 1967, 1968, 1970a, 1970b); and Shergold (1969, 1971, 1973, 1975). Most of the published palaeontological and biostratigraphic studies of the Georgina Basin have been in the carbonate facies of western Queensland. In this study we have collected from both the clastic and carbonate facies of the basin from western Queensland to central Northern Territory. Our specimens are preserved as moulds and casts in sandstone, chert, and limestone, or as silicified replicas. None of the specimens seen by us are preserved as calcareous replacements of the original shell material, and so we have seen no shell microstructure.

The Australian material described here provides important new insights into the Rostroconchia in several ways. (1) Perhaps most important is the new information about Cambrian forms. Eleven of the 32 species recognized here are Late Cambrian in age. In the rest of the world there are only four known species of Cambrian rostroconchs; two of these are Early Cambrian and two Late Cambrian (Pojeta & Runnegar, 1976). (2) The Australian material has caused the known ranges of several genera to be revised, as the oldest known well-documented species of *Bransonia* Pojeta & Runnegar, *Eopteria* Billings, *Euchasma* Billings, *Pinnocaris* Etheridge, *Ribeiria* Sharpe, and *Tolmachovia* Howell & Kobayashi, occur in Australia. *Oepikila* Runnegar & Pojeta 1974 and the new genera *Apoptopegma, Cymatopegma, Kimopegma, Pauropegma, Pleuropegma,* and *Ptychopegma* are at present unique to Australia. (3) Of the 61 species of ribeirioids known worldwide, 19 are known only from Australia. (4) A particularly important new morphological fact obtained from the Australian material is the occurrence of a pegma (Pl. 25, figs. 11, 13) in the genus *Eopteria.* This genus is ancestral to the conocardiaceans, and the presence of a pegma reinforces the interpretation that conocardioids are descended from ribeirioids, all of which have a prominent pegma (Pojeta & Runnegar, 1976). (5) The species *Ribeiria jonesi* sp. nov. shows a slight angulation of the posterior umbonal slope (Pl. 11, figs. 8-11) suggesting the beginning of a radial rib similar to that of *Technophorus* Miller and showing how the technophorids could have developed phylogenetically from the ribeiriids.

The specimen figured on Plate 10, figure 10 is at the University of Queensland (UQ F67151); all other specimens are a part of the

Fig. 1. Major morphological features of rostroconchs.

1–8. *Eopteria struszi* sp. nov.; all specimens are silicified replicas. 1, 2. Right (1) and left (2) valves showing snout (S), beak (B), and rostrum (R). 3. Posterior view showing gape; dorsal part of gape is circular (J) and forms aperture of rostrum. 4. Interior view looking anteriorly at posterior face of pegma (P) and anterior gape; posterior part of shell broken away. 5. Interior of right valve showing pegma (P) and marginal denticles (M); the latter extend dorsally as internal ribs. 6. Dorsal view showing snout (S) and rostrum (R); grooves on either side of rostrum are the longitudinal rostral clefts. 7. Anterior view showing gape and marginal denticles. 8. Ventral view showing gape. 9. *Technophorus planei* sp. nov., internal mould showing rostrum (R) and impressions of pegma (P) and marginal denticles (M). D, dorsal side; A, anterior end; V, ventral side; Po, posterior end; Rt, right valve; Lt, left valve.

Commonwealth Palaeontological Collection (CPC) and are housed at the Bureau of Mineral Resources, Canberra.

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2. BIOSTRATIGRAPHIC SUMMARY

The biostratigraphical conclusions and age determinations for each of the localities at which we have found rostroconchs in the Amadeus and Georgina Basins are given in the description of each species under the heading *Distribution.* As far as possible we have dated the rostroconch occurrences by the associated trilobites (mostly in the clastic facies) and conodonts (mostly in the carbonate facies). This was done because the Cambrian and Ordovician stages of northern Australia have largely been established on the basis of conodont and trilobite faunas (Druce & Jones, 1971; Jones, Shergold, & Druce, 1971; Öpik, 1961, 1963, 1967; Shergold, 1971, 1975). Occasionally molluscs have been used for dating the rock units (Gilbert-Tomlinson, 1973). Identifications of the conodonts, trilobites, and molluscs are listed in the Locality Register, pages 31-51, for each locality at which they were found associated with rostroconchs. In this way, we have been able to date 56 of the 95 localities at which we found rostroconchs. At the remaining localities, rostroconchs are either associated with fossils which at present cannot be used to date them, or else are the only fossils known at the locality. As indicated in the accompanying range chart (Table 1) and in the listing of species by locality (Table 2), in all cases we have tried to establish the stage(s) in which each rostroconch species occurs. At this point in our knowledge we cannot establish in which part of a stage some or all of the rostroconchs may occur, and as indicated by the question marks in the two tables, several of the species may occur above or below, as well as within, the stage indicated.

The great majority of the rostroconch specimens available to us are from grab samples and were not collected in sequence from measured sections. Hence, we do not propose a series of rostroconch zones, but try to establish the stratigraphic age in which each species occurs. This is a first step in trying to provide a new biostratigraphic tool for the dating of the Cambrian and Ordovician rocks of northern Australia; the next step would be to collect the rostroconchs sequentially from the better exposed sections in the Georgina and Amadeus Basins and to establish a series of rostroconch zones, which could then be compared to the trilobite and conodont zones. In July 1974 Pojeta and Shergold did sample the entire 1285-m Black Mountain Section of western Queensland (Jones, Shergold, & Druce, 1971; Druce & Jones, 1971) for rostroconchs. The section still had the measurements that Druce & Jones (1971) had painted on it, and thus we could correlate our rostroconch samples with their conodont samples. We consider the rostroconch biostratigraphy discussed here and shown diagramatically in Table 1 to be preliminary. We have established the minimum age ranges of the various species and have shown that many of them seem to be limited to one or two stages; they thus have potential biostratigraphic usefulness in the Late Cambrian and Early Ordovician of northern Australia.

Our collections are from 10 rock units. In the Georgina Basin we have samples from the Coolibah Formation (localities 52, 53, 87, 88, 89, 91, 92, 93); Georgina Limestone (locality 85); Mungerebar Limestone (localities 50, 51); Ninmaroo Formation (localities 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 37, 38, 39, 41, 42, 43, 44, 45, 46, 47, 48, 49, 54, 90, 95); Nora Formation (locality 55); Swift Formation (localities 35, 36, 40); and Tomahawk Beds (localities 1, 2, 14, 15,

16, 17, 18, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 94). In the Amadeus Basin we have collections from the Goyder Formation (locality 8); Pacoota Sandstone (localities 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 56, 59); and Stairway Sandstone (localities 57, 86). Locality 96 is in the Georgina Basin, but the identification of the rock unit is uncertain.

We have accepted the age assignment of the Coolibah Formation given by Gilbert-Tomlinson (1973) and regard all collections made from this unit as Arenigian in age (late Early Ordovician). The age of the one locality in the Georgina Limestone is established as Idamean (early Late Cambrian) on the basis of trilobites identified by A. A. Öpik. From the Goyder Formation we had one collection at one locality whose trilobites were determined to be Mindyallan in age (earliest Late Cambrian) by A. A. Öpik. The age of the single collection from the Nora Formation at Neeyamba Hill may be lower Chazyan (early Middle Ordovician), on the basis of the work of Nieper (1970), who collected the conodont fauna at this locality. Druce (oral comm., January 1975) noted the occurrence of Arenigian (Early Ordovician) conodonts in the Nora. We had two collections from the Mungerebar Limestone, both of which are dated as Mindyallan by trilobites identified by A. A. Öpik. Our two collections from the Stairway Sandstone can only be dated as near the Early/Middle Ordovician boundary; this formation probably varies in age from late Canadian to Llandeilian, and the fossils associated with the rostroconchs do not allow us to determine to which age or epoch the collections belong. The three collections from the Swift Formation are regarded as of possible Arenigian (late Early Ordovician) age (Druce & Jones, 1971; Jones, Shergold, & Druce, 1971; and p. 24 herein).

Most of our collections are from three rock units: Ninmaroo Formation, Pacoota Sandstone, and Tomahawk Beds, all of which cross the Cambrian/Ordovician boundary (Druce & Jones, 1971; Jones, Shergold, & Druce, 1971; Smith. 1972; Wells, Forman, Ranford, & Cook, 1970). Of the 17 Ninmaroo localities that could be dated, 20, 21, 22, 41, 42, 43, 44, 47, and 48 are Datsonian in age (early Tremadocian; Early Ordovician); localities 29, 30, 31, 37, 38, 39, 45, and 90 are Warendian (late Tremadocian; Early Ordovician). Fourteen of the 17 dated Ninmaroo localities are in the Boulia map area. We have no rostroconchs from the Payntonian (late Upper Cambrian) part of the Ninmaroo Formation. Rostroconchs from locality 41 (Black Mountain Section) occur above the highest Payntonian trilobites and below the lowest Datsonian conodonts; two of the three genera found at this locality (*Eopteria* and *Bransonia*) are not known from rocks older than Ordovician elsewhere in the world, and on this basis we regard locality 41 as Datsonian in age; the third genus found at locality 41 (*Apoptopegma*) is newly described and is unique to Australia.

In the Pacoota Sandstone, the trilobites at localities 3, 4, 6, 7 and 12 indicate a Payntonian age (late Late Cambrian). At localities 5 and 56, the trilobites suggest an Arenigian age. In the Waterhouse Range and in the Alice Springs area, Gilbert-Tomlinson has observed the trilobites that occur at locality 56 overlying the trilobites that occur at locality 5.

The Tomahawk Beds are dated as Payntonian (late Late Cambrian) at localities 15, 16, 17, 18, 61, 71, 82, and 83, and as Early Ordovician (probably Datsonian) at localities 73, 74, 77, 78, and 84. In the Barrow Creek map area (localities 15-18) the Tomahawk Beds are not known to be younger than Payntonian, whereas to the southeast in the Huckitta map area, the formation contains both Payntonian and Early Ordovician trilobites. This may suggest that Tomahawk deposition continued longer in the Huckitta area than in the Barrow Creek area and that the rostroconchs in the southwestern part of the Georgina Basin may prove useful in making palaeogeographic interpretations.

During the Cambrian, the Amadeus and Georgina Basins had five known species of rostroconchs in common. The oldest, *Oepikila cambrica,* occurs in the Goyder Formation (Mindyallan) of the Amadeus Basin and in the slightly younger Georgina Limestone (Idamean) of the Georgina Basin. During the Payntonian, the following species occur in both the Pacoota Sandstone of the Amadeus Basin and the Tomahawk Beds of the Georgina Basin: *Cymatopegma semiplicatum, Kimopegma pinnatum, Ribeiria huckitta,* and *R. jonesi.* After the Payntonian, we know of no rostroconch species in common between the two basins. This difference between the Cambrian and Ordovician distribution of the species of the two basins may be largely an artifact of collecting, as we have only four dated post-Payntonian localities in the Amadeus Basin at which rostroconchs have been found

TABLE 1

Range chart showing known stratigraphic distribution by stage of Northern Australian Cambrian and Ordovician Rostroconchs

The question marks indicate that the species concerned may occur above or below, as well as within, the stage indicated.

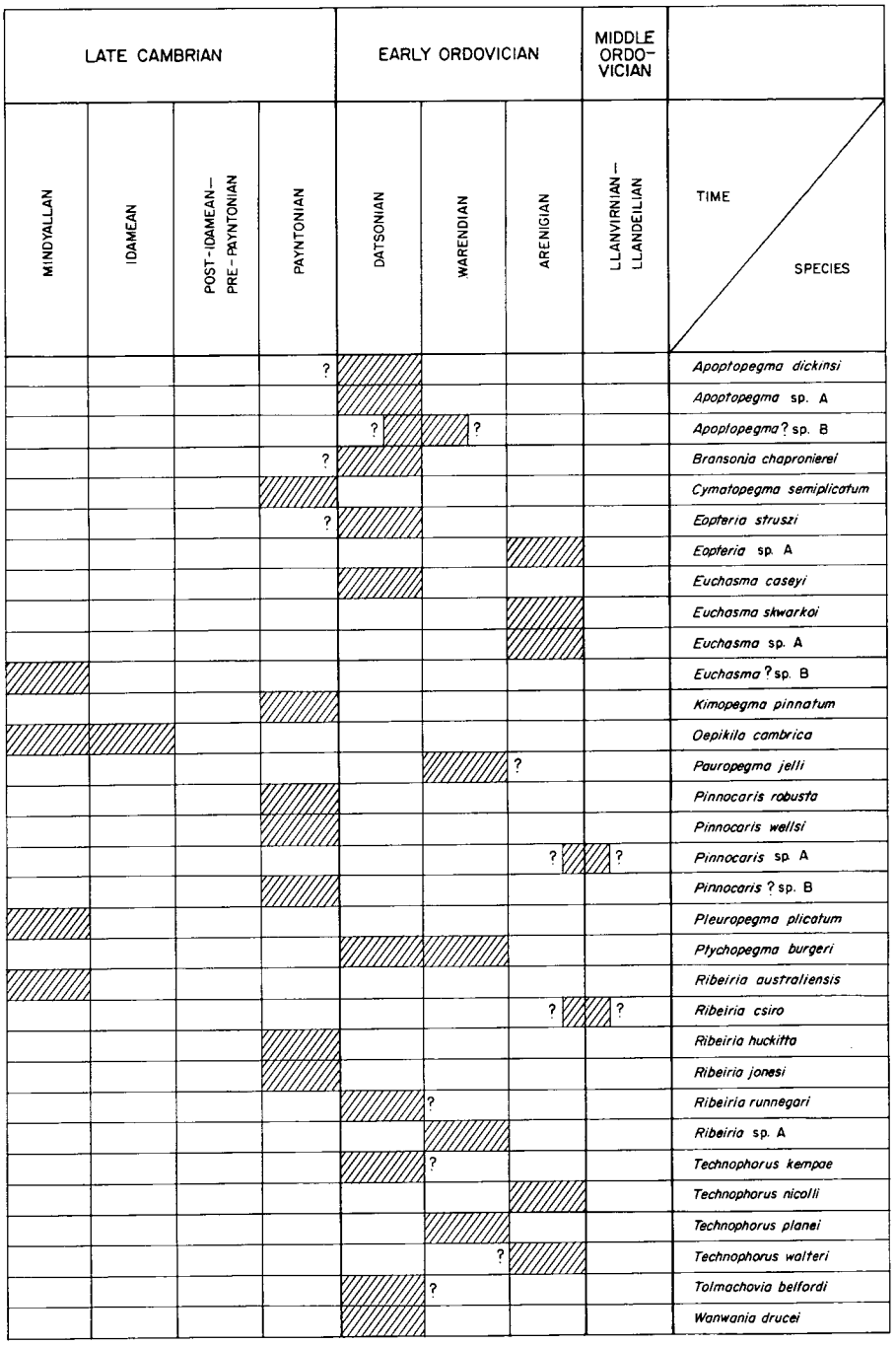

TABLE 2

Northern Australian Cambrian and Ordovician rostroconch species listed by locality, basin, and rock unit

Stage determination is given for each locality where stratigraphically useful fossils are found associated with the rostroconchs. ———, uncertain.

Species Name	*Locality Number*	*Basin*	*Rock Unit*	*Stage*
Apoptopegma dickinsi	41	Georgina	Ninmaroo Formation	Datsonian?
Apoptopegma sp. A	48	Georgina	Ninmaroo Formation	Datsonian
Apoptopegma? sp. B	46	Georgina	—	—
Bransonia chapronierei	41	Georgina	Ninmaroo Formation	Datsonian?
Cymatopegma semiplicatum	3	Amadeus	Pacoota Sandstone	Payntonian
Cymatopegma semiplicatum	4	Amadeus	Pacoota Sandstone	Payntonian
Cymatopegma semiplicatum	6	Amadeus	Pacoota Sandstone	Payntonian
Cymatopegma semiplicatum	7	Amadeus	Pacoota Sandstone	Payntonian
Cymatopegma semiplicatum	9	Amadeus	Pacoota Sandstone	—
Cymatopegma semiplicatum	12	Amadeus	Pacoota Sandstone	Payntonian
Cymatopegma semiplicatum	13	Amadeus	Pacoota Sandstone	—
Cymatopegma semiplicatum	14	Georgina	Tomahawk Beds	—
Cymatopegma semiplicatum	16	Georgina	Tomahawk Beds	Payntonian
Cymatopegma semiplicatum	18	Georgina	Tomahawk Beds	Payntonian
Cymatopegma semiplicatum	59	Amadeus	Pacoota Sandstone	—
Cymatopegma semiplicatum	60	Georgina	Tomahawk Beds	—
Cymatopegma semiplicatum	61	Georgina	Tomahawk Beds	Payntonian
Cymatopegma semiplicatum	64	Georgina	Tomahawk Beds	—
Cymatopegma semiplicatum	65	Georgina	Tomahawk Beds	—
Cymatopegma semiplicatum	68	Georgina	Tomahawk Beds	—
Cymatopegma semiplicatum	69	Georgina	Tomahawk Beds	—
Cymatopegma semiplicatum	71	Georgina	Tomahawk Beds	Payntonian
Cymatopegma semiplicatum	72	Georgina	Tomahawk Beds	—
Cymatopegma semiplicatum	75	Georgina	Tomahawk Beds	—
Cymatopegma semiplicatum	80	Georgina	Tomahawk Beds	—
Cymatopegma semiplicatum	82	Georgina	Tomahawk Beds	Payntonian
Cymatopegma semiplicatum	96	Georgina	—	Payntonian
Eopteria struszi	19	Georgina	Ninmaroo Formation	—
Eopteria struszi	20	Georgina	Ninmaroo Formation	Datsonian
Eopteria struszi	22	Georgina	Ninmaroo Formation	Datsonian
Eopteria struszi	23	Georgina	Ninmaroo Formation	—
Eopteria struszi	24	Georgina	Ninmaroo Formation	—
Eopteria struszi	25	Georgina	Ninmaroo Formation	—
Eopteria struszi	26	Georgina	Ninmaroo Formation	—
Eopteria struszi	27	Georgina	Ninmaroo Formation	—
Eopteria struszi	28	Georgina	Ninmaroo Formation	—
Eopteria struszi	32	Georgina	Ninmaroo Formation	—
Eopteria struszi	41	Georgina	Ninmaroo Formation	Datsonian?
Eopteria struszi	43	Georgina	Ninmaroo Formation	Datsonian
Eopteria struszi	44	Georgina	Ninmaroo Formation	Datsonian
Eopteria struszi	47	Georgina	Ninmaroo Formation	Datsonian
Eopteria struszi	48	Georgina	Ninmaroo Formation	Datsonian
Eopteria struszi	54	Georgina	Ninmaroo Formation	—
Eopteria sp. A	52	Georgina	Coolibah Formation	Arenigian
Euchasma caseyi	19	Georgina	Ninmaroo Formation	—
Euchasma caseyi	22	Georgina	Ninmaroo Formation	Datsonian
Euchasma caseyi	24	Georgina	Ninmaroo Formation	—
Euchasma caseyi	25	Georgina	Ninmaroo Formation	—
Euchasma caseyi	26	Georgina	Ninmaroo Formation	—

Species Name	*Locality Number*	*Basin*	*Rock Unit*	*Stage*
Euchasma caseyi	27	Georgina	Ninmaroo Formation	—
Euchasma caseyi	28	Georgina	Ninmaroo Formation	—
Euchasma caseyi	42	Georgina	Ninmaroo Formation	Datsonian
Euchasma caseyi	47	Georgina	Ninmaroo Formation	Datsonian
Euchasma caseyi	48	Georgina	Ninmaroo Formation	Datsonian
Euchasma caseyi	49	Georgina	Ninmaroo Formation	—
Euchasma caseyi	54	Georgina	Ninmaroo Formation	—
Euchasma skwarkoi	87	Georgina	Coolibah Formation	Arenigian
Euchasma skwarkoi	88	Georgina	Coolibah Formation	Arenigian
Euchasma skwarkoi	89	Georgina	Coolibah Formation	Arenigian
Euchasma skwarkoi	91	Georgina	Coolibah Formation	Arenigian
Euchasma skwarkoi	92	Georgina	Coolibah Formation	Arenigian
Euchasma skwarkoi	93	Georgina	Coolibah Formation	Arenigian
Euchasma sp. A	53	Georgina	Coolibah Formation	Arenigian
Euchasma? sp. B	50	Georgina	Mungerebar Limestone	Mindyallan
Kimopegma pinnatum	4	Amadeus	Pacoota Sandstone	Payntonian
Kimopegma pinnatum	16	Georgina	Tomahawk Beds	Payntonian
Kimopegma pinnatum	18	Georgina	Tomahawk Beds	Payntonian
Kimopegma pinnatum	96	Georgina	—	Payntonian
Oepikila cambrica	8	Amadeus	Goyder Formation	Mindyallan
Oepikila cambrica	85	Georgina	Georgina Limestone	Idamean
Pauropegma jelli	30	Georgina	Ninmaroo Formation	Warendian
Pauropegma jelli	31	Georgina	Ninmaroo Formation	Warendian
Pauropegma jelli	33	Georgina	Ninmaroo Formation	—
Pauropegma jelli	34	Georgina	Ninmaroo Formation	—
Pauropegma jelli	35	Georgina	Swift Formation	Arenigian?
Pauropegma jelli	37	Georgina	Ninmaroo Formation	Warendian
Pauropegma jelli	38	Georgina	Ninmaroo Formation	Warendian
Pauropegma jelli	39	Georgina	Ninmaroo Formation	Warendian
Pauropegma jelli	40	Georgina	Swift Formation	Arenigian?
Pauropegma jelli	45	Georgina	Ninmaroo Formation	Warendian
Pauropegma jelli	90	Georgina	Ninmaroo Formation	Warendian
Pauropegma jelli	95	Georgina	Ninmaroo Formation	—
Pinnocaris robusta	4	Amadeus	Pacoota Sandstone	Payntonian
Pinnocaris robusta	6	Amadeus	Pacoota Sandstone	Payntonian
Pinnocaris robusta	10	Amadeus	Pacoota Sandstone	—
Pinnocaris robusta	11	Amadeus	Pacoota Sandstone	—
Pinnocaris wellsi	4	Amadeus	Pacoota Sandstone	Payntonian
Pinnocaris sp. A	57	Amadeus	Stairway Sandstone	Arenigian-Llandeilian
Pinnocaris? sp. B	82	Georgina	Tomahawk Beds	Payntonian
Pleuropegma plicatum	8	Amadeus	Goyder Formation	Mindyallan
Ptychopegma burgeri	21	Georgina	Ninmaroo Formation	Datsonian
Ptychopegma burgeri	29	Georgina	Ninmaroo Formation	Warendian
Ptychopegma burgeri	42	Georgina	Ninmaroo Formation	Datsonian
Ribeiria australiensis	51	Georgina	Mungerebar Limestone	Mindyallan
Ribeiria csiro	86	Amadeus	Stairway Sandstone	Arenigian-Llandeilian
Ribeiria huckitta	1	Georgina	Tomahawk Beds	—
Ribeiria huckitta	7	Amadeus	Pacoota Sandstone	Payntonian
Ribeiria huckitta	17	Georgina	Tomahawk Beds	Payntonian
Ribeiria huckitta	61	Georgina	Tomahawk Beds	Payntonian
Ribeiria huckitta	62	Georgina	Tomahawk Beds	—
Ribeiria huckitta	66	Georgina	Tomahawk Beds	—
Ribeiria huckitta	67	Georgina	Tomahawk Beds	—

Species Name	*Locality Number*	*Basin*	*Rock Unit*	*Stage*
Ribeiria huckitta	76	Georgina	Tomahawk Beds	—
Ribeiria huckitta	79	Georgina	Tomahawk Beds	—
Ribeiria huckitta	83	Georgina	Tomahawk Beds	Payntonian
Ribeiria huckitta	96	Georgina	—	Payntonian
Ribeiria jonesi	4	Amadeus	Pacoota Sandstone	Payntonian
Ribeiria jonesi	12	Amadeus	Pacoota Sandstone	Payntonian
Ribeiria jonesi	59	Amadeus	Pacoota Sandstone	—
Ribeiria jonesi	94	Georgina	Tomahawk Beds	—
Ribeiria runnegari	84	Georgina	Tomahawk Beds	Datsonian?
Ribeiria sp. A	38	Georgina	Ninmaroo Formation	Warendian
Technophorus kempae	2	Georgina	Tomahawk Beds	—
Technophorus kempae	63	Georgina	Tomahawk Beds	—
Technophorus kempae	73	Georgina	Tomahawk Beds	Datsonian?
Technophorus kempae	74	Georgina	Tomahawk Beds	Datsonian?
Technophorus kempae	77	Georgina	Tomahawk Beds	Datsonian?
Technophorus kempae	78	Georgina	Tomahawk Beds	Datsonian?
Technophorus kempae	84	Georgina	Tomahawk Beds	Datsonian?
Technophorus nicolli	5	Amadeus	Pacoota Sandstone	Arenigian
Technophorus planei	31	Georgina	Ninmaroo Formation	Warendian
Technophorus planei	38	Georgina	Ninmaroo Formation	Warendian
Technophorus walteri	56	Amadeus	Pacoota Sandstone	Tremadocian-Arenigian
Tolmachovia belfordi	2	Georgina	Tomahawk Beds	—
Tolmachovia belfordi	77	Georgina	Tomahawk Beds	Datsonian?
Tolmachovia belfordi	84	Georgina	Tomahawk Beds	Datsonian?
Wanwania drucei	24	Georgina	Ninmaroo Formation	—
Wanwania drucei	42	Georgina	Ninmaroo Formation	Datsonian
Wanwania drucei	44	Georgina	Ninmaroo Formation	Datsonian

(5, 56, 57, 86), whereas in the Georgina Basin we have 35 such localities.

Local Australian stratigraphic stage names are used throughout this paper, except for those intervals for which local stage names are not yet available. Such intervals are referred to either British or North American stages, and these correlations must be considered approximate. Quotation marks in the locality register around such foreign stage names imply this degree of uncertainty in the estimated age.

3. ECOLOGY

Pojeta & Runnegar (1976) noted that pre-Silurian rostroconchs are most commonly known from carbonate rock types. Of the Australian material described here, 14 of the 32 known species occur in clastic rocks: *Cymatopegma semiplicatum, Kimopegma pinnatum, Pinnocaris robusta, P. wellsi, Pinnocaris* sp. A, *Pinnocaris? sp. B, Ribeiria csiro, R. huckitta, R. jonesi, R. runnegari, Technophorus kempae, T. nicolli, T. walteri,* and *Tolmachovia belfordi.* All the other known northern Australian Cambrian and Ordovician species occur in carbonate rock types, and none occur in both clastic and carbonate rocks. Therefore it seems likely that the distribution of rostroconchs at the species level was strongly influenced by sediment type, a common occurrence in benthonic invertebrates. In part, this may explain why there are no known post-Payntonian rostroconch species in common between the Amadeus and Georgina Basins; as a generalization, most of the post-Payntonian rocks of the Amadeus Basin and southwestern Georgina Basin are clastic, whereas most of those of the southeastern Georgina Basin are carbonate. At the generic level, on the other hand, there are Australian rostroconch taxa that occur in both carbonates and clastics.

The major clastic units in the Cambrian and Ordovician of the Amadeus and Georgina

Basins were probably deposited in shallow water. They are sometimes glauconitic, and cross-bedding is common in the Pacoota Sandstone and the Stairway Sandstone. Ichnofossils are widespread. *Skolithos* is abundant in the Pacoota Sandstone and common in the Tomahawk Beds, forming the so-called pipe rock. *Cruziana* is common in the Stairway and occurs in the pipe rock of the Pacoota. *Rusophycus* is present in both the Pacoota and the Tomahawk. The most common rostroconch in these latter rock units is *Cymatopegma semiplicatum,* which often covers bedding planes and sometimes forms coquinites. None of the specimens of this species seen by us were in life position; most are unworn articulated moulds lying parallel to the bedding. The fact that they are not worn suggests they were not transported far. Rostroconchs are most commonly found in an articulated condition; the fact that one or more shell layers are continuous across the dorsal margin means that there is no dorsal commissure and that the valves are not readily disarticulated. Pelecypods, which have a dorsal commissure, are disarticulated much more quickly.

The carbonate rocks were also probably deposited in shallow water, as indicated by stromatolites, cross-bedding, and ripple marks in the Ninmaroo Formation. The petrology and environments of origin of Georgina Basin carbonate rocks are currently under study by Bruce Radke and John Draper of the Bureau of Mineral Resources.

Pojeta & Runnegar (1976) discussed the possible modes of life of rostroconchs and came to the following conclusions, which also apply to the Australian forms. Ribeiriids and bransoniids were infaunal mobile deposit feeders, whereas most technophorids were infaunal sessile suspension-feeders. *Eopteria* was a semi-infaunal to infaunal mobile deposit-feeder. Species of *Euchasma* show variation in the amount of reduction of the anterior end, which produces a shell homeomorphic with that of mytilid and some ambonychiid pelecypods. Pojeta & Runnegar regarded those species of *Euchasma* that have a prominent anterior lobe, and are thus modioliform in shape, as being semi-infaunal, and those species that lack an anterior lobe and are mytiliform (such as *E. caseyi* and *E. skwarkoi*) as being epifaunal. *Euchasma* is the only known rostroconch to have evolved epifaunal representatives. They were not able to resolve whether the epifaunal species of *Euchasma* were mobile deposit feeders or sessile suspension feeders and suggested both alternatives (1976, p. 21, 38). Because the epifaunal species of *Euchasma* must have had some method of attaching themselves to the substrate, it seems likely that the attachment structures passed through the keyhole-shaped anteroventral shell gape (Pl. 22, figs. 4, 7), which would have been apposed to the sea floor. The attachment structures would have adhered to the shell at the anterior pallial sinus (Pl. 24, figs. 1, 2, 5), and the animal could have suspension-fed through the posterior rostral gape. On these grounds we think it likely that the epifaunal species of *Euchasma* were sessile suspension-feeders.

4. SYSTEMATIC PALAEONTOLOGY

Phylum **MOLLUSCA** Cuvier, 1797

Subphylum **DIASOMA** Runnegar & Pojeta, 1974

Class **ROSTROCONCHIA** Pojeta, Runnegar, Morris, & Newell, 1972

Diagnosis: Molluscs with an uncoiled and untorted larval shell (protoconch, beak) which straddles the dorsal midline of the adult shell, and with a bivalved adult shell; with one or more shell layers continuous across the dorsal margin so that a dorsal commissure is lacking.

Stratigraphic distribution: Early Cambrian (Georgian)-Late Permian (Makarewan).

Order **RIBEIRIOIDA** Kobayashi, 1933

Diagnosis: Rostroconchs with all shell layers continuous across the dorsal margin, an anterior pegma, and a dominant posterior growth component; musculature consisting of anterior and posterior median pedal retractor muscles connected by right and left side muscles, and a pallial line in some forms.

Stratigraphic distribution: Early Cambrian (Georgian)-Late Ordovician (Ashgillian).

Family **RIBEIRIIDAE** Kobayashi, 1933

Diagnosis: Ribeirioids with anterior and posterior shell gapes and without radial ornament.

Stratigraphic distribution: Early Cambrian (Georgian)-Late Ordovician (Ashgillian).

Remarks: The family Ribeiriidae contains nine known genera of which three are known only from Australia and are newly described herein. There are 33 recognized species of which 11

are known only from Australia; 10 of these are newly described. The non-Australian species have been reviewed by Pojeta & Runnegar (1976). Ribeiriids are known from all continents except Antarctica and South America.

Genus **Ribeiria** Sharpe, 1853

Pls. 1-4, 11, 12

Type species: Ribeiria pholadiformis Sharpe, 1853 (p. 158) by monotypy.

Diagnosis: Posteriorly elongated ribeiriids in which the dorsal and ventral margins are not subparallel, the beak is not the anteriormost point of the shell, and rugose comarginal ornament is lacking.

Stratigraphic distribution: Late Cambrian (Mindyallan)-Late Ordovician (Ashgillian).

Remarks: Ribeiria is a widespread genus which occurs in Australia, western and central Europe, Manchuria, Morocco, and North America; its non-Australian stratigraphic and geographic distribution has been reviewed by Pojeta & Runnegar (1976).

The Australian material provides significant new information about the stratigraphic distribution of *Ribeiria,* because three of the five known Australian species are from Upper Cambrian rocks (Mindyallan-Payntonian). Outside Australia, only *R. taylori* Pojeta & Runnegar is known from Upper Cambrian (Trempealeauan) rocks, in New York State. The oldest known species is *R. australiensis* (Pl. 1, figs. 1-20), which is from rocks of Mindyallan age in western Queensland.

The designations rebeirioids Genera B and C (Casey & Gilbert-Tomlinson, 1956, p. 65, 70, 71) were used for species here placed in *Ribeiria.*

Ribeiria australiensis Pojeta & Runnegar, 1976

Pl. 1, figs. 1-20

1974. *Ribeiria* sp., Runnegar & Pojeta, p. 313, fig. 3J.

1976. *Ribeiria australiensis* Pojeta & Runnegar, p. 50, pl. 4, figs. 26-29.

Diagnosis: Small ovate *Ribeiria* with nearly straight carinate dorsum, and with anterior gape extending dorsally to beak.

Description: Small ovate *Ribeiria* with straight to gently concave dorsal margin, umbo projecting little or not at all above rest of dorsal margin, and dorsal carina extending posteriorly from protoconch; ventral margin arcuate, not straight; anterior margin projecting forward of beak; shell attenuated posteriorly. Anterior, ventral, and posterior shell gapes prominent, anterior gape extending dorsally to beak.

The only known internal feature is the pegma, which is small and placed high in the umbonal cavity.

Types and material: R. australiensis is known from 80 specimens, of which we figure the holotype (Pl. 1, figs. 3-7) and nine paratypes (Pl. 1, figs. 1, 2, 8-20). Eight of the paratypes have not previously been figured. The holotype (CPC 14670) is 9.4 mm long and 5.9 mm high. All known specimens of *R. australiensis* are silicified replicas.

Type locality: All known specimens of *R. australiensis* are from the Mungerebar Limestone at our locality 51, eastern Georgina Basin, western Queensland.

Stratigraphic distribution: According to Öpik (1967, v. 2, p. 8; and written communication, September 1974), at our locality 51 (Öpik locality G128), *R. australiensis* occurs with trilobites which indicate a Mindyallan Age (early Late Cambrian); his trilobite identifications are listed in the locality register.

Remarks: As noted above, *R. australiensis* is the oldest known species of the genus *Ribeiria;* it differs from other Australian species placed in the genus in its carinate dorsum (Pl. 1, figs. 5, 16, 17) and small pegma (Pl. 1, fig. 14). The anterior gape, which extends dorsally to the protoconch (Pl. 1, figs. 3, 5, 10, 16, 17) distinguishes it from all other species of *Ribeiria.*

Etymology: The species name was derived from Australia, referring to the fact that it was the first described species of the genus *Ribeiria* from Australia.

Ribeiria csiro sp. nov.

Pl. 3, figs. 3, 4

Diagnosis: Medium-sized elongated *Ribeiria* with narrow slightly concave dorsum which lacks an obvious carina.

Description: Dorsum narrow, slightly concave, and lacking a carina; umbo and beak projecting above rest of dorsal margin; anterior margin projecting forward of beak; ventral margin arcuate, not straight; shell markedly attenuated posteriorly; beak not terminal on dorsal margin; anterior gape not extended dorsally to beak.

Internally there is a prominent oblique pegma, and a shell thickening along the posterodorsal margin which produces a notch in internal moulds.

Types and material: Ribieria csiro is known at present only from the two specimens that form the type suite. We figure the holotype (Pl. 3, fig. 3) and the paratype (Pl. 3, fig. 4), both of which are preserved in the same piece of rock. The holotype (CPC 14715) is an internal mould which shows the pegma and the notch in the posterior

part of the dorsal margin. It also shows the dorsal shell margin above the internal mould, indicating that in shelled specimens the dorsal margin is less concave than in internal moulds. The holotype is 25.2 mm long and 10.2 mm high. The paratype (CPC 14716) is largely imbedded in the indurated sandstone matrix; it preserves the shell, which is exposed dorsally and shows the absence of an obvious carina and that the anterior gape does not extend to the protoconch. Just in front of the protoconch is a prominent transverse slit, which is probably the exposed dorsal part of the pegma, although it may be a transverse cleft.

Type locality: Both known specimens of *R. csiro* are from the Stairway Sandstone at our locality 86, Amadeus Basin, southern Northern Territory.

Stratigraphic distribution: The only fossils known to occur with *R. csiro* at locality 86 are palaeotaxodont pelecypods. As *Ribeiria* is not known to occur in post-Ordovician rocks (Pojeta & Runnegar, 1976), and as palaeotaxodonts are unknown from rocks older than the Tremadocian (Early Ordovician; Pojeta & Runnegar, 1974; Pojeta, 1975), an Ordovician age is indicated for the Stairway Sandstone.

Gilbert-Tomlinson (*in* Wells et al., 1970, p. 71; *in* Cook, 1972a, p. 5) suggested that the Stairway Sandstone ranges in age from late Llanvirnian to Llandeilian (early Middle Ordovician); and (1973, p. 75) suggested that the Stairway Sandstone is no younger than Llandeilian and that it may be Llanvirnian in age. She has since (unpublished data) found a *Ptyocephalus*-like (=*Kirkella* Kobayashi) trilobite in the Stairway Sandstone which suggests late Canadian (Early Ordovician) age (Harrington et al., 1959; Hintze, 1952; Ross, 1951).

Druce (oral communication, December 1974) noted that on exceedingly preliminary studies of grab samples, the conodonts of the Stairway Sandstone suggest a possible early Llanvirnian Age (early Middle Ordovician).

Because the Stairway Sandstone outcrops are distributed over 50 000 km^2 of the Amadeus Basin (Cook, 1972a, p. 5), it may well be that the formation varies in age from place to place and that each section will have to be dated independently to obtain the regional picture. On the basis of what is presently known, the maximum age span of the Formation is probably late Canadian (late Early Ordovician) to Llandeilian (early Middle Ordovician).

Remarks: R. csiro is at present the youngest known species of *Ribeiria* from northern Australia. It differs from other Australian species in its size and marked posterior attenuation. The posterodorsal shell thickening creates similarities to *Ribeiria pholadiformis* Sharpe, which differs in having a markedly projecting umbo.

Etymology: The species name is derived from the acronym of the Australian government agency known as the Commonwealth Scientific and Industrial Research Organisation; officers of CSIRO headed the field party which collected the known specimens of the species. Pronounced 'SYRO'.

Ribeiria huckitta sp. nov.

Pl. 3, figs. 1, 2, 5-8; Pl. 4, figs. 3-5, 10-12

Diagnosis: Small *Ribeiria* with arcuate ventral margin, and umbo which markedly projects dorsally, making the dorsal margin convex.

Description: Small *Ribeiria* with markedly projecting umbo so that the dorsal margin of internal moulds is convex; ventral margin arcuate, not straight; anterior margin projecting forward of beak; shell attenuated posteriorly; lateral profile of shell subcircular; beak terminal or near terminal on dorsal margin.

Internally there is a prominent oblique pegma and a slight shell thickening along the posterodorsal margin which produces a slight saddle posterior to the umbonal projection in internal moulds.

Types and material: R. huckitta is known from 35 specimens of which the holotype (Pl. 4, fig. 11) and nine paratypes (Pl. 3, figs. 1, 2, 5-7; Pl. 4, figs. 3, 5, 10, 12) are figured. The holotype (CPC 14713) is 11 mm long and 7.5 mm high.

Two specimens (Pl. 3, fig. 8; Pl. 4, fig. 4) are tentatively assigned to this species as *R.* aff. *R. huckitta.* They lack the slight posterodorsal saddle and projecting umbo; rather the dorsal margin is straight. They have a shape reminiscent of *R. australiensis* but are significantly larger than that species, and nothing is known of their shell gapes or whether or not they have a dorsal carina.

All known specimens of *R. huckitta* are sandstone moulds and casts.

Type locality: The holotype and three of the figured paratypes are from the Tomahawk Beds at our locality 17, Georgina Basin, southern Northern Territory.

Distribution: Ribeiria huckitta is known from our localities 1, 7, 17, 61, 62, 66, 67, 76, 79, 83, and 96. All except two localities are in the Tomahawk Beds of the southern Georgina Basin; locality 7 is in the Pacoota Sandstone of the Amadeus Basin, and locality 96 is in the southern Georgina Basin, but the rock unit is uncertain. All known occurrences of *R. huckitta* are in the Northern Territory.

At localities 7, 17, 61, 83 and 96, *R. huckitta* occurs with various saukiid and *Tsinania*-like trilobites which indicate Late Cambrian (Payntonian) age. The trilobite identifications are listed in the locality register. At localities 1, 62, 66, 67, 76, and 79, *Ribeiria huckitta* occurs either with no other identifiable megafossils or with forms that are not yet useful for detailed correlation.

Etymology: The species name is derived from the Huckitta 1:250 000 map sheet (Smith, 1963), as seven of the eleven known localities at which the species occurs are in this map area.

Remarks: R. huckitta differs from other Australian species in its lateral profile.

Ribeiria jonesi sp. nov.

Pl. 4, figs. 1, 2, 6-9; Pl. 11, figs. 8-15

Diagnosis: Small *Ribeiria* with straight or nearly straight ventral margin and umbo which markedly projects dorsally, making the dorsal margin convex.

Description: Small *Ribeiria* with markedly projecting umbo so that the dorsal margin of internal moulds is convex; ventral margin straight or nearly straight; anterior margin projecting forward of beak; shell broad posteriorly, not attenuated; lateral profile of shell quadrate. Beak terminal or nearly terminal on the dorsal margin. Slight angulation of posterior umbonal slope.

Internally there is a prominent oblique pegma and a marked shell thickening along the posterodorsal margin, which produces a prominent notch posterior to the umbonal projection in internal moulds.

Types and material: R. jonesi is known from about 15 specimens of which the holotype (Pl. 11, fig. 14) and eight paratypes (Pl. 4, figs. 1, 2, 6-9; Pl. 11, figs. 8-13, 15) are figured. The holotype (CPC 14787) is 14.2 mm long and 7.7 mm high. All known specimens of *R. jonesi* are sandstone moulds and casts.

Distribution: Ribeiria jonesi is known from our localities 4, 12, 59, and 94. At the first three localities it occurs in the Pacoota Sandstone, Amadeus Basin, and at locality 94 in the Tomahawk Beds of the southern Georgina Basin. All known occurrences are in the southern Northern Territory.

At localities 4 and 12, *R. jonesi* occurs with saukiid trilobites which indicate a Late Cambrian (Payntonian) age. The trilobite identifications are listed in the locality register. At localities 59 and 94, *R. jonesi* occurs either with no other identifiable megafossils or with forms that are not yet useful for detailed correlation.

Etymology: The species is named for P. J. Jones, Bureau of Mineral Resources.

Ribeiria runnegari sp. nov.

Pl. 2, figs. 1-13

Diagnosis: Medium-sized quadrate *Ribeiria* in which the anterior margin of the shell does not project forward of the beak.

Description: Medium-sized *Ribeiria* with umbo projecting little above the rest of the dorsal margin so that the margin is straight or gently convex; dorsum flat, wide; ventral margin arcuate, not straight; anterior margin not projecting forward of beak; shell slightly attenuated posteriorly. Beak terminal on dorsal margin.

The only known internal feature is a long, thin, oblique pegma placed low in the anterior part of the shell.

Types and material: Ribeiria runnegari is known from 35 specimens, of which the holotype (Pl. 2, figs. 2, 13) and 10 paratypes (Pl. 2, figs. 1, 3-12) are figured. The holotype (CPC 14683) is 22.9 mm long and 13.5 mm high. All known specimens are sandstone moulds and casts.

Type locality: All known specimens of *R. runnegari* are from the Tomahawk Beds at our locality 84, southern Georgina Basin, southern Northern Territory.

Stratigraphic distribution: At locality 84, *R. runnegari* occurs with agnostid, asaphelloid, leiostegiacean, and kainelloid trilobites which indicate a Tremadocian (Datsonian?; Early Ordovician) age. The trilobite identifications are listed in the locality register.

Etymology: The species is named for Bruce Runnegar, University of New England, who has collaborated extensively with the senior author of this paper in the study of the palaeontology of rostroconch molluscs.

Remarks: R. runnegari is similar to *R. apusoides* Schubert & Waagen in its wide dorsum, but it differs from that species in that the anterior margin does not project forward of the beak.

Ribeiria sp. A

Pl. 12, fig. 18

Discussion: This small form is known from only one specimen, which is almost circular in lateral profile and resembles *Ribeiria parva* Collie from the Beekmantown Group (Lower Ordovician) of Pennsylvania (Pojeta & Runnegar, 1976, pl. 9, figs. 7-9). *R. parva* is also known from a single specimen, and we do not assign the Australian specimen to this species. The single known specimen of *Ribeiria* sp. A is a silicified internal mould which is 6.5 mm long and 4.9 mm high.

Distribution: Ribeiria sp. A is known from the Ninmaroo Formation at our locality 38 in the eastern Georgina Basin, western Queensland.

Druce (written and oral communication, December 1974) noted that at locality 38, *Ribeiria* sp. A occurs with the conodont *Scolopodus bassleri* in a stratigraphic position overlying conodonts that belong to the *Cordylodus rotundatus-C. angulatus* Zone (Jones, Shergold, & Druce, 1971), thus indicating a late Warendian Age (late Tremadocian; Early Ordovician).

Genus **Apoptopegma** nov.

Pl. 10

Type species: Apoptopegma dickinsi sp. nov. is designated the type species of the new genus *Apoptopegma.*

Description: Small posteriorly elongated ribeiriids with straight to gently arcuate dorsal margin. The beak is the anteriormost projection of the shell, and the anterior margin slopes posteroventrally from below the beak. Dorsal margin carinate.

Stratigraphic distribution: Early Ordovician (Datsonian; early Tremadocian).

Etymology: Apoptos, Greek, meaning far away from, referring to the position of the beak; *pegma,* Greek, meaning fastened or fixed. The pegma is a structure in rostroconchs, and the word is used as a combining form to indicate that the taxon is a rostroconch. Gender neuter.

Remarks: At present, *Apoptopegma* is known only from Australia, where it occurs in the Ninmaroo Formation, eastern Georgina Basin, western Queensland.

Apoptopegma dickinsi gen. et sp. nov.

Pl. 10, figs. 1-9

Diagnosis: Apoptopegma with weakly developed dorsal carina.

Description: Apoptopegma with nearly straight dorsal margin which curves only slightly downward in the region of the beak; beak not prominently hooked ventrally; dorsum with weak carina; anterior margin oblique to dorsal margin, nearly straight; posterior margin erect, nearly straight; ventral margin arcuate.

Types and material: Apoptopegma dickinsi is known from about 90 specimens, of which we figure the holotype (Pl. 10, figs. 1-3) and four paratypes (Pl. 10, figs. 4-9). The holotype (CPC 14767) is 3.8 mm long and 3.1 mm high. All known specimens are silicified replicas.

Type locality: All known specimens of *A. dickinsi* are from the Ninmaroo Formation at our locality 41, eastern Georgina Basin, western Queensland.

Stratigraphic distribution: Apoptopegma dickinsi occurs at 602 m above the base of the Black Mountain section of western Queensland (Jones, Shergold, & Druce, 1971, p. 16). This is 61 m below the known base of the *Cordylodus proavus* Zone in this section, which Jones, Shergold, & Druce (1971, p. 16) regarded as the basal conodont zone of the Ordovician. *Apoptopegma dickinsi* also occurs 41 m above the highest known occurrence of a Payntonian (Late Cambrian) trilobite (?*Calvinella solitaria* Shergold, 1975) in the Black Mountain section, which is at 461 m above the base.

At locality 41, *Apoptopegma dickinsi* occurs with species of the rostroconch genera *Eopteria* Billings and *Bransonia* Pojeta & Runnegar. Elsewhere in the world these genera are not known from rocks older than Ordovician (Pojeta & Runnegar, 1976), and on this basis we suggest that *Apoptopegma dickinsi* is Datsonian (early Tremadocian; Early Ordovician) in age at locality 41.

Etymology: The species is named for J. M. Dickins, Bureau of Mineral Resources.

Apoptopegma sp. A

Pl. 10, figs. 11-13

Discussion: This species is known from two specimens, neither of which is complete and both of which are silicified replicas. It differs from *A. dickinsi* in having a prominent dorsal carina, in its larger size, and in that the beak area of the shell is strongly hooked ventrally.

Distribution: Apoptopegma sp. A is known only from the Ninmaroo Formation at our locality 48 in the eastern Georgina Basin, western Queensland. We have dissolved more than 90 kg of limestone from this locality but were not able to recover any conodonts. Datsonian (early Tremadocian; Early Ordovician) age conodonts have been obtained from other outcrops of the Ninmaroo Formation in the vicinity of locality 48, and the regional stratigraphic picture (Druce, oral communication, December 1974) suggests that *Apoptopegma* sp. A is Datsonian in age at locality 48.

Apoptopegma? sp. B

Pl. 10, fig. 10

Discussion: This form is known from four incomplete silicified specimens, which resemble *Apoptopegma* in that the anterior margin slopes posteroventrally from the beak; however, the beak does not project forward of the rest of the shell, and the species is only tentatively assigned to *Apoptopegma.*

Distribution: All known specimens of *Apoptopegma*? sp. B are from the University of Queensland locality UQ L311 (our locality 46) at Mount Datson about 50 km east-northeast of Boulia, Queensland, in the eastern Georgina Basin. The known specimens are probably from the Ninmaroo Formation, which ranges in age from Late Cambrian (Payntonian) to Early Ordovician (Arenigian); at Mount Datson by far the greatest part of the Ninmaroo Formation is Tremadocian (Datsonian-Warendian; Early Ordovician) in age (Jones, Shergold, & Druce, 1971, p. 16).

Genus **Cymatopegma** nov.

Pls. 6, 7

Type species: Cymatopegma semiplicatum sp. nov. is herein designated the type species of the new genus *Cymatopegma.*

Description: Small posteriorly elongated ribeiriids with marginal denticles; anterior margin of shell rounded and projecting well beyond the beak; ornament of comarginal growth-lines and pronounced comarginal rugae which occur only on the posterior half of the shell.

Stratigraphic distribution: Late Cambrian (Payntonian).

Etymology: Cymato, Greek, meaning wave, referring to the comarginal rugae; *pegma,* Greek, meaning fastened or fixed. The pegma is a structure in rostroconchs and the word is used as a combining form to indicate that the taxon is a rostroconch. Gender neuter.

Remarks: At present, *Cymatopegma* is known only from Australia, where it occurs in the Pacoota Sandstone, Amadeus Basin, and the Tomahawk Beds, southern Georgina Basin. All occurrences are in the southern Northern Territory. *Cymatopegma* differs from all other ribeiriid genera in having comarginal rugae limited to the posterior half of the shell.

The designation ribeirioid Genus A was used by Casey & Gilbert-Tomlinson (1956, pp. 65, 67, 70, 71) for *Cymatopegma.*

Cymatopegma semiplicatum gen. et sp. nov.

Pl. 6, figs. 1-17; Pl. 7, figs. 1-10

Diagnosis: Cymatopegma with straight or nearly straight dorsal margin and rounded anterior and posterior margins.

Description: Small semicircular *Cymatopegma* with straight or nearly straight dorsal margin in shelled specimens—in internal moulds the umbo and beak project above the rest of the dorsal margin; ventral, anterior, and posterior margins arcuate. Along the dorsal margin the concentric rugae of the two valves alternate with one another producing a zigzag junction.

The only known internal features are the marginal denticles and a prominent pegma, which usually stands at a high angle of as much as 90° to the dorsal margin.

Types and material: Cymatopegma semiplicatum is known from thousands of specimens of which the holotype (Pl. 6, figs. 1-4) and 17 paratypes (Pl. 6, figs. 5-17; pl. 7, figs. 1-10) are figured. *C. semiplicatum* is the most abundant rostroconch found in the clastic Cambrian and Ordovician formations of the southern Northern Territory. It occurs covering bedding planes and may form a considerable part of the rock in which it occurs. The holotype (CPC 14717) measures 7.3 mm long and 4.9 mm high. One specimen (Pl. 7, fig. 4) preserves the shell, but all other known specimens are sandstone moulds and casts.

Type locality: The holotype and three of the figured paratypes are from the Tomahawk Beds at our locality 16, southern Georgina Basin, southern Northern Territory.

Distribution: Cymatopegma semiplicatum is known from our localities 3, 4, 6, 7, 9, 12, 13, 14, 16, 18, 59, 60, 61, 64, 65, 68, 69, 71, 72, 75, 80, 82, and 96. At localities 3, 4, 6, 7, 9, 12, 13, and 59, it occurs in the Pacoota Sandstone of the Amadeus Basin. At localities 14, 16, 18, 60, 61, 64, 65, 68, 69, 71, 72, 75, 80, and 82, it occurs in the Tomahawk Beds of the southern Georgina Basin. The rock unit at locality 96 is uncertain, but the locality is in the southern Georgina Basin.

At localities 3, 4, 6, 7, 12, 16, 18, 61, 71, 82, and 96, *C. semiplicatum* occurs with various saukiid and *Tsinania*-like trilobites which indicate a Late Cambrian (Payntonian) age. The trilobite identifications are listed in the locality register. At the remaining localities, *C. semiplicatum* occurs either with no other identifiable megafossils or with forms that are not yet useful for detailed correlation.

Etymology: Semi, Latin, meaning half; *plicatus,* Latin, meaning folded. The species name is derived from the concentric rugae that cover the posterior part of the shell, as this species has long been known to field geologists of the Bureau of Mineral Resources as 'half stripe'.

Genus **Pinnocaris** Etheridge, 1878

Pls. 8, 9

Type species: Pinnocaris lapworthi Etheridge, 1878 (p. 169), by monotypy.

Diagnosis: Large posteriorly elongated ribeiriids with anterior clefts and posterior end drawn out into a tubular rostrum.

Stratigraphic range: Late Cambrian (Payntonian) to Late Ordovician (Ashgillian).

Remarks: Pinnocaris is known from Iowa, Scotland (Pojeta & Runnegar, 1976), and Australia. The Australian material provides significant new information about the stratigraphic distribution of the genus, as the two named Australian species are both Late Cambrian (Payntonian) in age. Outside Australia the genus has not been reported from rocks older than Middle Ordovician (Prosser Member of the Galena Dolomite).

Pinnocaris wellsi sp. nov.

Pl. 8, figs. 13-21; Pl. 9, figs. 1-9

Diagnosis: Pinnocaris with narrow tubular rostrum whose height at its posterior end forms a ratio of 1:2.5 or larger with the maximum height of the shell.

Description: Pinnocaris with nearly straight to gently concave dorsal margin in undistorted specimens, umbo projecting slightly above rest

of dorsal margin, dorsum of internal moulds with thin but obvious carina; anterior margin projecting beyond beak; ventral margin arcuate in region of body of shell, straight along rostrum, sigmoidal overall; beak terminal or nearly terminal on dorsal margin. Ratio of height of posterior end of rostrum to maximum height of shell is 1:2.5 or larger.

The only known internal feature is a small oblique pegma.

Types and material: P. wellsi is known from 38 specimens, all of which are sandstone moulds and casts. We figure the holotype (Pl. 8, figs. 20-21) and 16 paratypes (Pl. 8, figs. 13-19; Pl. 9, figs. 1-9). The holotype (CPC 14751) is 37.4 mm long and 12.4 mm high.

Type locality: All known specimens of *P. wellsi* are from the Pacoota Sandstone at our locality 4, Amadeus Basin, southern Northern Territory.

Stratigraphic distribution: Throughout the section at locality 4, *Pinnocaris wellsi* is associated with saukiid and tsinaniid trilobites which indicate a Late Cambrian (Payntonian) age. The trilobite identifications are listed in the locality register.

Remarks: P. wellsi is closest to *P. robusta* sp. nov., from which it differs in the ratio of the height of the posterior end of the rostrum to the maximum height of the shell. From *P. lapworthi* Etheridge it differs in that it lacks comarginal rugae.

Etymology: The species is named for A. T. Wells, Bureau of Mineral Resources.

Pinnocaris robusta sp. nov.

Pl. 8, figs. 1-10

Diagnosis: Pinnocaris in which the ratio of the height of the posterior end of the rostrum to the maximum height of the shell is 1:2 or less.

Description: Pinnocaris with nearly straight to gently concave dorsal margin, umbo projecting slightly above rest of dorsal margin producing a sigmoidal dorsal profile in some specimens, dorsum of internal moulds with thin but obvious carina; anterior margin projecting beyond beak; ventral margin arcuate in region of body of shell, straight along rostrum, sigmoidal overall; beak terminal or nearly terminal on dorsal margin. Ratio of height of posterior end of rostrum to maxium height of shell is 1:2 or smaller.

The only known internal feature is a prominent oblique pegma.

Types and material: P. robusta is known from 22 specimens, all of which are sandstone moulds and casts, of which we figure the holotype (Pl. 8, figs. 7, 8) and six paratypes (Pl. 8, figs. 1-6, 9, 10). The holotype (CPC 14739) measures 50.9 mm long and 18.6 mm high.

Type locality: The holotype and four figured paratypes are from the Pacoota Sandstone at our locality 11, Amadeus Basin, southern Northern Territory.

Distribution: Pinnocaris robusta is known from the Pacoota Sandstone at our localities 4, 6, 10 and 11, in the Amadeus Basin, southern Northern Territory. At localities 4 and 6, *P. robusta* occurs with saukiid and tsinaniid trilobites which indicate a Late Cambrian (Payntonian) age. The identifications of the trilobites are given in the locality register. At localities 10 and 11, *P. robusta* occurs with megafossils that are not yet useful for detailed correlation.

Remarks: P. robusta is closest to *P. wellsi* sp. nov., from which it differs in the ratio of the height of the posterior end of the rostrum to the maximum height of the shell.

Etymology: Robustus, Latin, meaning hard and strong, referring to the more robust nature of this form than of other species of *Pinnocaris.*

Pinnocaris sp. A

Pl. 8, fig. 11

Discussion: This distinctive form has a highly placed nearly erect pegma; the beak is not terminal on the dorsal margin, and the ventral margin is arcuate throughout. *Pinnocaris* sp. A is known from only one specimen, which occurs in a highly indurated sandsone, and we do not give it a formal name.

Distribution: The single known specimen of *Pinnocaris* sp. A is from the Stairway Sandstone at locality 57, Amadeus Basin, southern Northern Territory. The age of the Stairway was discussed above under *Ribeiria csiro* (p. 14), where it was concluded that the formation has a maximum age range of late Canadian to Llandeilian (late Early Ordovician-early Middle Ordovician).

Pinnocaris? sp. B

Pl. 8, fig. 12

Discussion: This form is known from one specimen, an internal mould in sandstone, the back end of which is broken off; it may be a *Pinnocaris* of the *P. robusta* type.

Distribution: The single known specimen of *Pinnocaris*? sp. B is from the Tomahawk Beds at our locality 82, southern Georgina Basin, southern Northern Territory. It is the only known possible representative of the genus in Australia outside the Amadeus Basin. At locality 82, *Pinnocaris*? sp. B occurs with saukiid trilobites which indicate a Late Cambrian (Payntonian) age. The identifications of the trilobites are listed in the locality register.

Genus **Ptychopegma** nov.

Pl. 9

Type species: Ptychopegma burgeri sp. nov. is herein designated the type species of the new genus *Ptychopegma.*

Description: Small posteriorly elongated ribeiriids with anterior, ventral, and posterior shell gapes; anterior margin of shell rounded and projecting beyond the beak. Ornament of comarginal growth lines and pronounced comarginal rugae which cover the entire exterior of the shell. Pegma wide and erect.

Stratigraphic distribution: Early Ordovician (Datsonian-Warendian).

Etymology: Ptycho, Greek, meaning fold, referring to the comarginal rugae; *pegma,* Greek, meaning fastened or fixed. The pegma is a structure in rostroconchs and the word is used as a combining form to indicate that the taxon is a rostroconch. Gender neuter.

Remarks: At present *Ptychopegma* is known only from Australia, where it occurs in the Ninmaroo Formation, eastern Georgina Basin, western Queensland. *Ptychopegma* is most similar to *Heraultipegma* Pojeta & Runnegar in its comarginal rugae which cover the entire shell, but differs in its size and much narrower shell gapes.

Ptychopegma burgeri gen. et sp. nov.

Pl. 9, figs. 10-21

Diagnosis: Subcircular *Ptychopegma.*

Description: Subcircular *Ptychopegma* with a straight dorsal margin posterior to the beak, anterior, ventral, and posterior margins arcuate; beak not terminal, umbo projecting above rest of dorsal margin. Along the dorsum, the comarginal rugae of the two valves alternate with one another to produce a zigzag junction.

The only known internal feature is a broad erect pegma which is at a right angle to the dorsal margin.

Types and material: Ptychopegma burgeri is known from 10 specimens of which the holotype (Pl. 9, figs. 10-16) and five paratypes (Pl. 9, figs. 17-21) are figured herein. The holotype (CPC 14761) measures 15.6 mm long and 12.3 mm high. All specimens are silicified replicas or silicified internal moulds.

Type locality: The holotype and one of the figured paratypes are from the Ninmaroo Formation at our locality 21, eastern Georgina Basin, western Queensland.

Distribution: P. burgeri occurs at our localities 21, 29, and 42, all of which are in the Ninmaroo Formation of western Queensland. Locality 21 is in the section at the West Swift Hills which Jones, Shergold, & Druce (1971, p. 16) regarded as entirely Datsonian (early Tremadocian; Early Ordovician) in age. At locality 42, *P. burgeri* occurs at 731 m above the base of the Black Mountain section. This is near the boundary of the *Oneotodus bicuspatus-Drepanodus simplex* and *Cordylodus oklahomensis-C. lindstromi* conodont Zones which Jones, Shergold, & Druce (1971, p. 16) placed in the middle and late Datsonian.

Our locality 29 is also at Black Mountain; here *P. burgeri* occurs 3 m below sample number B694 of Druce & Jones (1971, p. 111), which contains conodonts of the *Chosonodina herfurthi-Acodus* Zone, which they place at the top of the Warendian Stage (late Tremadocian). The occurrence of *P. burgeri* at locality 29 is probably also Warendian in age.

Therefore, *P. burgeri* probably occurs in both of the Tremadocian stages (Early Ordovician) of northern Australia recognized by Jones, Shergold, & Druce (1971).

Etymology: The species is named for Dennis Burger, Bureau of Mineral Resources.

Genus **Wanwania** Kobayashi, 1933

Pl. 5

Type species: Wanwania cambrica Kobayashi, 1933 (p. 282) by original designation.

Diagnosis: Dorsoventrally elongated ribeiriids in which the shell is higher than long or is subquadrate.

Stratigraphic distribution: Late Cambrian (*Tsinania* Zone, Yingtzu Series) to Early Ordovician (Wanwanian; Datsonian).

Remarks: The Australian material provides significant new information about the occurrence of *Wanwania,* as previously the genus was known only from Manchuria (Kobayashi, 1933).

Wanwania drucei sp. nov.

Pl. 5, figs. 1-18

Diagnosis: Subquadrate *Wanwania* with narrow gapes and small pegma.

Description: Small subquadrate *Wanwania* with straight to gently convex dorsal margin, no dorsal carina; anterior margin straight to gently convex; posterior and ventral margins arcuate. Beak terminal or near terminal. Shell gapes narrow, posterior gape with expanded dorsal part separated from rest of gape by a constriction.

The only known internal feature is a highly placed thin and small pegma.

Types and material: W. drucei is known from 80 specimens, all of which are silicified replicas, of which the holotype (Pl. 5, figs. 1-5) and eight paratypes (Pl. 5, figs. 6-18) are figured. The holotype (CPC 14692) is 7.1 mm long and 7.25 mm high.

Type locality: The holotype and figured paratypes are all from the Ninmaroo Formation at our locality 44, southern Georgina Basin, western Queensland.

Distribution: Wanwania drucei is known from our localities 24, 42, and 44, all of which are in the Ninmaroo Formation of western Queensland. The age of locality 42 was discussed under *Ptychopegma burgeri* (above (p. 19), where it was concluded that this locality is Datsonian (Early Ordovician).

Our locality 44 is from the same section as locality 42, Black Mountain, (Jones, Shergold, & Druce, 1971, p. 16). Locality 44 is 803 m above the base of the section. Here, *W. drucei* occurs with conodonts of the *Cordylodus oklahomensis-C. lindstromi* Zone, which Jones, Shergold, & Druce (1971, p. 16) placed at the top of the Datsonian Stage (Early Ordovician).

Remarks and comparisons: The figured specimens of *W. drucei* are silicified replicas, most of which have a pitted appearance (Pl. 5, figs. 1-17). We do not regard this pitting as original ornament, because it does not occur on all specimens (Pl. 5, fig. 18) and because it occurs on both the inside and outside of some specimens (Pl. 5, figs. 15, 16). A similar pitted appearance is found on some silicified replicas of *Pauropegma jelli* (Pls. 17-19); below the pitted surface of some specimens of this species, growth-lines can ge seen (Pl. 19, fig. 1).

There are only three named species of *Wanwania* other than *W. drucei*. *W. drucei* differs from *W. compressa* Kobayashi and *W. ambonychiformis* Kobayashi in being quadrate; the latter two species are higher than long. *W. drucei* and *W. cambrica* Kobayashi are both subquadrate; the major difference between them is that *W. cambrica* has a more robust and oblique pegma (Pojeta & Runnegar, 1976, pl. 3, fig. 12) than *W. drucei.*

Etymology: The species is named for E. C. Druce, Bureau of Mineral Resources.

Family **TECHNOPHORIDAE** Miller, 1889

Diagnosis: Ribeirioids with radial ornament and a posterior gape; with or without an anterior gape.

Stratigraphic distribution: Late Cambrian (Mindyallan) to Late Ordovician (Richmondian).

Remarks: This family contains eight known genera, of which four are presently known only from Australia; three of these are newly described herein. Of the 28 recognized species, nine are known only from Australia; seven of these are new. The non-Australian species have recently been reviewed by Pojeta & Runnegar (1976). Technophorids are known from all continents except Africa and Antarctica.

Genus **Technophorus** Miller, 1889

Pls. 10-13

Type species: Technophorus faberi Miller, 1889 (p. 514), by original designation and monotypy.

Diagnosis: Equivalved, posteriorly elongate technophorids lacking an anterior gape, with a single pegma and well-developed posterior radial ribs.

Stratigraphic distribution: Early Ordovician (Wolungian)-Late Ordovician (Richmondian).

Remarks: Technophorus occurs in Australia, central Europe, Korea, North America, Siberia, and perhaps South America. It is most diverse in North America, followed by Australia. The non-Australian species have been reviewed by Pojeta & Runnegar (1976). Four new Australian species are described herein from western Queensland and the southern Northern Territory. They differ from most other species of the genus in having a single posterior radial rib.

Technophorus kempae sp. nov.

Pl. 13, figs. 1-17

Diagnosis: Elongate *Technophorus* with single, long, straight to gently curved rib which intersects the dorsal margin at 15-20°.

Description: Elongate wedge-shaped *Technophorus* with straight to gently concave dorsal margin; anterior and ventral margins arcuate; umbo and beak projecting slightly above dorsal margin; ratio of height to length 1:2 or larger. Ornament of comarginal growth lines and a single, long, straight to gently curved radial rib in each valve; the rib intersects the dorsal margin at a low angle of 15-20°, and intersects the posterior margin at or slightly below its midpoint; at the posterior margin, the ribs of the two valves are opposite each other and set off the posterodorsal part of the shell as a rostrum.

The only known internal feature is a broad oblique pegma.

Types and material: T. kempae is known from 55 specimens, of which the holotype (Pl. 13, figs. 1-4) and 10 paratypes (Pl. 13, figs. 5-17) are figured. The holotype (CPC 14796) measures 16.8 mm long and 7.3 mm high. All known specimens are sandstone moulds and casts.

Type locality: The holotype and five of the figured paratypes are from the Tomahawk Beds at our locality 84 in the southern Georgina Basin in the southern Northern Territory.

Distribution: Technophorus kempae is known from our localities 2, 63, 73, 74, 77, 78, and 84, all of which are in the Tomahawk Beds, southern Georgina Basin, southern Northern Territory. At locali-

ties 73, 74, 77, 78, and 84, *T. kempae* occurs with agnostid, asaphelloid, leiostegiacean, and kainelloid trilobites which indicate a Tremadocian (Datsonian?; Early Ordovician) age for the species. The identifications of the trilobites are listed in the locality register. At localities 2 and 63 no megafossils are associated with *T. kempae*.

Etymology: The species is named for E. M. Kemp, Bureau of Mineral Resources.

Technophorus nicolli sp. nov.
Pl. 10, figs. 17-19; Pl. 11, figs. 1-7

Diagnosis: Subquadrate *Technophorus* with a single short straight to gently curved rib which intersects the dorsal margin at 30-40°.

Description: Subquadrate *Technophorus* with umbo projecting above rest of dorsal margin; anterior and ventral margins arcuate; posterior margin notched where intersected by radial rib; ratio of height to length 1:1.6 or smaller. Ornament of comarginal growth lines and a single short straight to gently curved radial rib in each valve; rib intersects posterior margin slightly below its midpoint; at the posterior margin, the ribs of the two valves are opposite each other and set off the posterodorsal part of the shell as a rostrum. Rib intersects dorsal margin at 30-40°.

The only known internal feature is an erect pegma.

Types and material: T. nicolli is known from 40 specimens, of which the holotype (Pl. 11, figs. 5-7) and five paratypes (Pl. 10, figs. 17-19; Pl. 11, figs. 1-4) are figured. The holotype (CPC 14781) is 16.5 mm long and 10.7 mm high. All known specimens are sandstone moulds.

Type locality: All known specimens of *T. nicolli* are from the Pacoota Sandstone at our locality 5, which is in the Amadeus Basin of the southern Northern Territory.

Stratigraphic distribution: Occurring with *T. nicolli* at locality 5 are kainellid and *Kayseraspis*-like trilobites. In the same section, below locality 5, in a float block was found a specimen of *Kayseraspis*. The occurrence of *Kayseraspis* in the same section as *Technophorus nicolli*, and *Kayseraspis*-like trilobites in the same collection, suggest an Arenigian age (late Early Ordovician; Harrington & Leanza, 1957).

Etymology: The species is named for R. S. Nicoll, Bureau of Mineral Resources.

Technophorus planei sp. nov.
Pl. 12, figs. 1-15

1976. *Technophorus* sp., Pojeta & Runnegar, p. 60, pl. 11, fig. 21.

Diagnosis: Technophorus with marginal denticles.

Description: Technophorus with concave dorsal margin in internal moulds, umbo projecting well above rest of dorsal margin; anterior and ventral margins arcuate and with marginal denticles; posterior margin erect, notched where intersected by rib; ratio of height to length 1:1.5 or smaller. Ornament of comarginal growth lines and a single gently curved rib in each valve; rib intersects dorsal margin at 15-20°, and intersects posterior margin at or above its midpoint. At the posterior margin, the ribs of the two valves are opposite each other and cause a constriction of the posterior gape, separating it into dorsal and ventral parts.

The known internal features include an erect pegma, which produces a flattened anterior umbonal face in internal moulds; marginal denticles along the anterior and ventral commissural margins; and the possible impression of the posterior median pedal retractor muscle in one specimen.

Types and material: T. planei is known from 26 specimens, of which the holotype (Pl. 12, figs. 1-5) and three paratypes (Pl. 12, figs. 6-15) are figured. The holotype (CPC 14789) measures 4.5 mm long and 3.1 mm high. All known specimens are silicified internal moulds.

Type locality: The holotype and two of the figured paratypes are from the Ninmaroo Formation at our locality 38 in the eastern Georgina Basin of western Queensland.

Distribution: T. planei is known from our localities 31 and 38, both in the Ninmaroo Formation, eastern Georgina Basin, western Queensland. Locality 31 is near the top of the section at Mount Ninmaroo in what Jones, Shergold, & Druce (1971, p. 16) called the encrinite member. At Mount Ninmaroo, this member contains the *Cordylodus rotundatus-C. angulatus* and *Chosonodina herfurthi-Acodus* conodont Assemblage Zones, which Jones, Shergold, & Druce (1971) regarded as middle and late Warendian (late Tremadocian; Early Ordovician) in age.

At locality 38, Druce (written and oral communication, December 1974) noted that *T. planei* occurs with the conodont *Scolopodus bassleri* in a stratigraphic position overlying conodonts that belong to the *Cordylodus rotundatus-C. angulatus* Zone, indicating that it is probably late Warendian in age.

Etymology: The species is named for M. D. Plane, Bureau of Mineral Resources.

Technophorus walteri sp. nov.
Pl. 10, figs. 14-16

Diagnosis: Technophorus in which the single lateral radial rib intersects the posteroventral angle of the shell.

Description: Technophorus with umbo projecting above rest of dorsal margin in internal moulds; anterior and ventral margins arcuate;

posterior margin erect; ratio of height to length 1:1.8 or smaller. Ornament of comarginal growth lines and a single straight to gently curved radial rib in each valve; rib intersects dorsal margin at an angle of more than 40°, and intersects posterior margin at its ventral point.

The only known internal feature is a prominent nearly erect pegma.

Types and material: T. walteri is known from three specimens which are internal moulds in an indurated sandstone, all of which are figured (Pl. 10, figs. 14-16). The holotype (CPC 14775, pl. 10, fig. 16) measures 5 mm long and 3.4 mm high.

Type locality: All known specimens of *T. walteri* are from the Pacoota Sandstone at our locality 56, Amadeus Basin, southern Northern Territory.

Stratigraphic distribution: The age of *T. walteri* is difficult to establish as it occurs with the little known trilobite *Psilocephalina* Hsü. Hsü & Ma (1948) regarded *Psilocephalina* as Tremadocian (early Early Ordovician) in age in China, where it occurs with the trilobite *Dactylocephalus* Hsü; in Australia, *Dactylocephalus* occurs in the *Drepanodus? gracilis-Scolopodus sexplicatus* conodont Zone of early Arenigian age (late Early Ordovician) in the Daly River Basin of northern Australia (Jones, 1971, p. 21). It is reasonable to regard *T. walteri* as Early Ordovician in age; it may be Arenigian.

Etymology: The species is named for M. R. Walter, Bureau of Mineral Resources.

Genus **Kimopegma** nov.

Pl. 16

Type species: Kimopegma pinnatum sp. nov. is herein designated the type species of the new genus *Kimopegma.*

Description: Posteriorly elongated technophorids with anterior margin of shell rounded and projecting well beyond the beak; ornament of comarginal growth lines and pronounced rugae the latter being limited to posterodorsal part of the shell and which terminate abruptly ventrally against a single oblique radial rib in each valve.

Stratigraphic distribution: Late Cambrian (Payntonian).

Etymology: The genus is named for the daughter of the senior author, Kim Louise. The second half of the generic name is taken from the Greek word *pegma* which means fastened or fixed; the pegma is a structure in rostroconchs and the word is used as a combining form to indicate that the taxon is a rostroconch. Gender neuter.

Remarks: At present, *Kimopegma* is known only from Australia, where it occurs in the Pacoota Sandstone of the Amadeus Basin and the Tomahawk Beds of the southern Georgina Basin, southern Northern Territory. *Kimopegma* differs from all other genera of technophorids in having comarginal rugae which are limited to the area dorsal to the radial rib.

Kimopegma pinnatum gen. et. sp. nov.

Pl. 16, figs. 1-10

Diagnosis: Kimopegma in which the rugae of the two valves alternate with one another along the dorsal margin to produce a zigzag junction.

Description: Elongate *Kimopegma* with straight to gently concave dorsal margin, umbo projecting above rest of dorsal margin; anterior margin rounded and projecting beyond beak; ventral margin arcuate to sigmoidal; posterior margin nearly erect to recurved anteriorly in its dorsal part. Beak not terminal. Along the dorsum, the rugae of the two valves alternate with one another, producing a zigzag junction.

The only known internal feature is a prominent oblique pegma.

Types and material: Kimopegma pinnatum is known from 12 specimens, of which the holotype (Pl. 16, figs. 9, 10) and six paratypes (Pl. 16, figs. 1-8) are figured. The holotype (CPC 14848) measures 15.8 mm long and 8.1 mm high. All known specimens are sandstone moulds.

Type locality: The holotype and one of the figured paratypes are from the Tomahawk Beds at our locality 16, southern Georgina Basin, southern Northern Territory.

Distribution: K. pinnatum is known from our localities 4, 16, 18, and 96. At locality 4, it occurs in the Pacoota Sandstone of the Amadeus Basin; at localities 16 and 18, it occurs in the Tomahawk Beds of the southern Georgina Basin; and at locality 96, the rock unit is uncertain, although the locality is in the southern Georgina Basin. All occurrences are in the southern Northern Territory.

At all localities *Kimopegma pinnatum* occurs with various saukiid and *Tsinania*-like trilobites, which indicate a Late Cambrian (Payntonian) age. The trilobite identifications are listed in the locality register.

Etymology: The species name is derived from the Latin word *pinna* meaning feather, referring to the rugae in the posterodorsal part of the shell.

Genus **Oepikila** Runnegar & Pojeta, 1974

Pl. 15

1940. [*Non*] *Öpikella* Thorslund, p. 181.
1974. *Opikella* Runnegar & Pojeta, p. 315, 317.
1974. *Oepikila* Runnegar & Pojeta, p. 316.
1976. *Oepikila* Runnegar & Pojeta, Pojeta & Runnegar, p. 61.

Type species: Opikella cambrica Runnegar & Pojeta, 1974 (p. 317), by original designation and monotypy.

Diagnosis: Small triangular technophorids with protoconch projecting prominently above the dorsal margin, and with radial ornament consisting of a single umbonal rib which extends to the most ventral point on the shell.

Stratigraphic distribution: Late Cambrian (Mindyallan-Idamean).

Etymology: The genus was named for A. A. Öpik, Bureau of Mineral Resources.

Remarks: At present *Oepikila* is known only from Australia, where it occurs in the Georgina Limestone, eastern Georgina Basin, western Queensland, and in the Goyder Formation, Amadeus Basin, southern Northern Territory. *Oepikila* differs from all other technophorids in that the radial rib forms an umbonal carina.

Oepikila cambrica (Runnegar & Pojeta), 1974

Pl. 15, figs. 19-21

1974. *Opikella cambrica* Runnegar & Pojeta, p. 317, fig. 3H.
1974. *Oepikila cambrica* (Runnegar & Pojeta), p. 316, 317, fig. 3H.
1976. *Oepikila cambrica* (Runnegar & Pojeta), Pojeta & Runnegar, p. 61, pl. 10, figs. 14, 15.

Diagnosis: Oepikila in which the length and height are subequal, and in which the umbonal carina divides the valve into nearly equal anterior and posterior halves.

Description: Oepikila with dorsal margin posterior to beak nearly straight, beak projecting above rest of dorsal margin; anterior margin projecting forward beyond beak; ventral margin oblique and meeting posterior margin at an acute angle; posterior margin oblique. Beak not terminal. Length and height subequal. Known ornament consists of a single radial rib which forms a prominent umbonal carina; this carina divides the valve into nearly equal anterior and posterior halves.

The only known internal feature is a small erect pegma.

Types and material: Oepikila cambrica is known from two specimens, both of which are figured (Pl. 15, figs. 19-21). The holotype (CPC 13953) is a calcareous mould consisting of part and counterpart, measuring 4.9 mm long and 4.2 mm high. The hypotype figured on Plate 15, figure 19 is a shelled specimen.

Type locality: The holotype is from the Georgina Limestone at our locality 85, eastern Georgina Basin, western Queensland.

Distribution: O. cambrica is known from our localities 8 and 85. At locality 8 it occurs in the Goyder Formation, Amadeus Basin, southern Northern Territory. Öpik (1967, v. 2, p. 16, and that the trilobites that occur at locality 8 (his locality NT 187) indicate a Mindyallan (early Late Cambrian) Age. The trilobite identifications are listed in the locality register.

At our locality 85 (locality W9 of Öpik, 1963, p. 17) *Oepikila cambrica* occurs in the *Erixanium sentum* Zone of the Idamean Stage (early Late Cambrian). Thus, the species is known from the earliest two stages of the Late Cambrian of northern Australia.

Etymology: The species name is derived from the Cambrian System.

Genus **Pauropegma** nov.

Pls. 12, 15, 17-19

1976. *Tolmachovia* Howell & Kobayashi [partim], Pojeta & Runnegar, p. 61.

Type species: Tolmachovia? jelli Pojeta & Runnegar, 1976, (p. 62), is herin designated the type species of the new genus *Pauropegma.*

Description: Technophorids with anterior, ventral, and posterior gapes. Beak placed well back on dorsal margin, subcentral; prominent transverse cleft anterior to beak, and less prominent transverse cleft posterior to beak. Internally, there is a large conical umbonal cavity bounded by a thick anterior pegma and an equally prominent posterior pegma; these internal features result in internal moulds which look little like shelled specimens.

Stratigraphic distribution: Early Ordovician (Tremadocian-Arenigian?).

Etymology: Pauros, Greek, meaning little or few, referring to the small radial ribs; *pegma,* Greek, meaning fastened or fixed. The pegma is a structure in rostroconchs, and the word is used as a combining form to indicate that the taxon is a rostroconch. Gender neuter.

Discussion: At present, *Pauropegma* is known only from Australia, where it occurs in the Ninmaroo Formation of the eastern Georgina Basin, western Queensland, and the southern Georgina Basin, southern Northern Territory. It is the only known technophorid genus to unequivocally show anterior and ventral shell gapes.

Pauropegma jelli (Pojeta & Runnegar), 1976

Pl. 12, figs. 16, 17; Pl. 15, figs. 9-18; Pl. 17, figs. 1-16; Pl. 18, figs. 1-16; Pl. 19, fig. 1

1969. *Ribeiria*? sp. Hill, Playford, & Woods, p. 010, pl. OV, figs. 1-3.
1976. *Tolmachovia? jelli* Pojeta & Runnegar, p. 62, pl. 14, figs. 9-19.

Diagnosis: Subcircular *Pauropegma* with single posterior radial rib in each valve and posterior gape divided into two parts.

Description: Pauropegma with beak the highest point on the dorsal margin; beak not terminal,

near central, and separated from rest of shell by short anterior and posterior transverse clefts; dorsal margin posterior to beak straight to gently concave; anterior margin arcuate, projecting far forward of beak; ventral margin arcuate; posterior margin oblique, directed forward. Anterior and ventral gapes narrow, slit-like; posterior gape constricted where intersected by radial ribs, and divided into dorsal and ventral parts. Ornament of comarginal growth lines and a single radial rib in each valve.

Most of the internal features of *P. jelli* are known. There are large and prominent anterior and posterior pegmas which produce internal moulds with a large conical umbonal filling. There are anterior and posterior median pedal retractor muscle scars connected by the scars of the right and left side muscles.

Types and material: Pauropegma jelli is known from 500 specimens, of which 29 hypotypes are figured. The holotype (UQ F60117), an internal mould, and three paratypes (UQ F60118, 60119, 67152) were figured by Pojeta & Runnegar (1976, pl. 14, figs. 9-19). All specimens are silicified replicas or silicified internal moulds.

Type locality: The type suite is from the Ninmaroo Formation just below the contact with the Swift Formation in the eastern Georgina Basin at the northern peak of Digby Peaks, about 100 km north of Boulia, western Queensland.

Distribution: In addition to the type locality, *P. jelli* is known from our localities 30, 31, 33, 34, 35, 37, 38, 39, 40, 45, 90, and 95. Localities 30-45 are in the eastern Georgina Basin of western Queensland, and localities 90 and 95 are in the southern Georgina Basin of the southern Northern Territory. At localities 35 and 40, *P. jelli* occurs in the Swift Formation; but at all other localities, it occurs in the Ninmaroo Formation.

At localities 30, 31, *P. jelli* occurs in the section at Mount Ninmaroo in what Jones, Shergold, & Druce (1971, p. 16) call the breccia and encrinite members. At Mount Ninmaroo these members contain the three Warendian (upper Tremadocian; Lower Ordovician) conodont zones (*Cordylodus prion-Scolopodus* to *Chosonodina herfurthi-Acodus* Assemblage Zones). At localities 37, 38, 39, and 90, *P. jelli* occurs with conodonts that indicate a middle to late Warendian Age (*Cordylodus rotundatus-C. angulatus* and *Chosonodina herfurthi-Acodus* Zones). At locality 45, *P. jelli* occurs with the conodont *Oneotodus gracilis,* which ranges from the early Datsonian to the top of the Warendian. This locality is 881 m above the base of the Black Mountain section in a position that Jones, Shergold, & Druce regarded as early Warendian in age. The conodont identifications given in the locality register were made in written communications to us by P. J. Jones & E. C. Druce (November 1974).

At localities 35 and 40, both in the Swift Formation, no conodonts were found with *P. jelli.* Jones, Shergold, & Druce (1971, p. 16, 23) indicated that there is an unconformity between the Ninmaroo Formation and the Swift Formation representing a Warendian-Arenigian hiatus, and that the Swift Formation is Bendigonian in age. This suggests that the latest Lancefieldian (early Arenigian) could be missing in western Queensland. Druce (oral communication, December 1974) noted that recent mapping has shown that at least in some places in western Queensland the Ninmaroo and Swift Formations interfinger, thus indicating no early Arenigian unconformity.

Most documented occurrences of *P. jelli,* therefore, are in Warendian age rocks (late Tremadocian); the species may range into the Arenigian, but this is uncertain.

At localities 33, 34, and 95, *P. jelli* is not associated with conodonts or with megafossils that are at present useful for detailed correlation.

Remarks: The figured specimens of *P. jelli* that are not internal moulds are silicified replicas that have a pitted appearance (Pl. 17, figs. 7, 12). We do not regard this pitting as original ornament, because it occurs on both the inside and outside of some specimens (Pl. 18, figs. 2, 9, 13, 14), because it occurs on nautiloid cephalopods in the same block of rock as the rostroconchs, and because in some specimens growth-lines can clearly be seen below the pitted surface (Pl. 19, fig. 1). Silicified replicas of *Wanwania drucei* (Pl. 5) have a similar pitted surface.

A difficulty in identifying *P. jelli* is that internal moulds (Pl. 15, figs. 9-16; Pl. 17, figs. 1-5) bear little resemblance to shelled specimens, owing to the stoutness of the pegmas. In some silicified replicas the ventral part of the shell was broken away (Pl. 17, figs. 7, 12) and from these we made latex internal moulds (Pl. 17, figs. 6, 8, 10, 11). The latex internal moulds show the same conical umbonal filling as the natural moulds (Pl. 17, figs. 1-3). Views of the dorsal interior of silicified specimens (Pl. 18, figs. 5-7) clearly show the conical umbonal cavity and the thick anterior and posterior pegmas. Plate 18, figures 13, 14 are of the inside of a single valve; here can be seen the anterior and posterior pegmas in lateral view. In figure 13, the ventral edges of the pegmas and umbonal cavity have been outlined in ink to show what the dorsal margin of an internal mould would look like.

Etymology: The species was named for J. S. Jell, University of Queensland.

Genus **Pleuropegma** nov.
Pl. 15

Type species: Pleuropegma plicatum sp. nov. is herein designated the type species of the new genus *Pleuropegma.*

Description: Small elongate technophorids with carinate dorsal margin and several radial ribs in each valve; anterior gape lacking; beak not terminal.

Stratigraphic distribution: Late Cambrian (Mindyallan).

Etymology: Pleuron, Greek, meaning rib, referring to the several radial ribs in each valve; *pegma,* Greek, meaning fastened or fixed. The pegma is a structure in rostroconchs and the word is used as a combining form to indicate that the taxon is a rostroconch. Gender neuter.

Discussion: At present, *Pleuropegma* is known only from Australia, where it occurs in the Goyder Formation of the Amadeus Basin, southern Northern Territory. *Pleuropegma* is the only technophorid known to have more than two radial ribs.

Pleuropegma plicatum gen. et sp. nov.
Pl. 15, figs. 1-8

Diagnosis: Pleuropegma with 4-5 radial ribs in each valve.

Description: Modioliform *Pleuropegma* with straight or nearly straight dorsal margin; anterior margin projecting beyond beak; ventral margin oblique, not arcuate; posterior margin more or less erect. Ornament of growth varices and 4-5 radial ribs in each valve. Anterior to the ribs a prominent sulcus causes an indentation in the ventral margin.

Types and material: P. plicatum is known from 14 calcareous shelled specimens, of which the holotype (Pl. 15, fig. 1) and five paratypes (Pl. 15, figs. 2-8) are figured. The holotype (CPC 14832) measures 6 mm long and 4.5 mm high.

Type locality: All known specimens of *Pleuropegma plicatum* are from the Goyder Formation at our locality 8, Amadeus Basin, southern Northern Territory.

Stratigraphic distribution: As noted above (p. 23), for *Oepikila cambrica,* the trilobites at locality 8 indicate a Mindyallan Age (early Late Cambrian).

Etymology: The species name is derived from the Latin word *plicatus,* meaning folded, referring to the several radial ribs in each valve.

Genus **Tolmachovia** Howell & Kobayashi, 1936
Pl. 14

Type species: Tolmachovia concentrica Howell & Kobayashi, 1936 (p. 60), by original designation and monotypy.

Diagnosis: Technophorids with anterior and posterior pegmas and lacking an anterior gape.

Stratigraphic distribution: Early Ordovician (Tremadocian) to Middle Ordovician.

Remarks: Tolmachovia is known only from Siberia, Portugal, and Australia. The single known Australian species is the oldest thus far assigned to the genus. The non-Australian species are discussed by Pojeta & Runnegar (1976).

Tolmachovia belfordi sp. nov.
Pl. 14, figs. 1-31

Diagnosis: Tolmachovia with posterior pegma longer than anterior pegma, and with marginal denticles.

Description: Tolmachovia with beak forming high point on anterior dorsal margin; anterior and ventral margins arcuate; posterior margin erect to oblique and directed forward. Ornament of coarse growth-lines which are sometimes rugose anteriorly, and a single radial rib in each valve; at the posterior margin, the ribs of the two valves are opposite each other and set off the posterodorsal part of the shell as a rostrum; rostrum projects dorsally as high as or higher than the protoconch.

Known internal features are the marginal denticles, a small erect anterior pegma, and a large oblique posterior pegma; posterior pegma markedly concave posteriorly so that in internal moulds there is a projection between the two lobes of the pegma.

Types and material: Tolmachovia belfordi is known from 200 specimens of which the holotype (Pl. 14, figs. 9, 10) and 24 paratypes (Pl. 14, figs. 1-8, 11-31) are figured. The holotype (CPC 14815) is 12.1 mm long and 7.4 mm high. All known specimens are sandstone moulds and casts.

Type locality: The holotype and 22 of the paratypes are from the Tomahawk Beds at our locality 84, southern Georgina Basin, southern Northern Territory.

Distribution: T. belfordi is known from our localities 2, 77, and 84, all of which are in the Tomahawk Beds of the southern Georgina Basin of the southern Northern Territory. At localities 77 and 84, *T. belfordi* occurs with agnostid, asaphelloid, leiostegiacean, and kainelloid trilobites which indicate a Tremadocian (Datsonian?; Early Ordovician) age for the species. The identifications of the trilobites are listed in the locality register. At locality 2, no other megafossils are associated with *T. belfordi. T. belfordi* is the only species of the genus in which the posterior pegma is markedly longer than the anterior pegma.

Etymology: The species is named for D. J. Belford, Bureau of Mineral Resources.

Order **CONOCARDIOIDA** Neumayr, 1891

Diagnosis: Rostroconchs with numerous external and internal ribs, with the latter expressed as marginal denticles on the inside edge of the commissure. Anterior gape and longitudinal dorsal clefts present. Musculature consisting of laterally placed primary and secondary pedal retractor muscles and a pallial line.

Stratigraphic distribution: Early Ordovician (Datsonian) to Late Permian (Makarewan).

Superfamily **EOPTERIACEA** Miller, 1889

Diagnosis: Conocardioids with anterior, or both anterior and posterior, or posterior dorsal longitudinal clefts; anterior, ventral, and posterior shell gapes (which are continuous with one another); rostrum rudimentary or lacking; shell posteriorly elongate in most forms.

Stratigraphic distribution: Early Ordovician (Datsonian) to Middle Ordovician (Wilderness-sian).

Family **EOPTERIIDAE** Miller, 1889

This is the only family presently assigned to the Eopteriacea, and it has the same definition and stratigraphic range as that superfamily.

Genus **Eopteria** Billings, 1865

Pls. 21, 24-27

Type species: Eopteria typica Billings, 1865 (p. 221) by indication.

Diagnosis: Eopteriids with a prominent anterior snout that lacks radial ribs.

Stratigraphic range: Early Ordovician (Datsonian) to Middle Ordovician (Wildernessian).

Remarks: In addition to Australia, *Eopteria* is known from France, Manchuria, possibly the eastern Baltic (Neben & Krueger, 1971, pl. 19, figs. 1-2), and North America. The genus is especially widespread in North America, where it occurs in Lower Ordovician rocks from Newfoundland to Texas. The single known named Australian species of *Eopteria* is the oldest thus far assigned to the genus. The non-Australian species have been reviewed by Pojeta & Runnegar (1976).

Eopteria struszi sp. nov.

Pl. 24, figs. 6-13; Pl. 25, figs. 1-14; Pl. 26, figs. 1-11; Pl. 27, figs. 1-11

Diagnosis: Eopteria with large snout; obvious rostrum separated from rest of shell by posterior longitudinal clefts; and subcentral beak.

Description: Eopteria with nonterminal subcentral beak; dorsal margin anterior and posterior to beak straight or nearly straight, oblique; posterior margin more or less erect; ventral margin oblique; anterior margin arcuate. Snout of shell projecting far forward, ornamented only with growth-lines; rest of shell ornamented with growth-lines and simple radial ribs. Anterior gape subcircular above, slit-like ventrally, with prominent marginal denticles, denticles of the two valves alternate with one another and almost touch; ventral gape slit-like; dorsal part of posterior gape sub-circular and forming aperture of rostrum; ventral part of posterior gape slit-like. Rostrum projecting little or not at all past posterior margin of shell, but clearly marked off from the rest of the shell by posterior longitudinal clefts.

The only known internal features are the marginal denticles and a prominent anterior pegma.

Types and material: Eopteria struszi is known from 800 specimens, of which the holotype (Pl. 26, fig. 11; Pl. 27, figs. 1-4) and 34 paratypes (Pl. 24, figs. 6-13; Pl. 25, figs. 1-14; Pl. 26, figs. 1-10; Pl. 27, figs. 5-11) are figured. The holotype (CPC 14940) measures 12 mm long and 10.7 mm high. All known specimens are silicified replicas.

Type locality: The holotype and 10 paratypes are from the Ninmaroo Formation at our locality 48, eastern Georgina Basin, western Queensland.

Distribution: E. struszi is known from our localities 19, 20, 22, 23, 24, 25, 26, 27, 28, 32, 41, 43, 44, 47, 48, and 54, all of which are in the Ninmaroo Formation of the eastern Georgina Basin in western Queensland. At locality 41, *E. struszi* occurs at 602 m above the base of the Black Mountain section (Jones, Shergold, & Druce, 1971, p. 16). The age of this occurrence was discussed under *Apoptepegma dickinsi* (p. 16), where it was concluded it is probably Datsonian (early Tremadocian; Early Ordovician).

Locality 43 is at 739 m above the base of the Black Mountain section. This occurrence of *E. struszi* is in the lower part of the *Cordylodus oklahomensis-C. lindstromi* Zone, which Jones, Shergold, & Druce (1971, p. 16) place at the top of the Datsonian Stage (early Tremadocian; Early Ordovician). At locality 44, *E. struszi* occurs 803 m above the base of the Black Mountain section; this occurrence is also in the *Cordylodus oklahomensis-C. lindstromi* Zone, and at this locality we have obtained conodonts of that zone occurring with *E. struszi*. The identifications of the conodonts are listed in the locality register.

At localities 47 and 48 we did not obtain any conodonts associated with *Eopteria struszi;* however, Datsonian conodonts have been obtained from the Ninmaroo Formation near the two locali-

ties, and the regional stratigraphic picture (Druce, oral communication, December 1974) suggests that at these localities *E. struszi* is Datsonian in age.

At localities 19, 23, 24, 25, 26, 27, 28, 32, and 54, no conodonts or megafossils at present useful for detailed correlation have been found associated with *E. struszi*. Localities 20 and 22 are in the section at the West Swift Hills of western Queensland, which Jones, Shergold, & Druce (1971, p. 10) regarded as entirely Datsonian (early Tremadocian; Early Ordovician) in age.

Thus, the information we have at present suggests that *E. struszi* occurs in Lower Ordovician (Datsonian) rocks of western Queensland.

Remarks: Eopteria struszi shows the unequivocal presence of an anterior pegma and a posterior rostrum in the genus *Eopteria;* these structures were not recognized in the genus previously (Pojeta & Runnegar, 1976).

The specimens from locality 41 (Pl. 24, figs. 6-13) herein placed in *E. struszi* differ from those at other localities in having a less prominent snout which results in the beak being placed more anteriorly on the dorsal margin. The marginal denticles are also more prominent in the specimens from locality 41, and at least in some of the specimens there is a prominent mid-umbonal rib that is more marked than the other ribs.

Etymology: The species is named for D. L. Strusz, Bureau of Mineral Resources.

Eopteria sp. A

Pl. 21, fig. 11

Discussion: This taxon is known from one internal mould preserved in chert; it has a prominent anterior snout and is more erect than *E. struszi,* and is 22.5 mm long and 17.6 mm high.

Distribution: Eopteria sp. A is known only from the Coolibah Formation at our locality 52 (= locality G317 of Gilbert-Tomlinson, 1973, p. 80) in the eastern Georgina Basin, western Queensland. The species occurs with *Teiichispira cornucopiae,* which Gilbert-Tomlinson (1973, p. 80-81) regarded as Arenigian (late Early Ordovician) in age.

Genus **Euchasma** Billings, 1865

Pls. 19-24

Type species: Conocardium blumenbachii Billings, 1859 (p. 350) by monotypy.

Diagnosis: Tumid oblique eopteriids with rudimentary rostrum, anterior pegma, a broad anterior face, and snout reduced to anterior lobe or absent; anterior gape keyhole-shaped.

Stratigraphic range: Early Ordovician (Datsonian-Whiterockian).

Discussion: Euchasma is known from Korea, Malaysia, Manchuria, North America, and perhaps Norway as well as Australia. Like *Eopteria, Euchasma* is especially widespread in North America, occurring from Newfoundland to Texas. One of the Australian species, *E. caseyi,* is the oldest thus far assigned to the genus.

Euchasma caseyi sp. nov.

Pl. 20, figs. 8-15; Pl. 21, figs. 1-9; Pl. 22, figs. 1-9; Pl. 23, figs. 1-10; Pl. 24, figs. 1-5

Diagnosis: Mytiliform *Euchasma* with flattened anterior face which lacks radial ribs and with prominent wide umbonal carinas which form a flange around the anterior face.

Description: Euchasma with terminal beak marked off from rest of shell by anterior clefts; dorsal margin straight to gently concave; anterior margin straight, oblique, meeting ventral margin at an acute angle; posterior margin gently rounded, oblique. Anterior lobe absent. Laterally, the shell is ornamented with growth-lines and radial ribs, anterior face flattened ornamented only with growth-lines; each umbo has a prominent carina which is extended laterally into a broad flange. Anterior gape keyhole-shaped, circular above and slit-like below; edges of ventral part of anterior gape with marginal denticles; posterior gape limited to circular aperture of rostrum; below this, the external ribs of the two valves alternate with one another and interlock. Rostrum not projecting past the posterior margin of the shell but clearly marked off from rest of shell by posterior longitudinal clefts.

The known internal features are the marginal denticles, the pallial line, which has an anterodorsal pallial sinus that bends laterally in the region of the circular part of the anterior gape, and a massive semicircular pegma which covers the circular part of the anterior gape posteriorly. The pegma is attached to the shell dorsally and laterally and is free posteriorly.

Types and material: Euchasma caseyi is known from 400 specimens, of which the holotype (Pl. 21, figs. 1-5) and 28 paratypes (Pl. 20, figs. 8-15; Pl. 21, figs. 6-9; Pl. 22; Pl. 23; Pl. 24, figs. 1-5) are figured. The holotype (CPC 14888) is 12.4 mm long and 12.2 mm high. All known specimens are silicified replicas.

Type locality: The holotype and one of the figured paratypes are from the Ninmaroo Formation at our locality 24, eastern Georgina Basin, western Queensland.

Distribution: E. caseyi is known from our localities 19, 22, 24, 25, 26, 27, 28, 42, 47, 48, 49, and 54, all of which are in the Ninmaroo Formation of

the eastern Georgina Basin, western Queensland. *Euchasma caseyi* occurs with *Eopteria struszi* at 10 of these localities, and it may have the same stratigraphic range as *E. struszi*. At only 4 localities have we been able to determine the stage in which *Euchasma caseyi* occurs. At locality 42, *E. caseyi* occurs 731 m above the base of the Black Mountain section. This is at the top of the *Oneotodus bicuspatus-Drepanodus simplex* conodont Zone of Jones, Shergold, & Druce (1971, p. 16), which is in the middle Datsonian (early Tremadocian; Early Ordovician). At locality 47 and 48, we did not obtain any conodonts with *Euchasma caseyi;* however, Datsonian age conodonts have been obtained from the Ninmaroo Formation in the vicinity of localities 47 and 48, and the regional stratigraphic picture (Druce, oral communication December 1974) suggests that at these localities, *E. caseyi* is Datsonian in age. Locality 22 is in the section at West Swift Hills, western Queensland, which Jones, Shergold, and Druce (1971, p. 10) regarded as entirely Datsonian in age.

Etymology: The species is named for J. N. Casey, Bureau of Mineral Resources.

Remarks: E. caseyi differs from all other species of *Euchasma* in its extremely flattened anterior face and the large carinal flange.

Euchasma skwarkoi sp. nov.

Pl. 19, figs. 3-11

Diagnosis: Euchasma with radial ribs on anterior face of shell; umbonal carinas show little development of a flange.

Description: Euchasma with anterior margin straight, oblique, meeting ventral margin at an acute angle. Laterally, shell ornamented with growth-lines and radial ribs; anterior face flattened and ornamented with radial ribs, ribs fine nearest circular part of keyhole gape, becoming coarser laterally. Umbonal carinas with little development of a flange.

Internally there is a large pegma, and the pallial line develops an anterodorsal pallial sinus in the region of the circular part of the keyhole gape, where it bends laterally.

Types and material: E. skwarkoi is known from 40 specimens of which the holotype (Pl. 19, fig. 6) and seven paratypes (Pl. 19, figs. 3-5, 7-11) are figured. The holotype (CPC 14873) is 15.1 mm high, but its length cannot be measured. All specimens of *E. skwarkoi* are preserved in chert.

Type locality: The holotype and two of the figured paratypes are from the Coolibah Formation at our locality 92, southern Georgina Basin, southern Northern Territory.

Distribution: Euchasma skwarkoi is known from our localities 87, 88, 89, 91, 92, and 93, all of which are in the Coolibah Formation, southern Georgina Basin, southern Northern Territory.

Gilbert-Tomlinson (1973, p. 71) gave the rock in which this species occurs the informal name *'Euchasma* chert' and placed it in the Coolibah Formation. She (p. 81) placed the Coolibah Formation in the Arenigian (Lower Ordovician).

Etymology: The species is named for S. K. Skwarko, Bureau of Mineral Resources.

Euchasma sp. A

Pl. 19, fig. 2

Discussion: This form is known from only one incomplete silicified specimen; it differs from *E. caseyi* and *E. skwarkoi* in being erect rather than oblique. The known specimen is 22.7 mm high and 17.5 mm long.

Distribution: Euchasma sp. A is known only from the Coolibah Formation at our locality 53, eastern Georgina Basin, western Queensland. Gilbert-Tomlinson (1973, p. 81) noted that the age of the Coolibah Formation is Arenigian (Early Ordovician) and that at our locality 53 (her locality G321), *Euchasma* sp. A occurs with *Teiichispira cornucopiae,* which is Arenigian in age.

Euchasma? sp. B

Pl. 21, fig. 10

Discussion: This form is known from a poorly preserved silicified specimen with the anterior face covered with matrix. It is important because of its stratigraphic occurrence. The specimen measures 10.2 mm high and 4.2 mm long.

Distribution: Euchasma? sp. B is from the Mungerebar Limestone at our locality 50, eastern Georgina Basin, western Queensland. According to Öpik (1967, 2, 8; and written communication, September 1974) at our locality 50 (Öpik locality G127) *Euchasma*? sp. B occurs with trilobites that indicate a Mindyallan (Late Cambrian) Age. The trilobite identifications are listed in the locality register.

Superfamily **CONOCARDIACEA** Miller, 1889

Diagnosis: Anteriorly elongate conocardioids with well-developed rostrum and posterior dorsal clefts, where the hinge and rostrum are not colinear; prominent anterior gape, posterior gape reduced to aperture of rostrum and ventral orifice (when present), ventral gape absent.

Stratigraphic distribution: Early Ordovician (Datsonian) to Late Permian (Makarewan).

Family **BRANSONIIDAE** Pojeta & Runnegar, 1976

Diagnosis: Conocardiaceans lacking anterior longitudinal shelves in snout of shell; snout and body of shell ribbed, not always clearly separated from one another; hood absent.

Stratigraphic distribution: Early Ordovician (Datsonian) to Late Permian (Capitanian).

Genus **Bransonia** Pojeta & Runnegar, 1976

Pl. 20

Type species: Bransonia wilsoni Pojeta & Runnegar, 1976 (p. 72) by original designation.

Diagnosis: Bransoniids with a reduced anterior gape, which is largely limited to the dorsal part of the anterior face.

Stratigraphic distribution: Early Ordovician (Datsonian) to Middle Permian (Tiverton Subgroup).

Remarks: The single Australian species placed in this genus herein is the oldest thus far assigned to *Bransonia.*

Bransonia chapronierei sp. nov.

Pl. 20, figs. 1-7

Diagnosis: Bransonia with subcentral beak, fine radial ribs, and with rostrum projecting little beyond posterior margin.

Description: Bransonia with subcentral beak; dorsal margin of rostrum straight, dorsal margin of snout arcuate and curved ventrally or straight, both parts of dorsal margin colinear, and therefore no rostral clefts developed; posterior and ventral margins arcuate. Rostrum small, projecting little beyond posterior margin. Anterior gape placed high in shell, small. Marginal denticles interlocking ventral to anterior gape.

Marginal denticles are the only known internal feature; they extend from the anterior gape to the aperture of the rostrum.

Types and material: B. chapronierei is known from eight specimens of which the holotype (Pl. 20, figs. 1-4) and two paratypes (Pl. 20, figs. 5-7) are figured. The holotype (CPC 14879) is 8.3 mm long and 5.3 mm high. All specimens are silicified replicas.

Type locality: All the known specimens of *B. chapronierei* are from the Ninmaroo Formation at our locality 41, eastern Georgina Basin, western Queensland.

Stratigraphic distribution: B. chapronierei occurs 602 m above the base of the Black Mountain section of Western Queensland (Jones, Shergold, & Druce, 1971, p. 16). The age of this occurrence was discussed on p. 16, where it was concluded it is probably Datsonian (early Tremadocian; Early Ordovician).

Etymology: The species is named for G. C. Chaproniere, Bureau of Mineral Resources.

Key to the Identification of the Named Species of Cambrian and Ordovician Rostroconchs from Northern Australia

1. (a) Radial ornament present 2
   (b) Radial ornament absent 3
2. (a) Radial ornament of five or fewer ribs 4
   (b) Radial ornament of more than five ribs 12
3. (a) Comarginal rugae present 15
   (b) Comarginal rugae absent 16
4. (a) Radial ornament of 4-5 ribs ..... *Pleuropegma plicatum*
   (b) Radial ornament of fewer than four ribs 5
5. (a) Radial ornament of one rib, dorsal to which are comarginal rugae ..... *Kimopegma pinnatum*
   (b) Radial ornament of one rib, comarginal rugae if present anterior and ventral to rib 6
6. (a) Two pegmas present 7
   (b) One pegma present 8
7. (a) Lacking anterior and ventral gapes ..... *Tolmachovia belfordi*
   (b) Anterior and ventral gapes present ..... *Pauropegma jelli*
8. (a) Radial rib forming umbonal carina ..... *Oepikila cambrica*
   (b) Radial rib dorsal and posterior to umbo 9
9. (a) Radial rib intersects posteroventral angle of shell ..... *Technophorus walteri*
   (b) Radial rib intersects posterior margin above posteroventral angle 10
10. (a) Marginal denticles present ..... *Technophorus planei*
    (b) Marginal denticles absent 11
11. (a) Radial rib intersects dorsal margin at an angle of 15°-20° ..... *Technophorus kempae*
    (b) Radial rib intersects dorsal margin at angle of 30°-40° ..... *Technophorus nicolli*
12. (a) Prominent snout present 13
    (b) Snout absent 14
13. (a) Ventral gape lacking, posterior gape limited to rostrum ..... *Bransonia chapronierei*
    (b) Full ventral and posterior gapes present ..... *Eopteria struszi*
14. (a) Anterior face of shell with radial ribs ..... *Euchasma skwarkoi*
    (b) Anterior face of shell lacking radial ribs ..... *Euchasma caseyi*
15. (a) Comarginal rugae limited to posterior half of shell ..... *Cymatopegma semiplicatum*
    (b) Comarginal rugae covering entire shell ..... *Ptychopegma burgeri*
16. (a) Posterior end of shell drawn out into a tubular rostrum 17
    (b) Posterior end of shell not drawn out into a tubular rostrum 18
17. (a) Height of rostrum at posterior end forms a ratio of 1:2.5 or larger with maximum height of shell ..... *Pinnocaris wellsi*
    (b) Height of rostrum at posterior end forms a ratio of 1:2 or smaller with maximum height of shell *Pinnocaris robusta*
18. (a) Shell quadrate ..... *Wanwania drucei*
    (b) Shell longer than high 19
19. (a) Anterior margin of shell sloping posteroventrally from beak ..... *Apoptopegma dickinsi*
    (b) Anterior margin of shell erect or projecting forward of beak 20
20. (a) Shell rectangular, ventral margin straight ..... *Ribeiria jonesi*
    (b) Shell not rectangular, ventral margin arcuate 21
21. (a) Anterior margin of shell erect, pegma low ..... *Ribeiria runnegari*
    (b) Anterior margin of shell projecting forward of beak, pegma high 22
22. (a) Dorsal carina present ..... *Ribeiria australiensis*
    (b) Dorsal carina absent 23
23. (a) Shell strongly attenuated posteriorly and with posterodorsal notch ..... *Ribeiria csiro*
    (b) Lateral profile subcircular, slight posterodorsal saddle ..... *Ribeiria huckitta*

5. LOCALITY REGISTER

Localities are numbered sequentially from 1-96. The numbers were assigned alphabetically according to the name of the 1:250 000 map area in which the localities occur and then in order of field numbers on the map. There is no locality 58. An asterisk after a field number indicates that the locality number is printed on the map; all such localities are indicated on the map by a fossil symbol and the field number. The number in parentheses after the field number is a computer register number for newer collections.

The 1:250 000 map areas from which we have collections are: Alcoota, N.T. (Shaw & Warren, 1975; locs. 1-2); Alice Springs, N.T. (Wells, 1969; locs. 3-13); Barrow Creek, N.T. (Smith & Milligan, 1964; locs. 14-18); Boulia, Q. (Casey, 1968; locs. 19-46); Duchess, Q. (Carter & Öpik, 1963; locs. 47-48); Glenormiston, Q. (Reynolds, 1965; locs. 49-55); Henbury, N.T. (Cook, 1968; locs. 56-57); Hermannsburg, N.T. (Quinlan & Forman, 1968; loc. 59); Huckitta, N.T. (Smith, 1963; locs. 60-84); Mount Whelan, Q. (Reynolds, 1968; loc. 85); Rodinga, N.T. (Cook, 1972b; loc. 86); Tobermory, N.T. (Smith, 1965; locs. 87-96). The locations of all map areas are shown in Figure 2.

We have tried to indicate each locality geographically and with a set of co-ordinates. The co-ordinates are given in millimetres, measured first east and then north from the southwest corner of the 1:250 000 sheet. For example, the position of locality 4 on the Alice Springs 1:250 000 sheet is 401 mm east of the southwest corner and 147 mm north of the 401 mm mark. Wherever possible, we have indicated the run, photo, and point numbers of localities that are marked on airphotos; often the points are not marked. These airphotos are at the Bureau of Mineral Resources, Geology and Geophysics, Canberra, where they are catalogued for each map area. Locality 4 is unusually complete, as all items in our locality outline are known. This is the kind of information we have tried to assemble for each locality, but it has not been possible to do so in all other cases because of the loss of information over the years. All available information for each locality is given in the register.

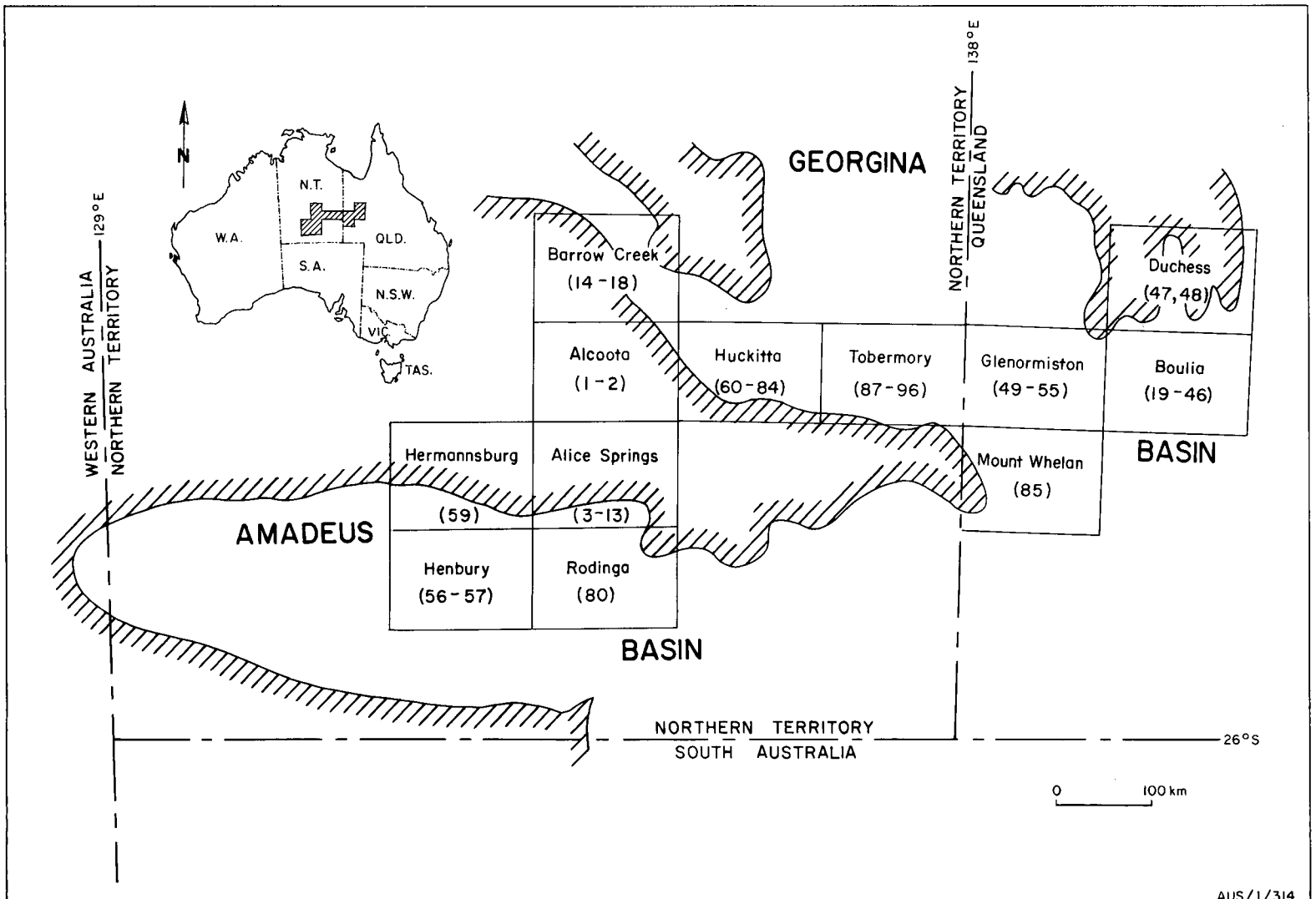

Fig. 2. Locality map showing all 1:250 000 sheets from which the rostroconchs described herein were collected. The numbers under the names of the map sheets are the localities within each map area. Hachured areas show boundaries of the basins.

Locality No. 1

Field No.:
NT 83
1:250 000 Sheet:
ALCOOTA, N.T.
Run, Photo, Point Nos.:
1/5111/-
Formation:
Tomahawk Beds
Geographical position:
Unknown
Co-ordinates:
Unknown
Lithology:
Sandstone
Collector:
D. E. Catley, 1954
Rostroconchs:
Ribeiria huckitta
Associated fossils:
None

Locality No. 2

Field No.:
NT 84
1:250 000 Sheet:
ALCOOTA, N.T.
Run, Photo, Point Nos.:
2/5074/-
Formation:
Tomahawk Beds
Geographic position:
Probably about 26 km NW of Utopia hstd
Co-ordinates:
Not plotted, 4′0″N, 7′2″E from SW corner of photo
Lithology:
Sandstone
Collector:
N. O. Jones, 1955
Rostroconchs:
Technophorus kempae
Associated fossils:
None

Locality No. 3

Field No.:
AS 177
1:250 000 Sheet:
ALICE SPRINGS, N.T.
Run, Photo, Point Nos.:
11/5062/2254
Formation:
Pacoota Sandstone
Age, Stage:
Late Cambrian, Payntonian
Geographic position:
56 km E of Alice Springs; 6 km NE of No. 6 Bore
Co-ordinates:
362 mm E; 140 mm N
Lithology:
White kaolinitic sandstone, cross-bedded, laminated, moderately friable
Occurrence:
Float—Boulders in streambed, not far from *in situ*
Collector:
A. J. Stewart, 1964
Rostroconchs:
Cymatopegma semiplicatum
Associated fossils:
Saukiid trilobites

Locality No. 4

Field Nos.:
AS 198, PW1-74, PW2-74, PW4a-74, PW4b-74, PW5a-74, PW5b-74, PW6-74, PW7-74, PW8-74, PW9-74
1:250 000 Sheet:
ALICE SPRINGS, N.T.
Run, Photo, Point Nos.:
10/5093/2525/A7S
Formation:
Pacoota Sandstone
Age, Stage:
Late Cambrian, Payntonian
Geographical position:
Ross River Valley 'East Bank' locality
Co-ordinates:
401 mm E; 147 mm N
Lithology:
Float blocks of somewhat variable lithology but largely quartz sandstone
Collectors:
J. Gilbert-Tomlinson, 1964; A. T. Wells & John Pojeta, 1974
Rostroconchs:
Pinnocaris robusta; Cymatopegma semiplicatum; Kimopegma pinnatum; Pinnocaris wellsi; Ribeiria jonesi
Associated fossils:
Trilobites: aff. *Tellerina,* nepeiform cranidium, *Mictosaukia, Lophosaukia, Geragnostus (Micragnostus), Kaolishaniella*?, tsinaniid, *Quadraticephalus,* non-saukiid genae, *Calvinella*?, *Tellerina*?, *Coreanocephalus*?

Locality No. 5

Field No.:
AS 260
1:250 000 Sheet:
ALICE SPRINGS, N.T.
Run, Photo, Point Nos.:
10/5094/3889
Formation:
Pacoota Sandstone
Age, Stage:
Early Ordovician, 'Arenigian'
Geographical position:
W slope of unnamed gorge east of N'Dahla Gorge, W of Ross River

Co-ordinates:
392 mm E; 159 mm N
Lithology:
Sandstone
Occurrence:
61 m below local top of Pacoota Sandstone; Mereenie Sandstone overlies
Collector:
J. Gilbert-Tomlinson, 1964
Rostroconchs:
Technophorus nicolli
Associated fossils:
Trilobites: Kainellid, *Kayseraspis*-like pygidium

Locality No. 6

Field No.:
AS 350
1:250 000 Sheet:
ALICE SPRINGS, N.T.
Formation:
Pacoota Sandstone
Age, Stage:
Late Cambrian, Payntonian
Geographical position:
8 km WSW of 'East Bank' locality
Co-ordinates:
372 mm E; 143 mm N
Lithology:
Sandstone
Rostroconchs:
Cymatopegma semiplicatum, Pinnocaris robusta
Associated fossils:
Trilobites: *Tellerina?*, aff. tsinaniid, aff. *Mictosaukia*. Molluscs: *Hypseloconus*?

Locality No. 7

Field No.:
AS 352
1:250 000 Sheet:
ALICE SPRINGS, N.T.
Run, Photo, Point Nos.:
11/5065/-
Formation:
Pacoota Sandstone
Age, Stage:
Late Cambrian, Payntonian
Geographic position:
Ross River syncline
Lithology:
Greyish-white silicified sandstone
Occurrence:
Float
Collector:
C. G. Gatehouse, 1964
Rostroconchs:
Cymatopegma semiplicatum, Ribeiria huckitta
Associated fossils:
Trilobites: aff. *Tellerina*, aff. *Mictosaukia*, aff. *Lophosaukia*

Locality No. 8

Field No.:
NT 187
1:250 000 Sheet:
ALICE SPRINGS, N.T.
Run, Photo, Point Nos.:
10/5093/B2690
Formation:
Goyder Formation
Age, Stage:
Late Cambrian, Mindyallan
Geographical position:
Bank of Ross River about 3.2 km S of Loves Creek Homestead 4.6 m above creek bed, rostroconchs at 'corner' of creek bed
Co-ordinates:
400 mm E; 168 mm N
Lithology:
Limestone, hard, grey, with dark spots and 'cystid' fragments, almost aphanitic. Rostroconchs in oolitic lst with aphanitic layers present
Occurrence:
Near *Girvanella* band towards top of lst sequence. Rostroconchs in lowermost 1 m
Collector:
J. Gilbert-Tomlinson & C. E. Prichard, 1956; A. A. Öpik, 1957
Rostroconchs:
Pleuropegma plicatum, Oepikila cambrica
Associated fossils:
Trilobites (lower bed with rostroconchs): *'Homagnostus'* sp. nov., *Plectrifer*? sp. nov., *Metopotropis* sp. nov., *Liostracina* cf. *L. krausei*
Trilobites (upper bed): *Auritama* sp. nov., Damesellidae, *Liostracina* cf. *L. volens*

Locality No. 9

Field No.:
NT 191
1:250 000 Sheet:
ALICE SPRINGS, N.T.
Run, Photo, Point Nos.:
10/5093/B2693
Formation:
Pacoota Sandstone
Geographical position:
Ross River area, W of Sawmill
Co-ordinates:
395 mm E; 149 mm N (approx.)
Lithology:
Sandstone
Occurrence:
Base of outcrop
Collector:
J. Gilbert-Tomlinson, 1956
Rostroconchs:
Cymatopegma semiplicatum
Associated fossils:
Trilobites: richardsonelloid?

Locality No. 10

Field No.:
NT 229
1:250 000 Sheet:
ALICE SPRINGS, N.T.
Run, Photo, Point Nos.:
13/5170/-
Formation:
Pacoota Sandstone
Geographical position:
14.5 km SW of Alice Springs, 1.6 km from Temple Bar Creek, low range of hills in front of main MacDonnell Range
Co-ordinates:
114 mm E; 86 mm N
Lithology:
Sandstone
Collector:
D. Woolley, 1961
Rostroconchs:
Pinnocaris robusta
Associated fossils:
Molluscs: *Hypseloconus*?

Locality No. 11

Field No.:
NT 323
1:250 000 Sheet:
ALICE SPRINGS, N.T.
Run, Photo, Point Nos.:
13/5170/-
Formation:
Pacoota Sandstone (Goyder Formation?)
Age, Stage:
Late Cambrian, Payntonian
Geographical position:
3.2 km E of Native Pine Gap, SW of Alice Springs
Co-ordinates:
Base of section 109 mm E; 87 mm N; top of section 109 mm E; 82 mm N
Lithology:
Compact white fine-grained sandstone
Occurrence:
Sample in measured section 27.6 m below locality 12
Collector:
D. Woolley & P. J. Jones, 1962
Rostroconchs:
Pinnocaris robusta
Associated fossils:
Trilobite fragments

Locality No. 12

Field No.:
NT 327
1:250 000 Sheet:
ALICE SPRINGS, N.T.
Run, Photo, Point Nos.:
13/5170/-
Formation:
Pacoota Sandstone
Age, Stage:
Late Cambrian, Payntonian
Geographic position:
3.2 km E of Native Pine Gap, SW of Alice Springs
Co-ordinates:
See locality 11
Lithology:
Sandstone
Collector:
D. Woolley & P. J. Jones, 1962
Occurrence:
Sample 6 in measured section, 27.6 m above locality 11
Rostroconchs:
Cymatopegma semiplicatum, Ribeiria jonesi
Associated fossils:
Trilobites: *Coreanocephalus*?, saukiid

Locality No. 13

Field No.:
FBH AW/10
1:250 000 Sheet:
ALICE SPRINGS, N.T.
Run, Photo, Point Nos.:
10/5094/-
Formation:
Pacoota Sandstone
Geographic position:
Ross River syncline, near axis
Co-ordinates:
396 mm E; 163 mm N
Lithology:
Fine-grained yellow sandstone
Collector:
Geologists of Frome-Broken Hill, 1958
Rostroconchs:
Cymatopegma semiplicatum
Associated fossils:
None

Locality No. 14

Field No.:
BC 2*
1:250 000 Sheet:
BARROW CREEK, N.T.
Run, Photo, Point Nos.:
7/5048
Formation:
Tomahawk Beds
Co-ordinates:
414 mm E; 224 mm N
Lithology:
Pale ferruginized quartzite
Collector:
K. G. Smith, 1961
Rostroconchs:
Cymatopegma semiplicatum
Associated fossils:
Trilobites: eulominid, librigenae indet.

Locality No. 15

Field No.:
BC 4*
1:250 000 Sheet:
BARROW CREEK, N.T.
Run, Photo, Point Nos.:
12/5017/-
Formation:
Tomahawk Beds
Geographical position:
Spring Range
Co-ordinates:
349 mm E; 94 mm N
Lithology:
Reddish-purple coarse quartz sandstone
Collector:
K. G. Smith, 1961
Rostroconchs:
Ribeiria sp.
Associated fossils:
Trilobites: *Quadraticephalus*?

Locality No. 16

Field No.:
BC 5*
1:250 000 Sheet:
BARROW CREEK, N.T.
Run, Photo, Point Nos.:
10/5155
Formation:
Tomahawk Beds
Age, Stage:
Late Cambrian, Payntonian
Co-ordinates:
514 mm E; 137 mm N
Lithology:
Brownish glauconitic quartz sandstone
Collector:
K. G. Smith, 1961
Rostroconchs:
Cymatopegma semiplicatum, Kimopegma pinnatum
Associated fossils:
Trilobites: *Coreanocephalus*?, *Saukia*?, *Mictosaukia*?, richardsonelloid?

Locality No. 17

Field No.:
BC 6*
1:250 000 Sheet:
BARROW CREEK, N.T.
Run, Photo, Point Nos.:
10/5156/-
Formation:
Tomahawk Beds
Age, Stage:
Late Cambrian, Payntonian
Co-ordinates:
513 mm E; 147 mm N
Lithology:
Yellow-buff glauconitic sandstone
Occurrence:
30-60 m below locality 16
Collector:
K. G. Smith, 1961
Rostroconchs:
Ribeiria huckitta
Associated fossils:
Trilobites: saukiid of the *Prosaukia misa* type

Locality No. 18

Field No.:
BC 11
1:250 000 Sheet:
BARROW CREEK, N.T.
Run, Photo, Point Nos.:
13/5171/-
Formation:
Tomahawk Beds
Age, Stage:
Late Cambrian, Payntonian
Geographical position:
Unknown
Co-ordinates:
Unknown
Lithology:
Yellow/white micaceous sandstone
Collector:
K. G. Smith, 1961
Rostroconchs:
Cymatopegma semiplicatum, Kimopegma pinnatum
Associated fossils:
Trilobites: *Mictosaukia*

Locality No. 19

Field No.:
B 88
1:250 000 Sheet:
BOULIA, Qld
Run, Photo, Point Nos.:
2A/5188/-
Formation:
Ninmaroo Formation
Age, Stage:
Early Ordovician, Datsonian
Geographical position:
3.2 km SE Digby Peaks hstd
Co-ordinates:
278 mm E; 395 mm N
Lithology:
Fine grey limestone, thick-bedded, with thin beds of medium calcarenite
Rostroconchs:
Euchasma caseyi, Eopteria struszi
Associated fossils:
None

Locality No. 20

Field No.:
B 227
1:250 000 Sheet:
BOULIA Qld
Run, Photo, Point Nos.:
2/5209/-
Formation:
Ninmaroo Formation
Age, Stage:
Early Ordovician, Datsonian
Geographical position:
Low rises on W side of Swift Hills about 1.5 km E of Middle Creek and 2.4 km north of the fence
Co-ordinates:
208 mm E; 414 mm N
Rostroconchs:
Eopteria struszi
Associated fossils:
None

Locality No. 21

Field No.:
B 230
1:250 000 Sheet:
BOULIA, Qld
Run, Photo, Point Nos.:
2/5209/-
Formation:
Ninmaroo Formation
Age, Stage:
Early Ordovician, Datsonian
Geographical position:
Same as locality 20 (measured section)
Co-ordinates:
Same as locality 20
Rostroconchs:
Ptychopegma burgeri
Associated fossils:
None

Locality No. 22

Field No.:
B 236
1:250 000 Sheet:
BOULIA, Qld
Run, Photo, Point Nos.:
2/5029/-
Formation:
Ninmaroo Formation
Age, Stage:
Early Ordovician, Datsonian
Geographical position:
Same as locality 20 (measured section)
Co-ordinates:
Same as locality 20
Rostroconchs:
Euchasma caseyi, Eopteria struszi
Associated fossils:
None

Locality No. 23

Field No.:
B 249
1:250 000 Sheet:
BOULIA, Qld
Run, Photo, Point Nos.:
2/5029/-
Formation:
Ninmaroo Formation
Geographical position:
Hills S of Signal Hill, 3.2 km S of Bore 34 (measured section)
Co-ordinates:
235 mm E; 416 mm N
Rostroconchs:
Eopteria struszi
Associated fossils:
None

Locality No. 24

Field No.:
B 251
1:250 000 Sheet:
BOULIA, Qld
Run, Photo, Point Nos.:
2/5209/-
Formation:
Ninmaroo Formation
Geographical position:
Same as locality 23
Co-ordinates:
Same as locality 23
Rostroconchs:
Euchasma caseyi, Eopteria struszi, Wanwania drucei
Associated fossils:
None

Locality No. 25

Field No.:
B 267
1:250 000 Sheet:
BOULIA, Qld
Run, Photo, Point Nos.:
1/5149/-
Formation:
Ninmaroo Formation
Geographical position:
Hills forming S extension of Swift Hills and about 3.2 km NNE of Bore 34
Co-ordinates:
230 mm E; 442 mm N
Rostroconchs:
Euchasma caseyi, Eopteria struszi
Associated fossils:
None

Locality No. 26

Field No.:
B 304
1:250 000 Sheet:
BOULIA, Qld

Run, Photo, Point Nos.:
2A/5185/-
Formation:
Ninmaroo Formation
Geographical position:
7.2 km NW of Digby Peaks, on E side of main structure through the lead mine. Near top of ridge
Co-ordinates:
237 mm E; 412 mm N
Lithology:
Grey calcarenite (containing fossils) with some intraformational conglomerate beds, medium-bedded
Collector:
J. N. Casey, 1957
Rostroconchs:
Euchasma caseyi, Eopteria struszi
Associated fossils:
None

Locality No. 27

Field No.:
B 305
1:250 000 Sheet:
BOULIA, Qld
Run, Photo, Point Nos.:
2/5211/-
Formation:
Ninmaroo Formation
Geographical position:
7.2 km NW of Digby Peaks, 1.2 km NE of B 304, E side of ridge
Co-ordinates:
241 mm E; 413 mm N
Lithology:
Grey calcarenite with some two-tone and intraformational conglomerate
Collector:
J. N. Casey, 1957
Rostroconchs:
Euchasma caseyi, Eopteria struszi
Associated fossils:
None

Locality No. 28

Field No.:
B 401
1:250 000 Sheet:
BOULIA, Qld
Run, Photo, Point Nos.:
2/5209/-
Formation:
Ninmaroo Formation
Geographical position:
Small ridges N of track between Digby Peaks turn-off from main Boulia-Selwyn rd and Noranside hstd. 2.4 km ENE of Bore 32 (Noranside)
Co-ordinates:
235 mm E; 394 mm N
Lithology:
Interbedded two-coloured fine-grained calcarenites and calcilutites with bands of intraformational conglomerate. Some beds have sparsely scattered coarse-grained sand
Rostroconchs:
Euchasma caseyi, Eopteria struszi
Associated fossils:
None

Locality No. 29

Field No.:
B 695
1:250 000 Sheet:
BOULIA, Qld
Formation:
Ninmaroo Formation
Age, Stage:
Early Ordovician, Warendian
Geographical position:
Black Mountain (about 3.2 km due W of Black Mountain Trigonometrical Cairn)
Co-ordinates:
304 mm E; 205 mm N
Lithology:
Limestone
Rostroconchs:
Ptychopegma burgeri
Associated fossils:
None

Locality No. 30

Field No.:
B 769D*
1:250 000 Sheet:
BOULIA, Qld
Run, Photo, Point Nos.:
10/5023/-
Formation:
Ninmaroo Formation
Age, Stage:
Early Ordovician, Warendian
Geographical position:
Mount Ninmaroo, E side, near faulted anticline
Co-ordinates:
331 mm E; 169 mm N
Lithology:
Intraformational limestone conglomerate
Rostroconchs:
Pauropegma jelli
Associated fossils:
None

Locality No. 31

Field No.:
B 771*
1:250 000 Sheet:
BOULIA, Qld
Run, Photo, Point Nos.:
10/5023/-

Formation:
Ninmaroo Formation
Age, Stage:
Early Ordovician, Warendian
Geographical position:
Mount Ninmaroo, near top
Co-ordinates:
329 mm E; 175 mm N
Lithology:
Fossiliferous coarse calcarenite
Rostroconchs:
Pauropegma jelli, Technophorus planei
Associated fossils:
None

Locality No. 32

Field No.
001/6-74 (74710006)
1:250 000 Sheet:
BOULIA, Qld
Formation:
Ninmaroo Formation
Geographical position:
Signal Hill, close to lead mine
Co-ordinates:
228 mm E; 433 mm N
Lithology:
Dolomite
Collector:
J. J. Draper, 1974
Rostroconchs:
Eopteria struszi
Associated fossils:
Nautiloid molluscs and brachiopods

Locality No. 33

Field No.:
010/21-74 (74710072)
1:250 000 Sheet:
BOULIA, Qld
Formation:
Ninmaroo Formation
Geographical position:
Digby Peaks, in creek which cuts Ninmaroo and Swift Formations
Co-ordinates:
257 mm E; 400 mm N
Lithology:
Silicified breccia
Collector:
J. J. Draper, 1974
Rostroconchs:
Pauropegma jelli
Associated fossils:
None

Locality No. 34

Field No.:
010/22-74 (74710073)
1:250 000 Sheet:
BOULIA, Qld
Formation:
Ninmaroo Formation
Geographical position:
Same as locality 33
Co-ordinates:
258 mm E; 392 mm N
Lithology:
Dolomite
Collector:
J. J. Draper, 1974
Rostroconchs:
Pauropegma jelli
Associated fossils:
None

Locality No. 35

Field No.:
012/9-74 (74710082)
1:250 000 Sheet:
BOULIA, Qld
Formation:
Swift Formation
Geographical position:
2.5 km SSE of Harvey Bore
Co-ordinates:
318 mm E; 249 mm N
Lithology:
Silicified coquina
Collector:
J. J. Draper, 1974
Rostroconchs:
Pauropegma jelli
Associated fossils:
None

Locality No. 36

Field No.:
102/2-74 (74711003)
1:250 000 Sheet:
BOULIA, Qld
Formation:
Swift Formation
Geographical position:
Swift Hills
Co-ordinates:
218 mm E; 418 mm N
Lithology:
Silicified coquinite
Collector:
E. C. Druce, 1974
Rostroconchs:
Euchasma sp.
Associated fossils:
None

Locality No. 37

Field No.:
109/6-74 (74711115)
1:250 000 Sheet:
BOULIA, Qld

Formation:
Ninmaroo Formation
Age, Stage:
Early Ordovician, Warendian
Geographical position:
2 km NW of locality 38
Co-ordinates:
299 mm E; 328 mm N
Lithology:
Encrinite
Collector:
E. C. Druce, 1974
Rostroconchs:
Pauropegma jelli, Ribeiria sp.
Associated fossils:
Conodonts: *Oistodus* cf. *O. inequalis, Scolopodus warendensis, S. bassleri,* and *Oneotodus gracilis*

Locality No. 38

Field No.:
110/10-74 (74711127)
1:250 000 Sheet:
BOULIA, Qld
Formation:
Ninmaroo Formation
Age, Stage:
Early Ordovician, Warendian
Geographical position:
About 5 km WSW of Datchet Downs
Co-ordinates:
306 mm E; 318 mm N
Lithology:
Encrinite
Collector:
E. C. Druce, 1974
Rostroconchs:
Technophorus planei, Pauropegma jelli, Ribeiria sp. A
Associated fossils:
Conodonts: *Scolopodus bassleri*

Locality No. 39

Field No.:
208/1-74 [=208/4-74] (74712092)
1:250 000 Sheet:
BOULIA, Qld
Run, Photo, Point Nos.:
C/Ph D PKS
Formation:
Ninmaroo Formation
Age, Stage:
Early Ordovician, Warendian
Geographical position:
SW of Digby Peaks
Co-ordinates:
262 mm E; 393 mm N
Lithology:
Limestone, grainstone, and coquinite; silicified encrinite
Collector:
B. Radke, 1974
Rostroconchs:
Pauropegma jelli
Associated fossils:
Conodonts: *Oneotodus gracilis, Drepanodus acutus, Cordylodus angulatus, Scolopodus bassleri, Scolopodus warendensis*

Locality No. 40

Field No.:
208/2-74 (74712093)
1:250 000 Sheet:
BOULIA, Qld
Run, Photo, Point Nos.:
C/Ph D PKS
Formation:
Swift Formation
Geographical position:
SW of Digby Peaks, same as locality 39
Co-ordinates:
Same as locality 39
Lithology:
Sandstone
Collector:
B. Radke, 1974
Rostroconchs:
Pauropegma jelli
Associated fossils:
None

Locality No. 41

Field No.:
305/3-74 (74713100)
1:250 000 Sheet:
BOULIA, Qld
Formation:
Ninmaroo Formation
Age, Stage:
Early Ordovician?, Datsonian?
Geographical position:
Black Mountain Section (of Jones, Shergold, & Druce, 1971)
Co-ordinates:
316 mm E; 212 mm N (top) to 324 mm E; 204 mm N (base)
Lithology:
Dark grey micrite with surface silicification and patches of calcilutite
Occurrence:
602 m above base of section
Collector:
J. H. Shergold & John Pojeta, 1974
Rostroconchs:
Bransonia chapronierei, Eopteria struszi, Apoptopegma dickinsi
Associated fossils:
None

Locality No. 42

Field No.:
305/5-74 (74713102)
1:250 000 Sheet:
BOULIA, Qld

Formation:
Ninmaroo Formation
Age, Stage:
Early Ordovician, Datsonian
Geographical position:
Same as locality 41
Co-ordinates:
Same as locality 41
Lithology:
Oosparite, surface silicification
Occurrence:
731 m above base of section
Collector:
J. H. Shergold & John Pojeta, 1974
Rostroconchs:
Euchasma caseyi, Ptychopegma burgeri, Wanwania drucei
Associated fossils:
Trilobites: *Leiostegium*

Locality No. 43

Field No.:
305/6-74 (74713103)
1:250 000 Sheet:
BOULIA, Qld
Formation:
Ninmaroo Formation
Age, Stage:
Early Ordovician, Datsonian
Geographical position:
Same as locality 41
Co-ordinates:
Same as locality 41
Lithology:
Silicified fossils in dark-grey mottled micrite
Occurrence:
739 m above base of section
Collector:
J. H. Shergold & John Pojeta, 1974
Rostroconchs:
Eopteria struszi, Ribeiria sp.
Associated fossils:
Molluscs: nautiloids

Locality No. 44

Field No.:
305/7-74 (74713104)
1:250 000 Sheet:
BOULIA, Qld
Formation:
Ninmaroo Formation
Age, Stage:
Early Ordovician, Datsonian
Geographical position:
Same as locality 41
Co-ordinates:
Same as locality 41
Lithology:
Marls and micrites
Occurrence:
803 m above base of section
Collector:
J. H. Shergold & John Pojeta, 1974
Rostroconchs:
Eopteria struszi, Wanwania drucei
Associated fossils:
Conodonts: *Oneotodus gracilis, O. datsonensis, Cordylodus oklahomensis, C. lindstromi*

Locality No. 45

Field No.:
305/8-74 (74713105)
1:250 000 Sheet:
BOULIA, Qld
Formation:
Ninmaroo Formation
Age, Stage:
Early Ordovician, Warendian
Geographical position:
Same as locality 41
Co-ordinates:
Same as locality 41
Lithology: Sandy calcilutite with silicified nautiloid fragments
Occurrence:
887 m above base of section
Collector:
J. H. Shergold & John Pojeta, 1974
Rostroconchs:
Pauropegma jelli
Associated fossils:
Conodonts: *Oneotodus gracilis, O. erectus, Cordylodus lindstromi, Scolopodus bassleri*

Locality No. 46

Field No.:
UQL 311
1:250 000 Sheet:
BOULIA, Qld
Formation:
Ninmaroo Formation?
Geographical position:
Mount Datson, 50 km ENE of Boulia
Co-ordinates:
363 mm E; 93 mm N (approx.)
Lithology:
Limestone
Collector:
F. W. Whitehouse, about 1930
Rostroconchs:
Apoptopegma? sp. B
Associated fossils:
None

Locality No. 47

Field Nos.:
D667, D160
1:250 000 Sheet:
DUCHESS, Qld*
Formation:
Ninmaroo Formation

Age, Stage:
Early Ordovician, Datsonian
Geographical position:
Same as locality 48
Co-ordinates:
Same as locality 48
Collector:
F. de Keyser, 1968
Rostroconchs:
Euchasma caseyi, Eopteria struszi
Associated fossils:
None

Locality No. 48

Field No.:
303-74 (74713095)
1:250 000 Sheet:
DUCHESS, Qld
Formation:
Ninmaroo Formation
Age, Stage:
Early Ordovician, Datsonian
Geographical position:
Signal Hill, S bank Ibis Creek, where road from Ibis Bore to 33 Bore crosses creek
Co-ordinates:
218 mm E; 24 mm N
Collector:
J. H. Shergold & J. Pojeta, 1974
Rostroconchs:
Euchasma caseyi, Eopteria struszi, Apoptopegma sp.
Associated fossils:
Nautiloid molluscs

Locality No. 49

Field No.:
G24*
1:250 000 Sheet:
GLENORMISTON, Qld
Run, Photo, Point Nos.:
13/5123/-
Formation:
Ninmaroo Formation
Co-ordinates:
187 mm E; 64 mm N
Lithology: Pelletoid oolitic limestone with intraformational breccia
Rostroconchs:
Euchasma caseyi
Associated fossils:
Molluscs: Nautiloids

Locality No. 50

Field No.:
G127*
1:250 000 Sheet:
GLENORMISTON, Qld
Formation:
Mungerebar Limestone
Age, Stage:
Late Cambrian, Mindyallan
Co-ordinates:
408 mm E; 314 mm N
Lithology:
Bituminous and grey sandy limestone with layers of silicified fossils
Collector:
A. A. Öpik, 1958
Rostroconchs:
Euchasma? sp. B
Associated fossils:
Trilobites: *Aedotes declivis, Blackwelderia sabulosa, Cermataspis abundans, Ferenepea hispida, Griphasaphus griphus, Leichneyella* sp. nov. A, *Meropalla quadrans, Palaeodotes* aff. *P. dissidens, Placosema caelatum, Rhyssometopus rhyssometopus, Stephanocare* indet., *Agnostascus gravis, Agnostoglossa bassa, Idolagnostus dryas*

Locality No. 51

Field No.:
G128*
1:250 000 Sheet:
GLENORMISTON, Qld
Formation:
Mungerebar Limestone
Age, Stage:
Late Cambrian, Mindyallan
Geographical position:
0.8 km SW of Chummy Bore
Co-ordinates:
421 mm E; 319 mm N
Lithology:
Thin-bedded limestone
Collector:
A. A. Öpik, 1958
Rostroconchs:
Ribeiria australiensis
Associated fossils:
Trilobites: Catillicephalidae indet., *Cermataspis abundans*?, *Palaeodotes* aff. *P. dissidens, Rhyssometopus rhyssometopus,* asaphiscid, nepeid, *Blackwelderia sabulosa*

Locality No. 52

Field No.:
G317*
1:250 000 Sheet:
GLENORMISTON, Qld
Formation:
Coolibah Formation
Age, Stage:
Early Ordovician, 'Arenigian'
Geographical Position:
Prominent ridge E of and parallel to Toko Range, between Linda and Wheelaman Creeks
Co-ordinates:
84 mm E; 86 mm N

Lithology:
Grey calcarenite with irregular silica bands and silicified fossils
Collector:
R. J. Paten, 1958
Rostroconchs:
Eopteria sp. A
Associated fossils:
Molluscs: *Teiichispira cornucopiae*

Locality No. 53

Field No.:
G321*
1:250 000 Sheet:
GLENORMISTON, Qld
Run, Photo, Point Nos.:
11/5219/-
Formation:
Coolibah Formation
Age, Stage:
Early Ordovician, 'Arenigian'
Geographical position:
Prominent ridge just E of Toko Range and just N of Linda Creek
Co-ordinates:
44 mm E; 119 mm N
Lithology:
Blue/white/pink-calcarenite/chert/dolomite
Rostroconchs:
Euchasma sp. A
Associated fossils:
Molluscs: *Teiichispira cornucopiae*

Locality No. 54

Field No.:
G410*
1:250 000 Sheet:
GLENORMISTON, Qld
Run, Photo, Point Nos.:
14/5197/-
Formation:
Ninmaroo Formation
Geographical position:
About 90 m E of Glenormiston/Herbert Downs boundary fence, 8.8 km N of boundary gate on Boulia-Glenormiston road. Top of small hill (benched), SW of larger higher one, both S of stream flowing W across fence. About 9 m above fence
Co-ordinates:
396 mm E; 48 mm N
Lithology:
Thin-bedded and laminated dolomite and calcareous dolomite, with thin coquinite bands in upper 6.1 m
Rostroconchs
Euchasma caseyi, Eopteria struszi
Associated fossils:
Molluscs: nautiloids

Locality No. 55

Field No.:
306/1-74 (74713106)
1:250 000 Sheet:
GLENORMISTON, Qld
Formation:
Nora Formation
Geographical position:
Neeyamba Hill
Co-ordinates:
125 mm E; 22 mm N
Collector:
J. H. Shergold & John Pojeta, 1974
Rostroconchs:
Technoporus sp.
Associated fossils:
Molluscs: pelecypods

Locality No. 56

Field No.:
Hy 260*
1:250 000 Sheet:
HENBURY, N.T.
Run, Photo, Point Nos.:
1/5188/-
Formation:
Pacoota Sandstone
Age, Stage:
Early Ordovician, 'Arenigian?'
Geographical position:
Waterhouse Range, S flank, 1188 m above dog-leg bend and about 90 m E up a side-creek of tributary creek to Hugh R.
Co-ordinates:
548 mm E; 429 mm N
Lithology: Fine-grained silty sandstone
Collector:
J. Gilbert-Tomlinson, 1963
Rostroconchs:
Technophorus walteri
Associated fossils:
Trilobites: *Psilocephalina*
Molluscs: pelecypods, gastropods, nautiloids

Locality No. 57

Field No.:
Hy 702*
1:250 000 Sheet:
HENBURY, N.T.
Run, Photo, Point Nos.:
Kulgera 1/5101/5124
Formation:
Stairway Sandstone
Geographical position:
About 19 km ENE Angas Downs hstd. Low mounds on valley floor between strike ridges of sandstone
Co-ordinates:
165 mm E; 9 mm N
Lithology:
Indurated sandstone

Collector:
A. T. Wells, 1963
Rostroconchs:
Pinnocaris sp. A
Associated fossils:
No identifiable forms

No Locality 58

Locality No. 59

Field No.:
NT 251
1:250 000 Sheet:
HERMANNSBURG, N.T.
Run, Photo, Point Nos.:
13/5028/-
Formation:
Pacoota Sandstone
Geographical position:
Ellery Creek, about 40 km NE of Hermannsburg Mission; gorge through strike ridges
Co-ordinates:
433 mm E; 80 mm N
Lithology:
Laminated fine-grained quartz sandstone
Occurrence:
427 m above base of Pacoota Sandstone
Collector:
M. A. Condon, 1957
Rostronconchs:
Cymatopegma semiplicatum, Ribeiria jonesi
Associated fossils:
None

Locality No. 60

Field No.:
H6*
1:250 000 Sheet:
HUCKITTA, N.T.
Formation:
Tomahawk Beds
Geographical position:
Grants Bluff section; Ooratha area 4 km ENE of Point Spring
Co-ordinates:
353 mm E; 170 mm N
Lithology:
Flaggy sandstone and shale
Collector:
J. N. Casey, 1954
Rostroconchs:
Cymatopegma semiplicatum
Associated fossils:
Trilobites: *Koldinioidia*

Locality No. 61

Field Nos.:
H24*, 310/4-74 (74713114)
1:250 000 Sheet:
HUCKITTA, N.T.
Run, Photo, Point Nos.:
10/5025/-
Formation:
Tomahawk Beds
Age, Stage:
Late Cambrian, Payntonian
Geographical position:
2.4 km SW of Huckitta hstd on E side of track to S, opposite mouths of two close parallel gullies from NW
Co-ordinates:
234 mm E; 178 mm N
Lithology:
Fine to medium grained porous white quartz sandstone
Collector:
J. N. Casey, 1954; J. Gilbert-Tomlinson, 1957; J. H. Shergold & John Pojeta, 1974
Rostroconchs:
Cymatopegma semiplicatum, Ribeiria huckitta
Associated fossils:
Trilobites: aff. *Tellerina*, aff. *Lophosaukia, Anderssonella*?, *Quadraticephalus*?, leiostegiacean, *Mansuyia*, shumardiid, *Geragnostus* (*Micragnostus*)

Locality No. 62

Field No.:
H60*
1:250 000 Sheet:
HUCKITTA, N.T.
Run, Photo, Point Nos.:
11/5197/5149?
Formation:
Tomahawk Beds
Geographical position:
About 8 km NNW of Oorobbra Rockholes, near top of E-W ridge, about 90 m above general level
Co-ordinates:
280.5 mm E, 150 mm N
Lithology:
Cross-bedded, medium-grained, white quartz sandstone
Collector:
D. Woolley, 1957
Rostroconchs:
Ribeiria huckitta
Associated fossils:
Trilobites: Kainelloid?

Locality No. 63

Field No.:
H 97C*
1:250 000 Sheet:
HUCKITTA, N.T.
Run, Photo, Point Nos.:
9/5053/5715
Formation:
Tomahawk Beds

Geographical position:
0.8 km SE of Huckitta hstd. Low rolling hills; steep bed in river cliff
Co-ordinates:
240 mm E; 183 mm N
Lithology:
Sequence of sandstone, glauconitic sandstone, and thin dolomite
Collector:
R. Vine, 1958
Rostroconchs:
Technophorus kempae
Associated fossils:
None

Locality No. 64

Field Nos.:
H108, H108 K
1:250 000 Sheet:
HUCKITTA, N.T.
Run, Photo, Point Nos.:
1/5123/5011
Formation:
Tomahawk Beds
Geographical position:
4 km NNW of end of Lucy Creek Boundary fence; scarp face at S tip of large mass of hills
Co-ordinates:
560 mm E; 438 mm N (approx.)
Lithology:
Medium-grained cream quartz sandstone
Collector:
D. Woolley, 1958
Rostroconchs:
Cymatopegma semiplicatum
Associated fossils:
None

Locality No. 65

Field No.:
H109F*
1:250 000 Sheet:
HUCKITTA, N.T.
Run, Photo, Point Nos.:
2/5116/2969
Formation:
Tomahawk Beds
Geographical position:
0.8 km E of road to Sandover River and 6.5 km S of where this road crosses sheet boundary. E side of prominent line of hills, on scarp face
Co-ordinates:
587 mm E; 414 mm N
Lithology:
Medium-grained yellow quartz sandstone
Collector:
D. Woolley, 1958
Rostroconchs:
Cymatopegma semiplicatum
Associated fossils:
None

Locality No. 66

Field No.:
H110*
1:250 000 Sheet:
HUCKITTA, N.T.
Run, Photo, Point Nos.:
8/5107/5277
Formation:
Tomahawk Beds
Geographical position:
About 1.6 km E of Mount Ultim in foothills of Dulcie Plateau
Co-ordinates:
170 mm E; 222 mm N
Lithology:
Medium-grained thin-bedded sandstone
Collector:
D. Woolley, 1958
Rostroconchs:
Ribeiria huckitta
Associated fossils:
None

Locality No. 67

Field No.:
H112*
1:250 000 Sheet:
HUCKITTA, N.T.
Run, Photo, Point Nos.:
1/5125/5025
Formation:
Tomahawk Beds
Geographical position:
About 8 km WNW of end of Lucy Creek boundary fence, in low hilly country just above creek bed on E side
Co-ordinates:
523 mm E; 435 mm N
Lithology:
Medium-grained quartz sandstone, white to pale brown
Collector:
D. Woolley, 1958
Rostroconchs:
Ribeiria huckitta
Associated fossils:
None

Locality No. 68

Field No.:
H119*
1:250 000 Sheet:
HUCKITTA, N.T.
Run, Photo, Point Nos.:
7/5137/4783
Formation:
Tomahawk Beds
Geographical position:
N side of valley of Tomahawk Creek 3.2 km SSW of Tomahawk Yard on top of low hill

Co-ordinates:
331 mm E; 241 mm N
Lithology:
Rubbly outcrops of weathered ferruginous sandstone
Occurrence:
Near base of formation
Collector:
R. Vine, 1958
Rostroconchs:
Cymatopegma semiplicatum
Associated fossils:
None

Locality No. 69

Field No.:
H123B*
1:250 000 Sheet:
HUCKITTA, N.T.
Run, Photo, Point Nos.:
7/5137/4784
Formation:
Tomahawk Beds
Geographical position:
2.4 km SW of Tomahawk Yard in very hilly country
Co-ordinates:
332 mm E; 244 mm N
Lithology:
Sandstone
Collector:
R. Vine, 1958
Rostroconchs:
Cymatopegma semiplicatum
Associated fossils:
None

Locality No. 70

Field No.:
H124
1:250 000 Sheet:
HUCKITTA, N.T.
Run, Photo, Point Nos.:
8/5097/4752
Formation:
Tomahawk Beds
Geographical position:
11 km S of Tomahawk Yard in rounded hills, collected in creek bed
Co-ordinates:
343 mm E; 211 mm N
Lithology:
Glauconitic sandstone
Collector:
R. Vine, 1958
Rostroconchs:
Ribeiria sp.
Associated fossils:
None

Locality No. 71

Field No.:
H125A*
1:250 000 Sheet:
HUCKITTA, N.T.
Run, Photo, Point Nos.:
7/5137/4654
Formation:
Tomahawk Beds
Age, Stage:
Late Cambrian, Payntonian
Geographical position:
9.6 km WNW Tomahawk Yard, creek bed in rounded hills
Co-ordinates:
301 mm E; 263 mm N
Lithology:
Micaceous sandstone
Collector:
R. Vine, 1958
Rostroconchs:
Cymatopegma semiplicatum
Associated fossils:
Trilobites: *Quadraticephalus*?, tsinaniid?

Locality No. 72

Field No.:
H 126A*
1:250 000 Sheet:
HUCKITTA, N.T.
Run, Photo, Point Nos.:
3A/5067/4821
Formation:
Tomahawk Beds
Geographical position:
On roadside, 19 km E of junction of Bundey and Ooratippra roads in low rounded hills
Co-ordinates:
186 mm E; 389 mm N
Lithology:
Sandstone
Occurrence:
Below Dulcie Sandstone
Collector:
R. Vine, 1958
Rostroconchs:
Cymatopegma semiplicatum
Associated fossils:
None

Locality No. 73

Field Nos.:
H 128A,* H 128E, H 128J
1:250 000 Sheet:
HUCKITTA, N.T.
Run, Photo, Point Nos.:
8/5099/4765
Formation:
Tomahawk Beds
Age, Stage:
Early Ordovician, Datsonian?

Geographical position:
10.5 km S of Tomahawk Yard in rounded hills
Co-ordinates:
334 mm E; 219 mm N
Lithology:
Micaceous sandstone (glauconitic)
Occurrence:
Stratigraphically below locality 74
Collector:
R. Vine, 1958
Rostroconchs:
Technophorus kempae
Associated fossils:
Trilobites: leiostegiacean

Locality No. 74

Field Nos.:
H129,* H129C, H129D, H129E, H129I
1:250 000 Sheet:
HUCKITTA, N.T.
Run, Photo, Point Nos.:
8/5099/4766
Formation:
Tomahawk Beds
Age, Stage:
Early Ordovician, Datsonian?
Geographical position:
10.5 km S of Tomahawk Yard in rounded hills
Co-ordinates:
331 mm E; 216 mm N
Lithology:
Sandstone
Occurrence:
Stratigraphically above locality 73
Collector:
R. Vine, 1958
Rostroconchs:
Technophorus kempae
Associated fossils:
Trilobites: leiostegiacean, dikelocephalinid?, and kainelloid

Locality No. 75

Field No.:
H148
1:250 000 Sheet:
HUCKITTA, N.T.
Formation:
Tomahawk Beds
Geographical position:
Unknown
Co-ordinates:
Unknown
Lithology:
Sandstone
Rostroconchs:
Cymatopegma semiplicatum
Associated fossils:
None

Locality No. 76

Field No.:
H163
1:250 000 Sheet:
HUCKITTA, N.T.
Formation:
Tomahawk Beds
Geographical position:
Unknown
Co-ordinates:
Unknown
Lithology:
Sandstone
Rostroconchs:
Ribeiria huckitta
Associated fossils:
None

Locality No. 77

Field Nos.:
H171*
1:250 000 Sheet:
HUCKITTA, N.T.
Run, Photo, Point Nos.:
8/5099/4766
Formation:
Tomahawk Beds
Age, Stage:
Early Ordovician, Datsonian?
Co-ordinates:
331 mm E; 213 mm N
Lithology:
Sandstone
Rostroconchs:
Technophorus kempae, Tolmachovia belfordi
Associated fossils:
Trilobites: leiostegiacean, kainelloid, asaphid, *Geragnostus* (*Micragnostus*)

Locality No. 78

Field No.:
H186E*
1:250 000 Sheet:
HUCKITTA, N.T.
Run, Photo, Point Nos.:
8/5099/5852
Formation:
Tomahawk Beds
Age, Stage:
Early Ordovician, Datsonian?
Geographical position:
NE side of Dulcie Range, 8 km NW of Picton Spring, foothills of Dulcie Range (including section in a gorge).
Co-ordinates:
327 mm E; 217 mm N
Lithology:
Sandstone
Collector:
R. Vine, 1958

Rostroconchs:
Technophorus kempae
Associated fossils:
Trilobites: leiostegiacean

Locality No. 79

Field No.:
H188*
1:250 000 Sheet:
HUCKITTA, N.T.
Run, Photo, Point Nos.:
1/5125/5951
Formation:
Tomahawk Beds
Geographical position:
3.2 km W of H185 (H185 being 1.6 km N of fence end. NE of Lucy Creek Station). Rolling hills
Co-ordinates:
519 mm E; 437 mm N
Lithology:
Sandstone in sequence with dolomite and sandy dolomite
Collector:
R. Vine, 1958.
Rostroconchs:
Ribeiria huckitta
Associated fossils:
None

Locality No. 80

Field No.:
LC 10, NT 284
1:250 000 Sheet:
HUCKITTA, N.T.
Run, Photo, Point Nos.:
4/5038 see below (†)
Formation:
Tomahawk Beds
Geographical position:
Close to T427* (Tobermory Sheet)
Co-ordinates:
(†) Tobermory Sheet, 3 mm E; 334 mm N
Lithology:
Sandstone interbedded with siltstone
Occurrence:
Underlain by 3 m of calcareous sandstone; below this calcareous shale and dolomite
Collector:
N. O. Jones, 1955
Rostroconchs:
Cymatopegma semiplicatum
Associated fossils:
None

Locality No. 81

Field No.:
310/1-74 (74713111)
1:250 000 Sheet:
HUCKITTA, N.T.
Formation:
Tomahawk Beds
Geographical position:
'Old Huckitta', Section on track to Old Huckitta hstd
Co-ordinates:
237 mm E; 178 mm N
Lithology:
Grey/white orthoquartzite with rottenstone layers/ochreous and brown leached rottenstone and sandstone
Collectors:
J. H. Shergold & John Pojeta, 1974
Rostroconchs:
Ribeiria sp.
Associated fossils:
Trilobites: asaphid, *Saltaspis* or *Jujuyaspis*

Locality No. 82

Field No.:
310/5-74 (74713115)
1:250 000 Sheet:
HUCKITTA, N.T.
Formation:
Tomahawk Beds
Age, Stage:
Late Cambrian, Payntonian
Geographical position:
'Old Huckitta' 0.8 km E of locality 61
Co-ordinates:
237 mm E; 178 mm N
Lithology:
Massive sugary yellow quartz sandstone with rottenstone layers
Collector:
J. H. Shergold & John Pojeta, 1974
Rostroconchs:
Cymatopegma semiplicatum, Pinnocaris? sp. B
Associated fossils:
Trilobites: *Quadraticephalus, Lophosaukia, Pseudagnostus*

Locality No. 83

Field No.:
311/3-74 (74713118)
1:250 000 Sheet:
HUCKITTA, N.T.
Formation:
Tomahawk Beds
Age, Stage:
Late Cambrian, Payntonian
Geographical position:
See locality 78
Co-ordinates:
325 mm E; 223 mm N
Lithology:
Pale olive/white leached shell coquina (*Tsinania*). Laminated shell layers

Collector:
J. H. Shergold & John Pojeta, 1974
Rostroconchs:
Ribeiria huckitta
Associated fossils:
Trilobites: *Tsinania*, kainelloid?

Locality No. 84

Field Nos.:
311/5A-74, 311/5B-74, 311/5C-74, 311/5D-74
1:250 000 Sheet
HUCKITTA, N.T.
Formation:
Tomahawk Beds
Age, Stage:
Early Ordovician, Datsonian?
Geographical position:
See locality 78
Co-ordinates:
325 mm E; 223 mm N
Lithology:
Sandstone
Occurrence:
Stratigraphically above locality 83
Collector:
J. H. Shergold & John Pojeta, 1974
Rostroconchs:
Technophorus kempae, Tolmachovia belfordi, Ribeiria runnegari
Associated fossils:
Trilobites: *Asaphellus*, leiostegiid, kainelloid, *Geragnostus*

Locality No. 85

Field No.:
W9*
1:250 000 Sheet:
MOUNT WHELAN, Qld
Run, Photo, Point Nos.:
13/5073 (top left hand corner)
Formation:
Georgina Limestone
Age, Stage:
Late Cambrian, Idamean
Geographical position:
9.5 km NNE of 20-mile Bore on road from Glenormiston to 20-mile Bore, low strike rises of limestone in low soil plains with sink-holes and much Gidyea scrub
Co-ordinates:
353 mm E; 387 mm N
Lithology:
Limestone
Collector:
J. N. Casey, 1957
Rostroconchs:
Oepikila cambrica
Associated fossils:
Trilobites: *Erixanium sentum*

Locality No. 86

Field No.:
CSIRO 303
1:250 000 Sheet:
RODINGA, N.T.
Run, Photo, Point Nos.:
14/5057/6.9″E, 7.5″N of SW corner of photo
Formation:
Stairway Sandstone
Geographical position:
Road from Maryvale hstd to Idracowra hstd, 40 km SW of Maryvale hstd. Low outcrop forming flat-topped hill 0.4 km N of road
Co-ordinates:
79 mm E; 74 mm N
Lithology:
Silicified sandstone
Collector:
T. Quinlan, 1956
Rostroconchs:
Ribeiria csiro
Associated fossils:
Molluscs: pelecypods

Locality No. 87

Field No.:
T3
1:250 000 Sheet:
TOBERMORY, N.T.
Formation:
Coolibah Formation
Age, Stage:
Early Ordovician, 'Arenigian'
Geographical position:
NE of T2* on Tobermory Sheet
Co-ordinates:
Unknown
Lithology:
Chert
Collector:
J. N. Casey, 1954
Rostroconchs:
Euchasma skwarkoi
Associated fossils:
None

Locality No. 88

Field No.:
T4
1:250 000 Sheet:
TOBERMORY, N.T.
Formation:
Coolibah Formation
Age, Stage:
Early Ordovician, 'Arenigian'
Geographical position:
3.2 km from (?W) Kelly Creek Bore
Co-ordinates:
592 mm E; 174 mm N
Lithology:
Chert

Collector:
J. N. Casey, 1954
Rostroconchs:
Euchasma skwarkoi
Associated fossils:
None

Locality No. 89

Field No.:
T100*
1:250 000 Sheet:
TOBERMORY, N.T.
Run, Photo, Point Nos.:
Tobermory 9/5133/-; Glenormiston 10/5005/-
Formation:
Coolibah Formation
Age, Stage:
Early Ordovician, 'Arenigian'
Geographical position:
Hills between Kelly Creek Bore (Tobermory) and Toko Range (foothills of Toko Range)
Co-ordinates:
593 mm E; 167 mm N
Lithology:
Chert
Collector:
R. J. Paten
Rostroconchs:
Euchasma skwarkoi
Associated fossils:
None

Locality No. 90

Field No.:
T110*
1:250 000 Sheet:
TOBERMORY, N.T.
Run, Photo, Point Nos.:
13/5053
Formation:
Ninmaroo Formation
Age, Stage:
Early Ordovician, Warendian
Geographical position:
4 km NNW of Burnt Well, gullies in limestone rises, outcrops partly obscured by sand
Co-ordinates:
547 mm E; 24 mm N
Lithology:
Buff grey oolitic limestone with silicified fossils
Rostroconchs:
Pauropegma jelli
Associated fossils:
Conodonts: *Oneotodus variabilis*
Molluscs: nautiloids

Locality No. 91

Field No.:
T112*
1:250 000 Sheet:
TOBERMORY, N.T.
Run, Photo, Point Nos.:
9/5137/-
Formation:
Coolibah Formation
Age, Stage:
Early Ordovician, 'Arenigian'
Geographical position:
4.8 km NW Alcoora Spring; poor outcrops in low country with scattered faulted hills
Co-ordinates:
543 mm E; 144 mm N
Lithology:
Iron-stained 'buckquartz' (cream chert)
Rostroconchs:
Euchasma skwarkoi
Associated fossils:
None

Locality No. 92

Field No.:
T215
1:250 000 Sheet:
TOBERMORY, N.T.
Run, Photo, Point Nos.:
12/5125/-
Formation:
Coolibah Formation
Age, Stage:
Early Ordovician, 'Arenigian'
Geographical position:
14 km N of No. 8 Dam (? S of Coolibah Dam). Good outcrops, almost cliff section
Co-ordinates:
529 mm E; 42 mm N
Lithology:
Fossiliferous dolomite and chert
Rostroconchs:
Euchasma skwarkoi
Associated fossils:
None

Locality No. 93

Field No.:
T368
1:250 000 Sheet:
TOBERMORY, N.T.
Run, Photo, Point Nos.:
7/5055/2664
Formation:
Coolibah Formation
Age, Stage:
Early Ordovician, 'Arenigian'
Geographical position:
46 km due NE of Marqua hstd. Top of low rise in plain
Co-ordinates:
467 mm E, 213 mm N
Lithology:
White and orange chert with fossiliferous bands, thin-bedded

Rostroconchs:
Euchasma skwarkoi
Associated fossils:
None

Locality No. 94

Field No.:
T421*
1:250 000 Sheet:
TOBERMORY, N.T.
Run, Photo, Point Nos.:
9/5155/1960
Formation:
Tomahawk Beds
Geographical position:
22.5 km E of Tarlton Downs hstd, on Tarlton-Southern Cross Bore track
Co-ordinates:
225 mm E; 155 mm N
Lithology:
Sandstone
Collector:
R. Vine
Rostroconchs:
Ribeiria jonesi
Associated fossils:
None

Locality No. 95

Field No.:
FBH 41653
1:250 000 Sheet:
TOBERMORY, N.T.
Run, Photo, Point Nos.:
13/5052/-
Formation:
Ninmaroo Formation
Geographical position:
Same as locality 90
Co-ordinates:
Same as locality 90
Lithology:
Calcarenite
Collector:
Geologists of Frome-Broken Hill, 1959
Rostroconchs:
Pauropegma jelli
Associated fossils:
None

Locality No. 96

Field No.:
309/1-74 (74713110)
1:250 000 Sheet:
TOBERMORY, N.T.
Formation:
Uncertain
Age, Stage:
Late Cambrian, Payntonian
Geographical position:
Gaphole Creek. Roadside exposures opposite Burnt Well, S of side road, due S of well
Co-ordinates:
398 mm E; 15 mm N
Lithology:
Thin-bedded decalcified siltstone
Collectors:
J. H. Shergold & John Pojeta, 1974
Rostroconchs:
Cymatopegma semiplicatum, Kimopegma pinnatum, Ribeiria huckitta
Associated fossils:
Trilobites: *Quadraticephalus*?, nepeid, *Tsinania*?, saukiid, *Haniwa*

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PLATE 1

Ribeiria australiensis Pojeta & Runnegar, 1976
(p. 13)

(All specimens are preserved as silicified replicas from locality 51)

Figs. 1-2 Left lateral and right lateral views of paratype (CPC 14672), X4.

Figs. 3-7 Anterior, left lateral, dorsal, ventral, and right lateral views of **holotype** (CPC 14670), showing lateral profile, shell gapes, and dorsal carina, X4.

Figs. 8-11 Ventral, right lateral, anterior, and posterior views of paratype (CPC 14673), showing lateral profile and shell gapes, X4.

Figs. 12-13 Left lateral and posterior views of paratype (CPC 14674), showing lateral profile and posterior gape, X4.5.

Fig. 14 Oblique view of posterior surface of pegma (arrow), posterior part of shell broken off, most of right valve missing. Paratype (CPC 14675), X4.5.

Fig. 15 Left lateral view of paratype (CPC 14676), X4.5.

Fig. 16 Dorsal view of paratype (CPC 14677), showing carina, X4.5.

Figs. 17-18 Dorsal and right lateral views of paratype (CPC 14671), showing carina and lateral profile, X4.

Fig. 19 Right lateral view of paratype (CPC 14678), X4.

Fig. 20 Right lateral view of paratype (CPC 14679), showing growth-lines, X4.5.

Plate 1

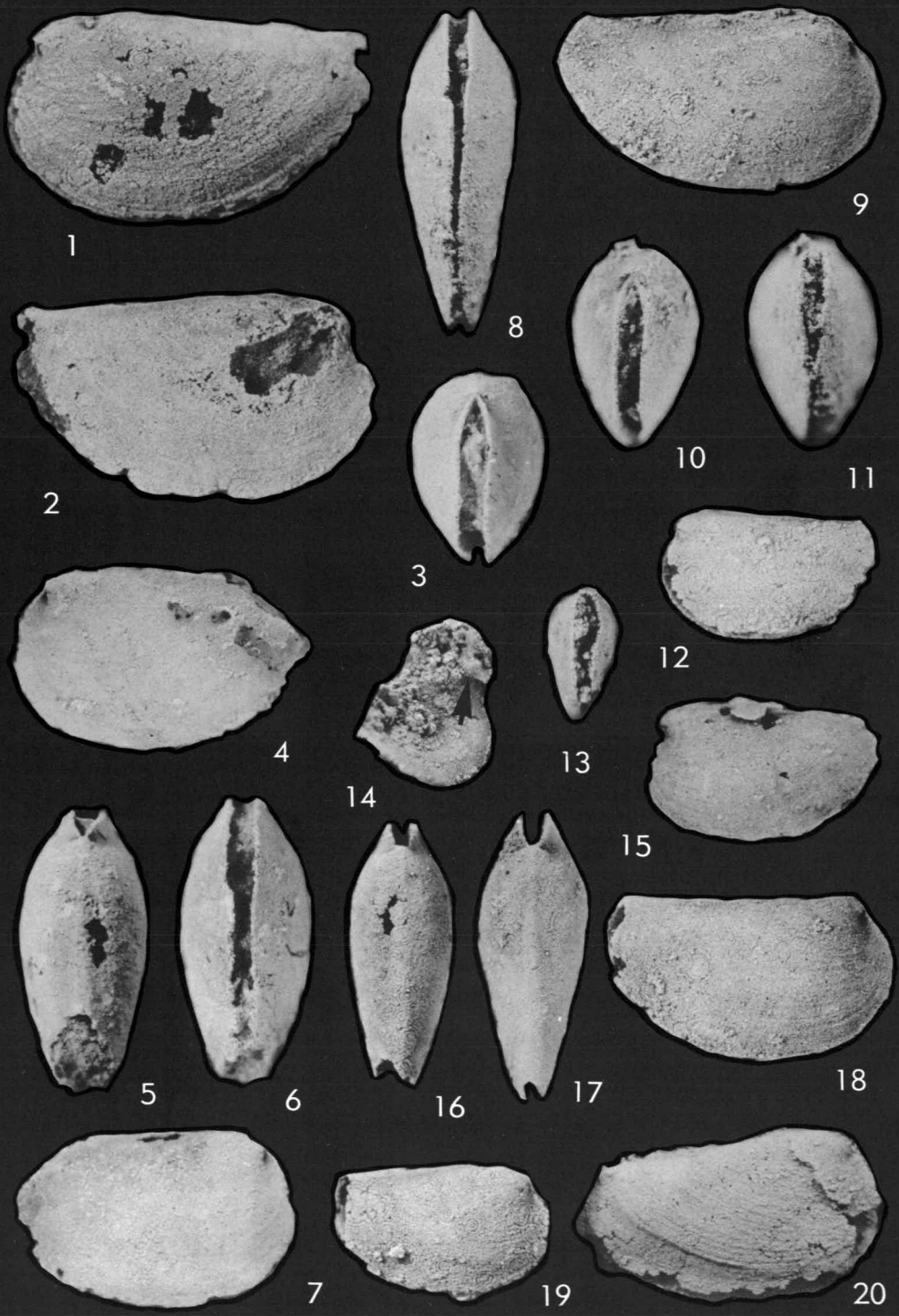


PLATE 2

Ribeiria runnegari sp. nov.
(p. 15)
(All specimens from locality 84)

Fig. 1 Right lateral view of paratype (CPC 14688), showing pegma; internal mould, X2.

Figs. 2, 13 Part and counterpart of **holotype** (CPC 14683), showing pegma and growth-lines; fig. 2, X2.5; fig. 13, X2.

Fig. 3 Left lateral view of paratype (CPC 14684) showing pegma; internal mould, X2.5.

Fig. 4 Left lateral view of paratype (CPC 14686); internal mould, X2.5.

Fig. 5 Left lateral view of paratype (CPC 14687); internal mould, X2.

Figs. 6-7 Dorsal and right lateral views of paratype (CPC 14689), showing wide dorsum and pegma; internal mould, X2.

Fig. 8 Dorsal view of paratype (CPC 14680), showing wide dorsum; internal mould, X2.

Fig. 9 Dorsal view of paratype (CPC 14690); internal moud, X2.

Fig. 10 Right lateral view of paratype (CPC 14681), showing pegma; internal mould, X2.

Fig. 11 Left lateral view of paratype (CPC 14682), showing pegma; internal mould, X2.

Fig. 12 Dorsal view of paratype (CPC 14691); internal mould, X2.

Plate 2

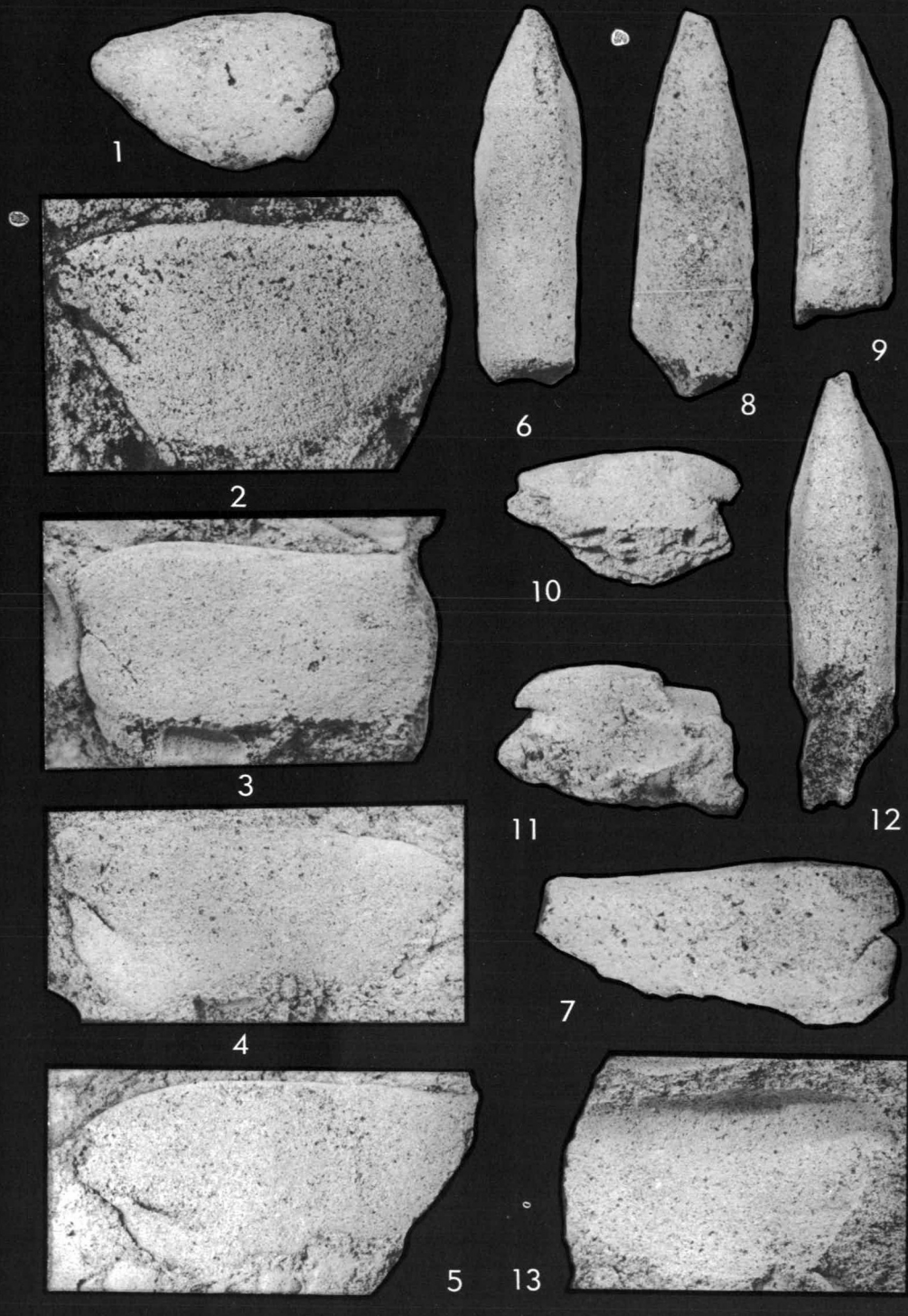


PLATE 3

Ribeiria huckitta sp. nov.
(p. 14)

Fig. 1 Left lateral view of paratype (CPC 14701), showing pegma; internal mould, locality 79, X4.5.

Fig. 2 Left lateral view of paratype (CPC 14702), showing profile and pegma; internal mould, locality 79, X4.

Fig. 5 Left lateral view of paratype (CPC 14704), showing profile and pegma; internal mould, locality 17, X4.

Fig. 6 Left lateral view of external cast showing growth-lines. Paratype (CPC 14706), locality 62, X5.5.

Fig. 7 Left lateral view of paratype (CPC 14703); internal mould, locality 79, X4.

Ribeiria aff. *R. huckitta* sp. nov.

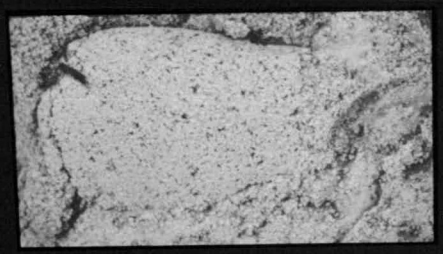
Fig. 8 Left lateral view (CPC 14707) showing profile and pegma; internal mould, locality 76, X6.

Ribeiria csiro sp. nov.
(p. 13)

Fig. 3 Right lateral view of **holotype** (CPC 14715), showing pegma; internal mould; locality 86, X3.

Fig. 4 Dorsal view of paratype (CPC 14716), shelled specimen, locality 86, X2.5.

Plate 3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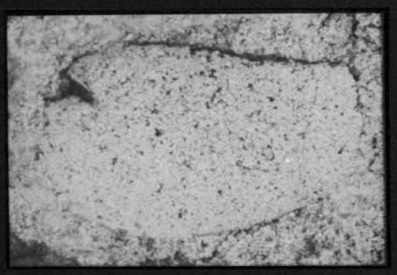
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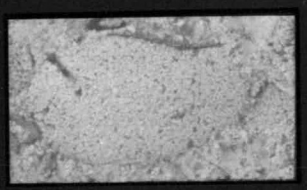
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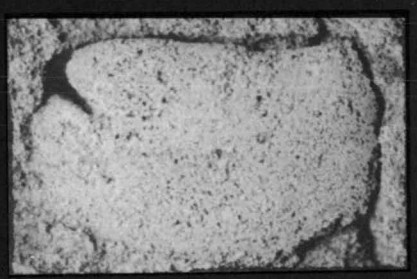
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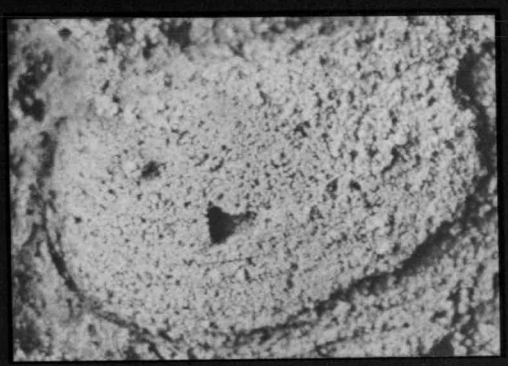
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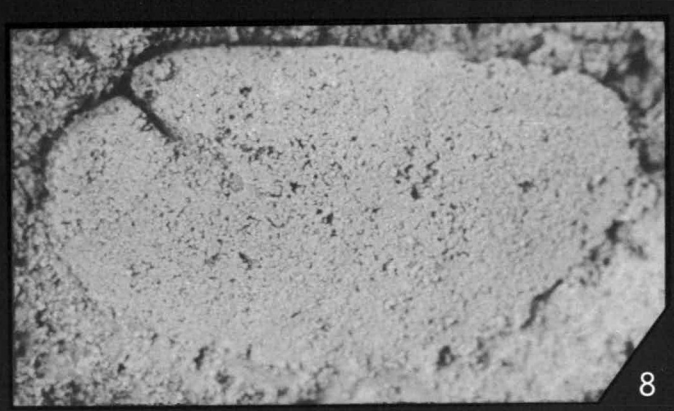
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PLATE 4

Ribeiria jonesi sp. nov.
(p. 15)

Figs. 1-2 Right lateral and left lateral views of paratype (CPC 14709), showing profile and pegma; internal mould, locality 7, X4.

Figs. 6-9 Left lateral, right lateral, and dorsal views of internal mould, and counterpart, showing lateral profile, pegma, and growth-lines. Paratype (CPC 14711), locality 4, X4.

Ribeiria huckitta sp. nov.
(p. 14)

(All specimens are internal moulds.)

Fig. 3 Left lateral view of paratype (CPC 14710), locality 67, X4.

Fig. 5 Left lateral view of paratype (CPC 14705) showing profile and pegma, locality 17, X4.

Fig. 10 Left lateral view of paratype (CPC 14712), locality 17, X4.

Fig. 11 Left lateral view of **holotype** (CPC 14713), showing profile and pegma, locality 17, X4.

Fig. 12 Right lateral view of paratype (CPC 14714), locality 61, X5.

Ribeiria aff. *R. huckitta* sp. nov.

Fig. 4 Left lateral view showing profile and pegma (CPC 14708); internal mould, locality 76, X4.

Plate 4

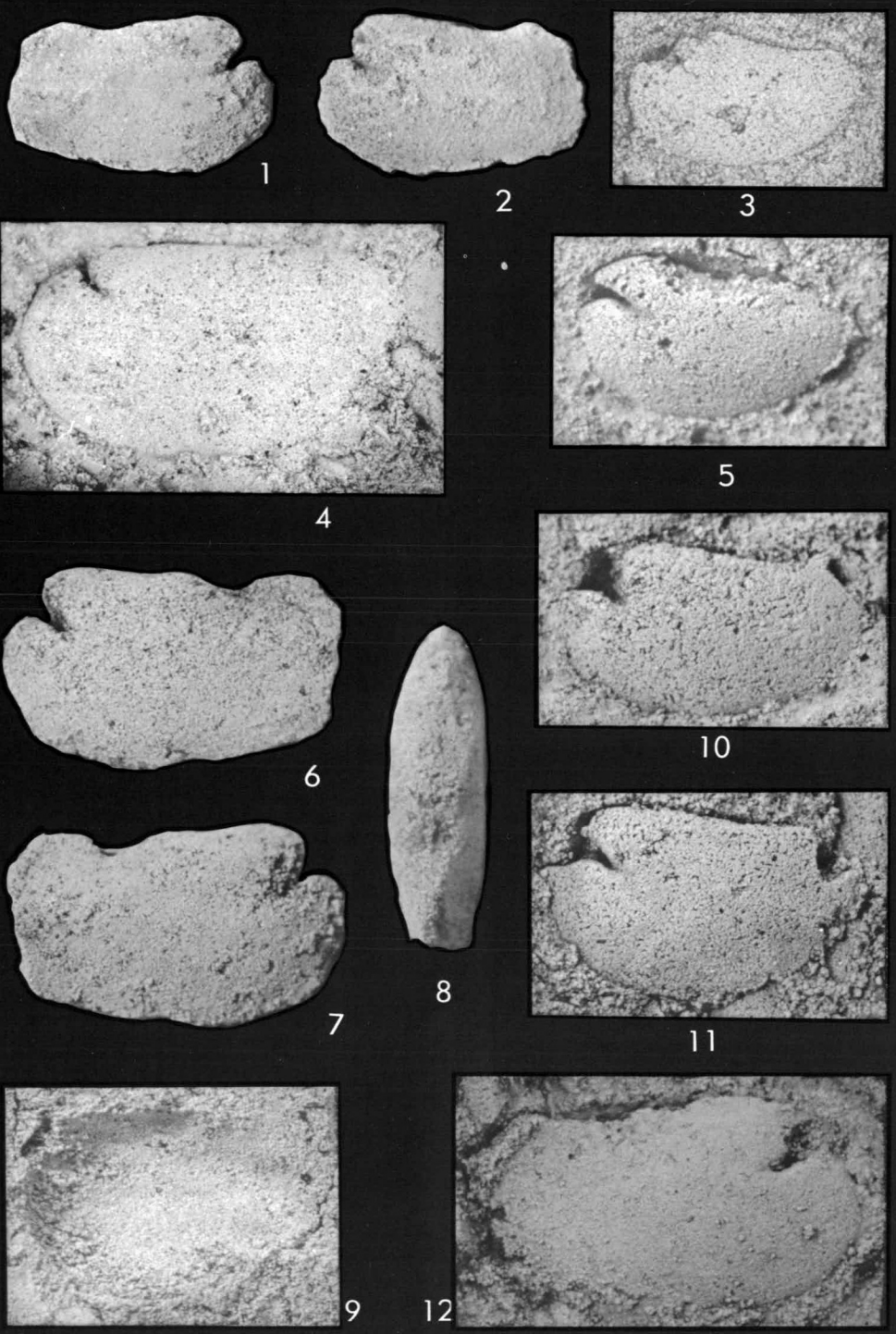


PLATE 5

Wanwania drucei sp. nov.
(p. 19)

(All specimens preserved as silicified replicas from locality 44.)

Figs. 1-5 Right lateral, posterior, ventral, left lateral, and dorsal views of **holotype** (CPC 14692), showing lateral profile and shell gapes, X5.

Fig. 6 Right lateral view of paratype (CPC 14693), X5.

Fig. 7 Anterior view of paratype (CPC 14694), showing gape, X5.

Fig. 8 Left lateral view of paratype (CPC 14695), X5.

Figs. 9-11 Left lateral, posterior, and dorsal views of paratype (CPC 14696), showing profile, gape, and lack of dorsal commissure, X5.

Fig. 12 View of pegma seen from posterior end of shell, posterior and ventral parts of shell broken off. Paratype (CPC 14697), X5.

Figs. 13-14 Right lateral and anterior views of paratype (CPC 14698), X5.

Figs. 15-16 Exterior and interior views of anterior part of shell, showing gape and pegma; posterior part of shell broken off. Paratype (CPC 14699), X5.

Figs. 17-18 Interior and exterior views of anterior part of shell showing pegma and anterior gape; posterior part of shell broken off. Paratype (CPC 14700), X5.

Plate 5

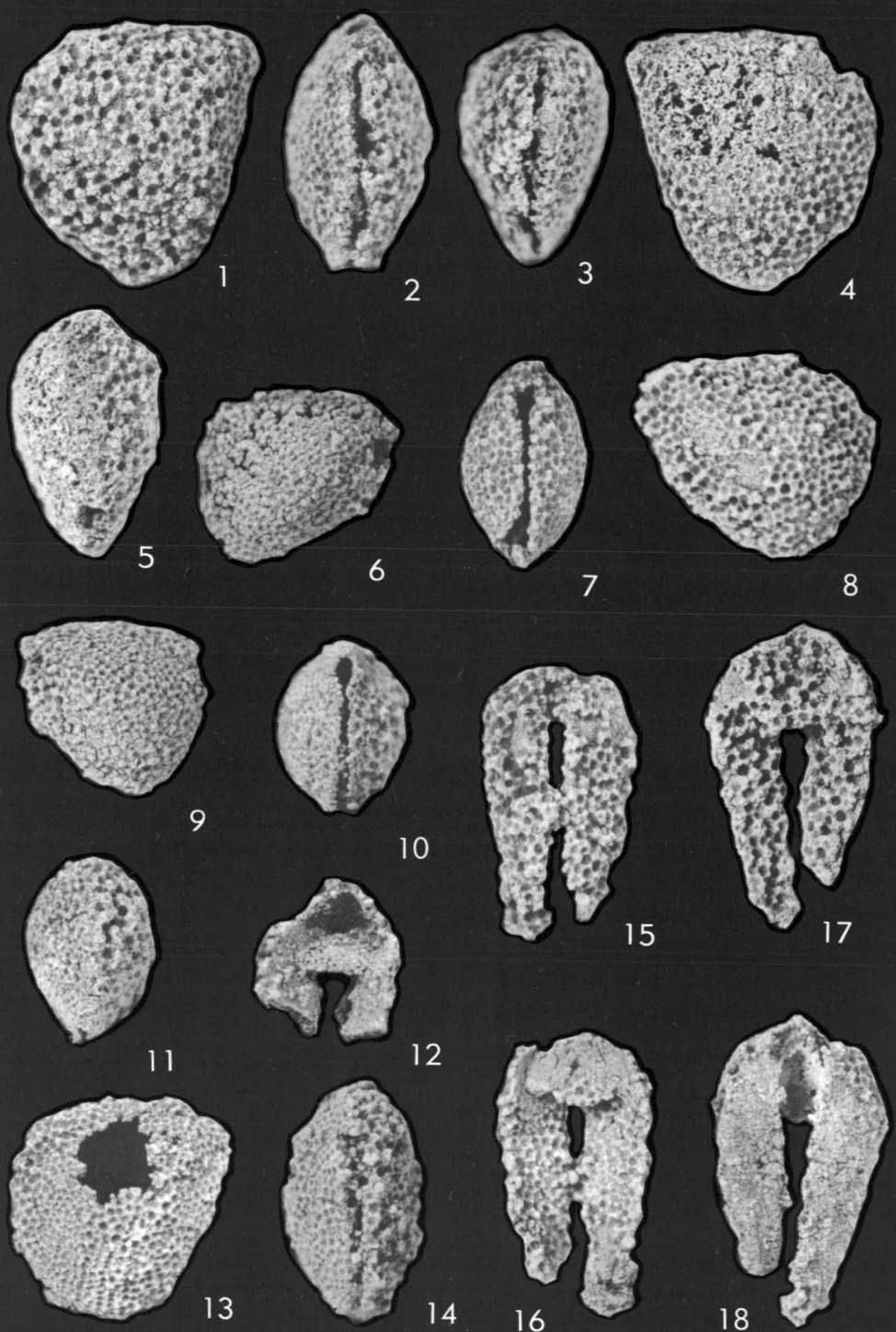


PLATE 6

Cymatopegma semiplicatum gen. nov. et sp. nov.
(p. 17)

Figs. 1-4 Right lateral, left lateral, and dorsal views of **holotype** (CPC 14717), internal mould. Figures 3-4 show the zigzag dorsal margin; in Figure 3, the margin is marked in ink. Locality 16, X5.

Figs 5-7 Left lateral and dorsal views of paratype (CPC 14718), internal mould. Figures 6-7 show the zigzag dorsal margin; in figure 6, the margin is marked with ink. Locality 4; Figure 5, X5; Figures 6-7, X7.

Fig. 8 Left lateral view of paratype (CPC 14719), showing ornament; internal mould, locality 4, X5.

Figs. 9-11 Left lateral and dorsal views of paratype (CPC 14720), internal mould. Figures 10-11 show the zigzag dorsal margin; in Figure 10, the margin is marked in ink. Locality 60; Figure 9, X5; Figures 10-11, X7.

Fig. 12 Left lateral view of exterior of paratype (CPC 14721), locality 60, X5.

Fig. 13 Left lateral view of paratype (CPC 14722), showing pegma; internal mould, locality 82, X5.

Figs. 14-15 Right lateral and left lateral views of paratype (CPC 14723); internal mould, locality 4, X5.

Figs. 16-17 Right lateral and left lateral views of paratype (CPC 14724), showing profile, pegma, and ornament; internal mould, locality 16, X5.

Plate 6

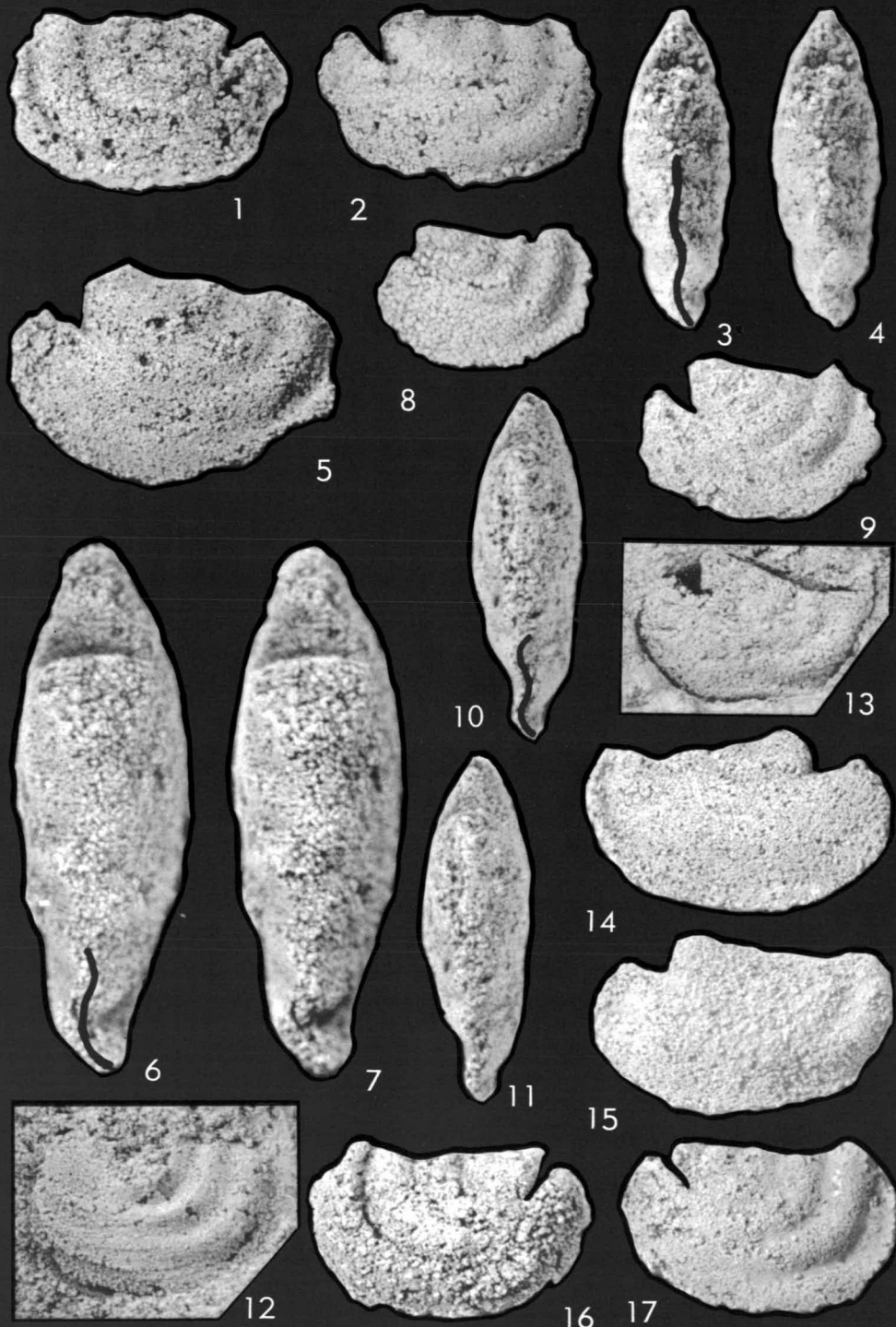


PLATE 7

Cymatopegma semiplicatum gen. nov. et sp. nov.
(p. 17)

Fig. 1 Right lateral view of paratype (CPC 14725), showing pegma, ornament, and mould of protoconch; internal mould, locality 82, X5.

Fig. 2 Left lateral view of paratype (CPC 14726) showing profile, pegma, and marginal denticles; internal mould, locality 4, X5.

Fig. 3 Left lateral view of paratype (CPC 14727), showing pegma and ornament, locality 6, X5.

Fig. 4 Right valve exterior, showing ornament and growth-lines, shelled specimen. Paratype (CPC 14728), locality 16, X5.

Fig. 5 Left lateral view of paratype (CPC 14729), showing ornament; internal mould, locality 6, X5.

Fig. 6 Right lateral view of paratype (CPC 14730), showing ornament, pegma, and marginal denticles; internal mould, locality 4, X5.

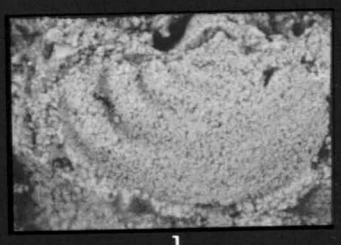
Fig. 7 Right valve exterior, showing ornament, decorticated anteroventrally and showing marginal denticles extended dorsally as internal ribs. Paratype (CPC 14731), locality 13, X5.

Fig. 8 Right lateral view of paratype (CPC 14732), showing ornament, pegma, and marginal denticles extended dorsally as internal ribs; locality 16, X5.

Fig. 9 Latex replica of left valve exterior showing ornament; external mould. Paratype (CPC 14733), locality 4, X5.

Fig. 10 Right lateral view of paratype (CPC 14734); internal mould, locality 4, X5.

Plate 7



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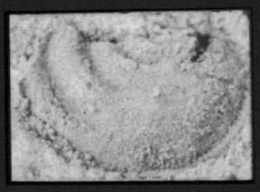

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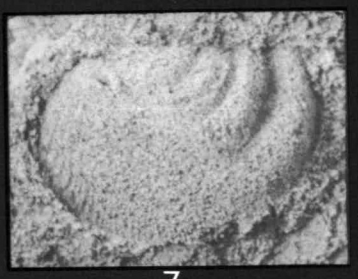

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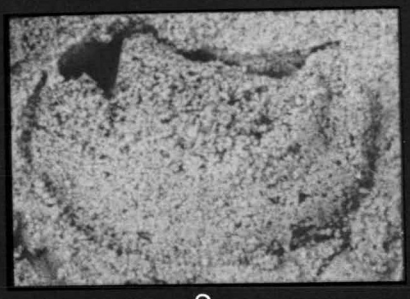

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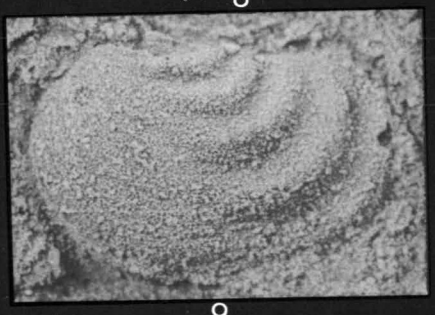

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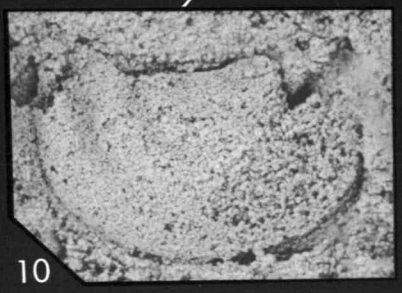

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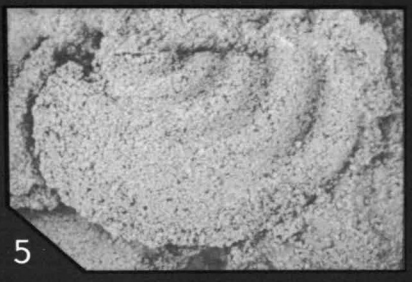

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PLATE 8

Pinnocaris robusta sp. nov.
(p. 18)

Figs. 1-2 Right lateral and dorsal views of paratype (CPC 14735), showing profile and dorsal carina; internal mould, locality 11, X1.

Figs. 3-4 Right lateral and dorsal views of paratype (CPC 14736), showing pegma and dorsal carina; internal mould, locality 11, X1.

Fig. 5 Right lateral view of paratype (CPC 14737), showing pegma; internal mould, locality 11, X1.

Fig. 6 Left lateral view of paratype (CPC 14738); internal mould, locality 4, X1.

Figs. 7-8 Part and counterpart of right valve. **Holotype** (CPC 14739), locality 11, X1.

Fig. 9 Right lateral view of paratype (CPC 14740), showing profile and pegma; internal mould, locality 11, X1.

Fig. 10 Right lateral view of paratype (CPC 14741), showing pegma; internal mould, locality 6, X1.

Pinnocaris sp. A
(p. 18)

Fig. 11 Left lateral view showing profile, growth-lines, and pegma (CPC 14742); composite mould, locality 57, X1.

Pinnocaris? sp. B
(p. 18)

Fig. 12 Left lateral view (CPC 14743); internal mould, locality 82, X1.

Pinnocaris wellsi sp. nov.
(p. 17)
(All specimens from locality 4.)

Fig. 13 Left lateral view of paratype (CPC 14744); internal mould, X1.

Fig. 14 Left lateral view of paratype (CPC 14745), slightly distorted, but showing markedly drawn out posterior end; internal mould, X1.

Fig. 15 Left lateral view of paratype (CPC 14746), showing profile and growth-lines; composite mould, X1.

Fig. 16 Left lateral view of paratype (CPC 14747), showing profile and growth-lines; composite mould, X2.

Fig. 17 Left lateral view of paratype (CPC 14748), showing profile and pegma; internal mould, X1.

Fig. 18 Left lateral view of paratype (CPC 14749), X1.

Fig. 19 Left lateral view of paratype (CPC 14750), slightly distorted, but showing growth-lines; composite mould, X2.

Figs. 20-21 Right lateral and dorsal views of **holotype** (CPC 14751), showing profile, pegma, and dorsal carina; internal mould, X1.

Plate 8

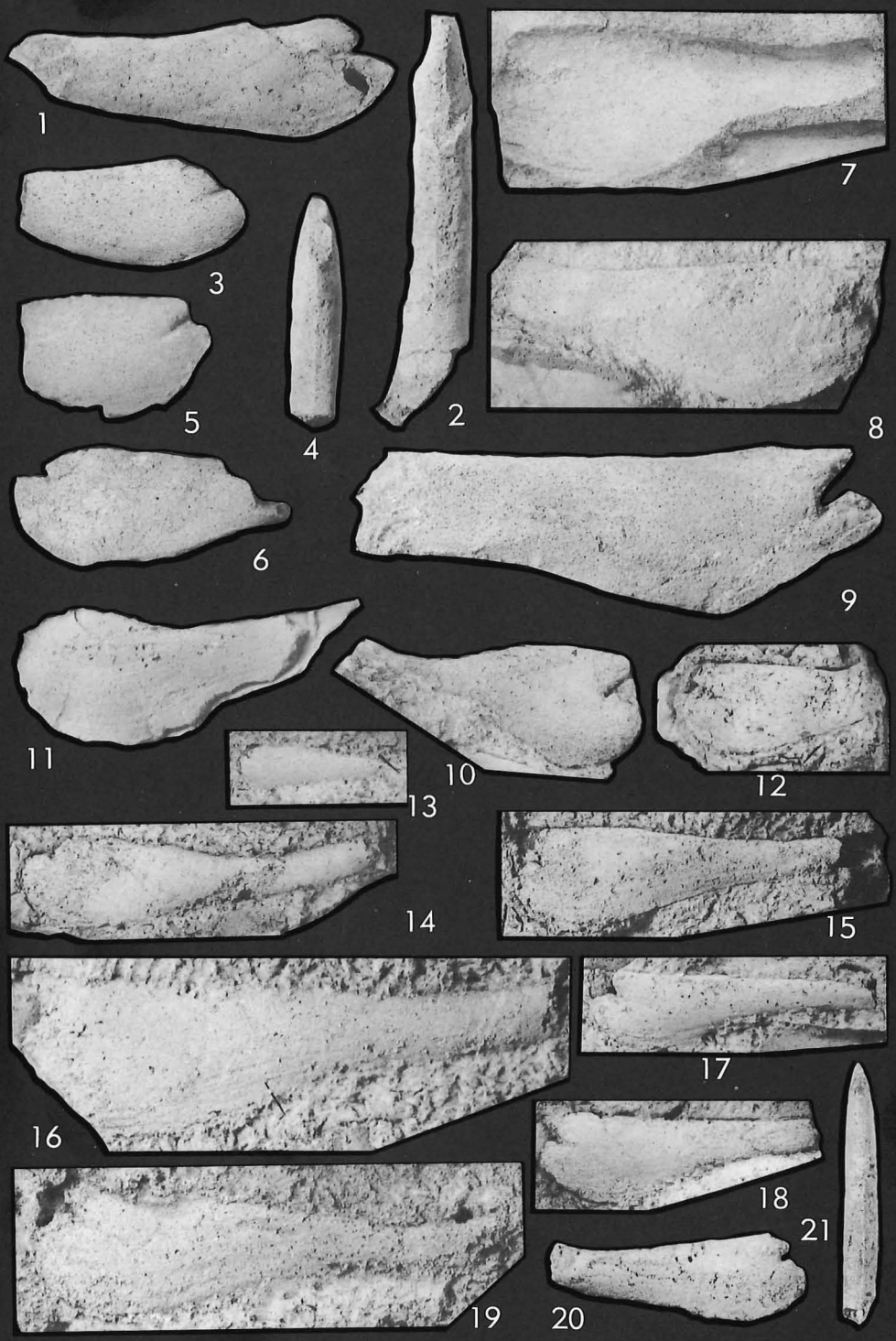

PLATE 9

Pinnocaris wellsi sp. nov.
(p. 17)
(All specimens from locality 4.)

Fig. 1 Right lateral view of paratype (CPC 14752); internal mould, X1.

Fig. 2 Right lateral view of paratype (CPC 14753), showing pegma; internal mould, X1.

Fig. 3 Right lateral view of paratype (CPC 14754), showing pegma; composite mould, X1.

Fig. 4 Right lateral view of paratype (CPC 14755), showing profile and pegma; internal mould, X1.

Fig. 5 Right lateral view of paratype (CPC 14756), showing profile and pegma; internal mould, X1.

Fig. 6 Right lateral view of paratype (CPC 14757), showing growth-lines; composite mould, X1.

Fig. 7 Right lateral view of paratype (CPC 14758); internal mould X1.

Fig. 8 Right lateral view of paratype (CPC 14759); internal mould, X1.

Fig. 9 Left lateral view of paratype (CPC 14760); composite mould, X1.

Ptychopegma burgeri gen. nov. et sp. nov.
(p. 19)

Figs. 10-16 Posterior, left lateral, right lateral, anterior, oblique posterodorsal, ventral, and dorsal views of **holotype** (CPC 14761), showing ornament and shell gapes; silicified replica, locality 21; Figures 11, 12, X2.5; Figures 10, 13-16, X3.5.

Fig. 17 Incomplete left valve showing ornament and growth-lines. Paratype (CPC 14762), silicified replica, locality 21, X2.5.

Fig. 18 Right lateral view of paratype (CPC 14763), showing pegma; silicified internal mould, locality 29, X2.5.

Fig. 19 Incomplete left (?) valve, silicified replica. Paratype (CPC 14764), locality 42, X2.5.

Fig. 20 Left lateral view of paratype (CPC 14765), showing ornament; silicified replica, locality 29, X2.5.

Fig. 21 Left lateral view of paratype (CPC 14766), showing ornament; silicified replica, locality 29, X2.5.

Plate 9

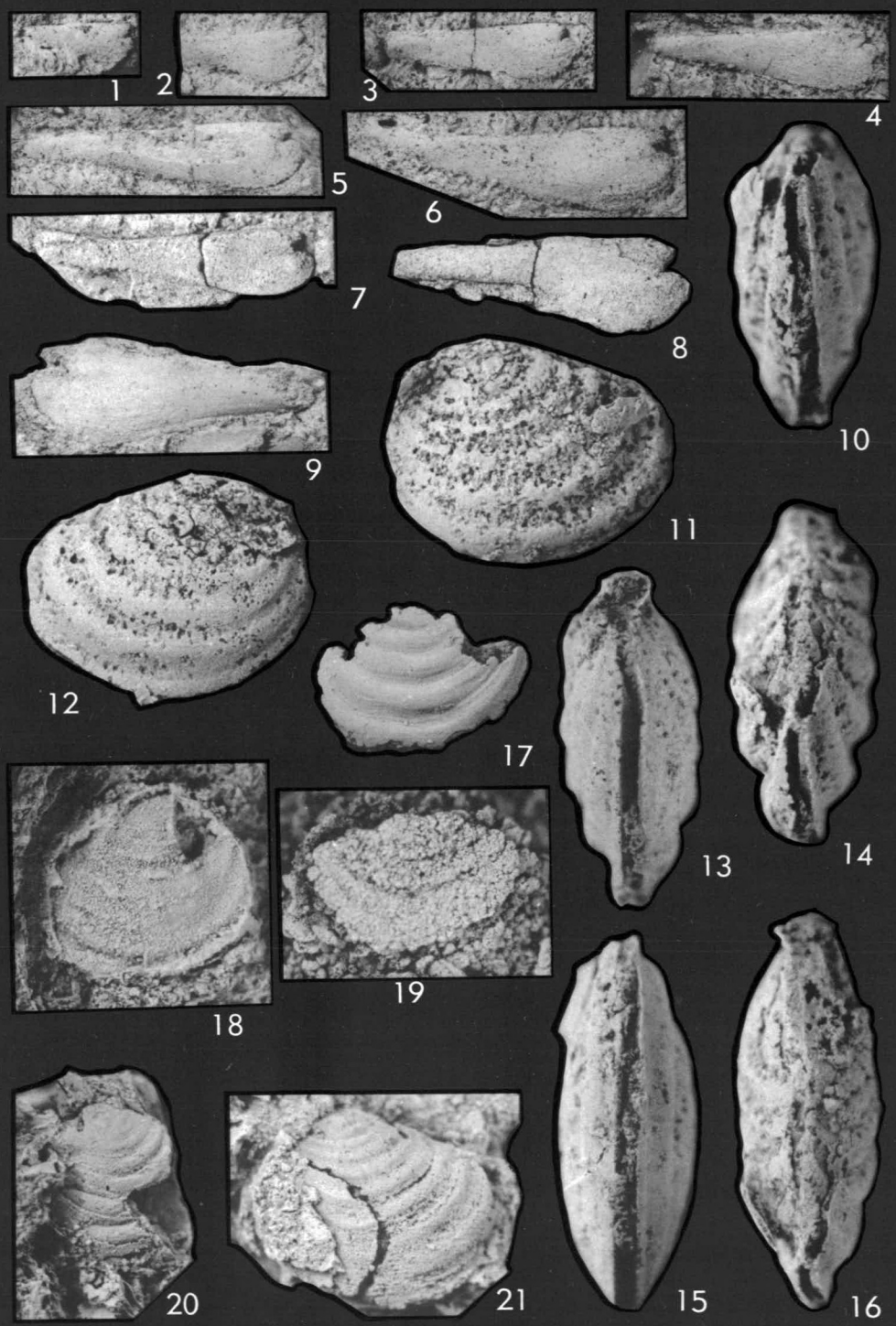

PLATE 10

Apoptopegma dickinsi gen. nov. et sp. nov.
(p. 16)

(All specimens silicified replicas from locality 41.)

Figs. 1-3 Left lateral, anterior, and dorsal views of **holotype** (CPC 14767), showing profile and gape, X10.

Figs. 4-6 Left lateral, anterior, and dorsal views of paratype (CPC 14768), showing profile and gape, X10.

Fig. 7 Right lateral view of paratype (CPC 14769), X10.

Fig. 8 Right lateral view of paratype (CPC 14770), X10.

Fig. 9 Dorsal view of paratype (CPC 14771), X10.

Apoptopegma? sp. B
(p. 16)

Fig. 10 Left lateral view (UQ F67151), silicified replica, locality 46, X3.

Apoptopegma sp. A
(p. 16)

Figs. 11-13 Dorsal, anterior, and left lateral views (CPC 14772), silicified replica, locality 48, X3.

Technophorus walteri sp. nov.
(p. 21)

Fig. 14 Left lateral view of paratype (CPC 14773), showing pegma and rib; internal mould, locality 56, X5.

Fig. 15 Left lateral view of paratype (CPC 14774), showing pegma and rib; internal mould, locality 56, X5.

Fig. 16 Right lateral view of **holotype** (CPC 14775), showing pegma and rib; composite? mould, X5.

Technophorus nicolli sp. nov.
(p. 21)

Fig. 17 Left valve exterior showing rib and growth-lines. Paratype (CPC 14776), locality 5, X5.

Fig. 18 Left valve exterior showing rib and growth-lines. Paratype (CPC 14777), locality 5, X5.

Fig. 19 Right lateral view of paratype (CPC 14778), showing ornament and pegma; composite mould, locality 5, X5.

Plate 10

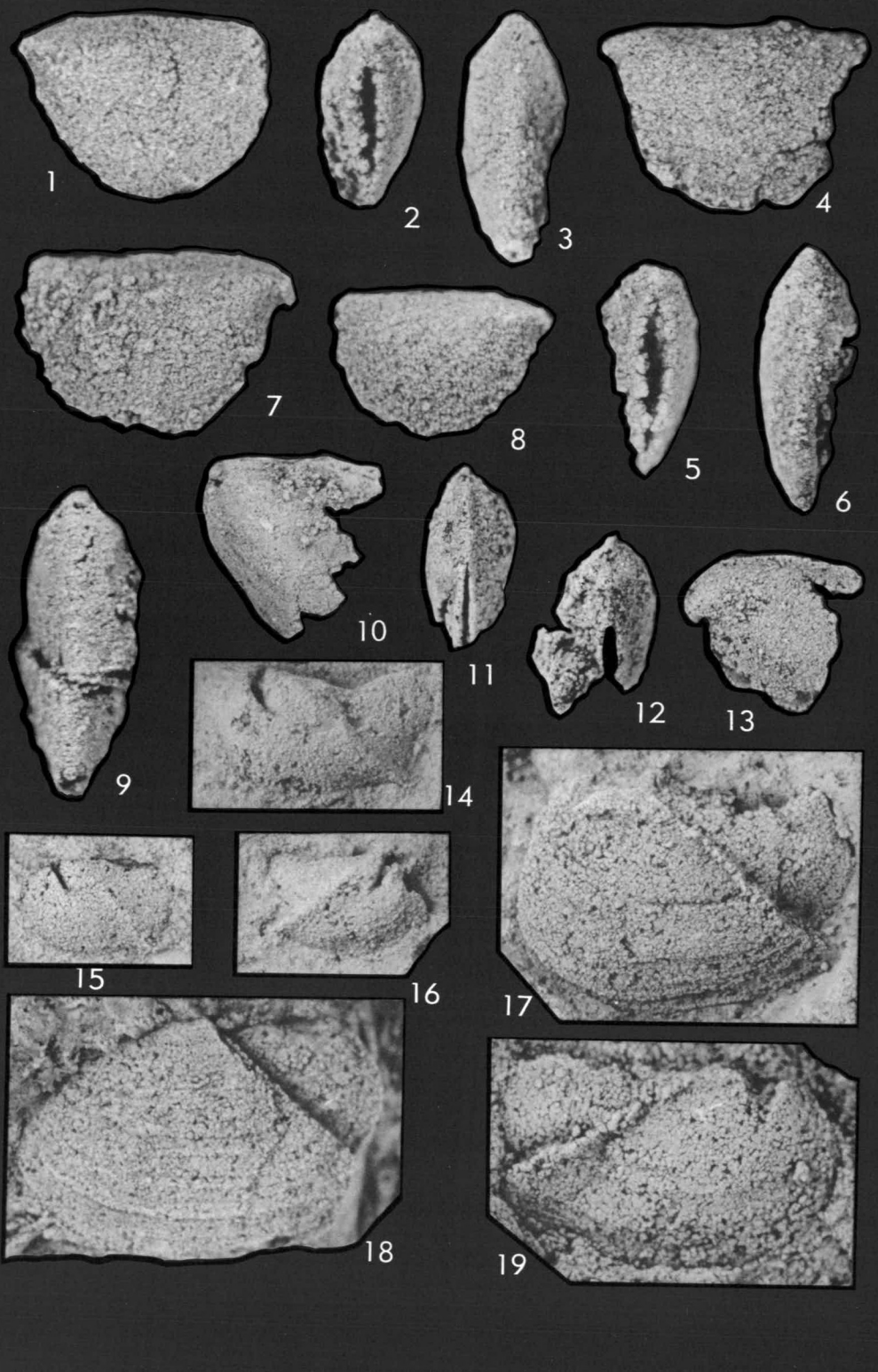

PLATE 11

Technophorus nicolli sp. nov.
(p. 21)

Fig. 1 Right lateral view of paratype (CPC 14779), showing rib; internal mould, locality 5, X3.

Figs. 2-4 Ventral, right lateral, and posterior views of paratype (CPC 14780), showing pegma, growth-lines, rib, and in Figure 4 the way in which the ribs of the two valves set off the dorsal part of the posterior end as a rostrum; composite mould, locality 5, X3.

Figs. 5-7 Left valve internal mould, and right and left valve external moulds. **Holotype** (CPC 14781), locality 5, X3.

Ribeiria jonesi sp. nov.
(p. 15)

Fig. 8 Right lateral view of paratype (CPC 14782); internal mould, locality 4, X3.

Fig. 9 Left lateral view of paratype (CPC 14783), showing pegma; internal mould, locality 12, X3.

Fig. 10 Left lateral view of paratype (CPC 14784), showing profile and pegma; internal mould, locality 59, X3.

Fig. 11 Right lateral view of paratype (CPC 14785), showing profile and pegma; internal mould, locality 59, X3.

Figs. 12-13 Right and left lateral views of paratype (CPC 14786), showing profile and pegma; internal mould, locality 4, X3.

Fig. 14 Right lateral view of **holotype** (CPC 14787), showing profile and pegma; internal mould, locality 59, X3.

Fig. 15 Right lateral view of paratype (CPC 14788), internal mould, locality 59, X3.

Plate 11

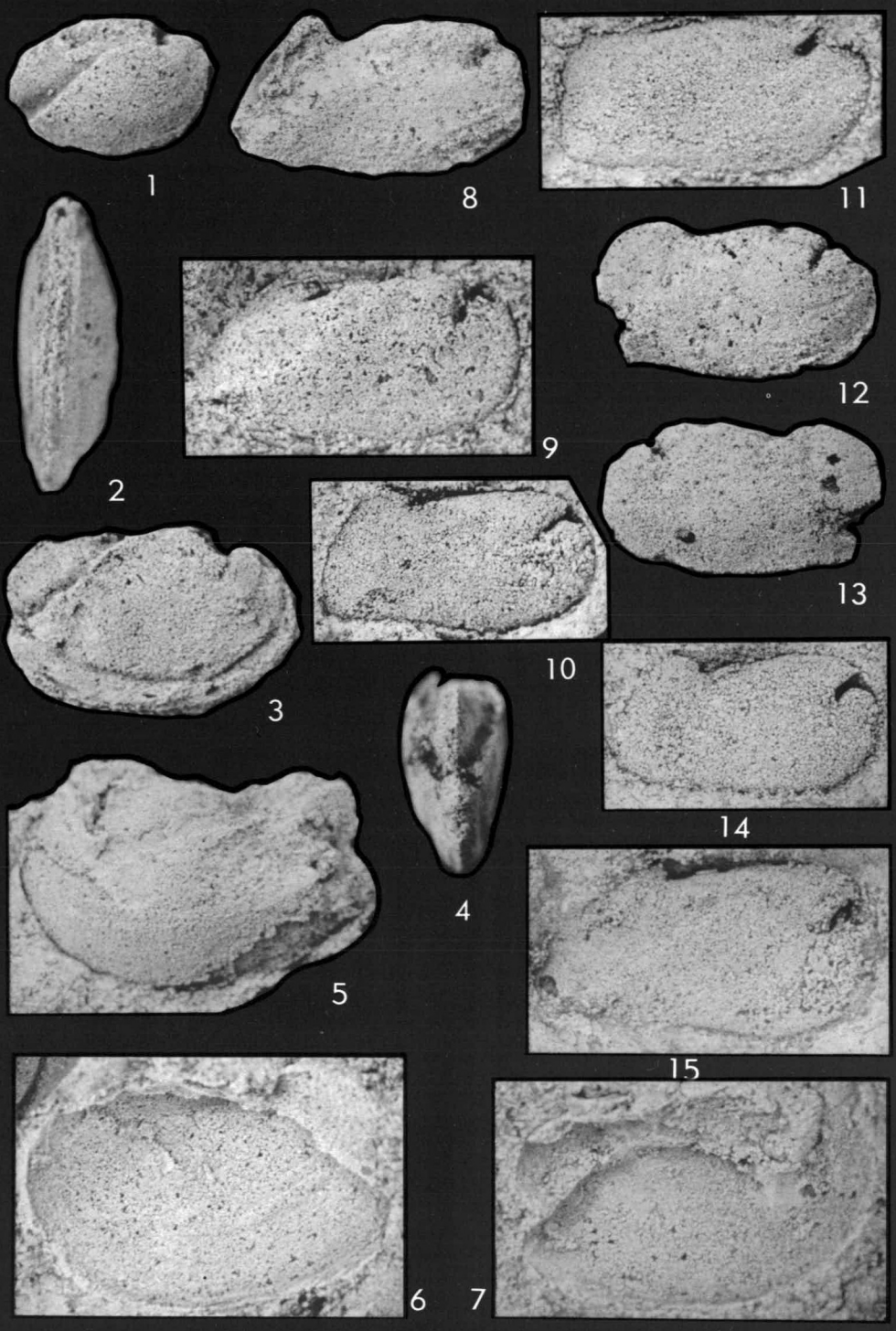

PLATE 12

Technophorus planei sp. nov.
(p. 21)

Figs. 1-5 Right lateral, dorsal, anterior, ventral, and left lateral views of **holotype** (CPC 14789), showing profile, pegma, and marginal denticles; silicified internal mould, locality 38, X7.

Figs. 6-7 Left lateral and right lateral views of paratype (CPC 14790), showing profile and marginal denticles; silicified internal mould, locality 38, X7.

Figs. 8-11 Dorsal, right lateral, posterior, and left lateral views of paratype (CPC 14791). Figure 10 shows the bilobed nature of the posterior gape, the dorsal part of which is the gape of the rostrum. Silicified internal mould, locality 38, X7.

Figs. 12-15 Left lateral, right lateral, dorsal, and posterior views of paratype (CPC 14792); silicified internal mould, locality 31, X7.

Pauropegma jelli (Pojeta & Runnegar), 1976
(p. 23)

Fig. 16 Left lateral view of hypotype (CPC 14793), showing ornament and protoconch; silicified replica, locality 30, X3.

Fig. 17 Right lateral view of hypotype (CPC 14794); silicified replica, locality 30, X3.

Ribeiria sp. A
(p. 15)

Fig. 18 Left lateral view, showing profile and pegma (CPC 14795); silicified internal mould, locality 30, X8.

Plate 12

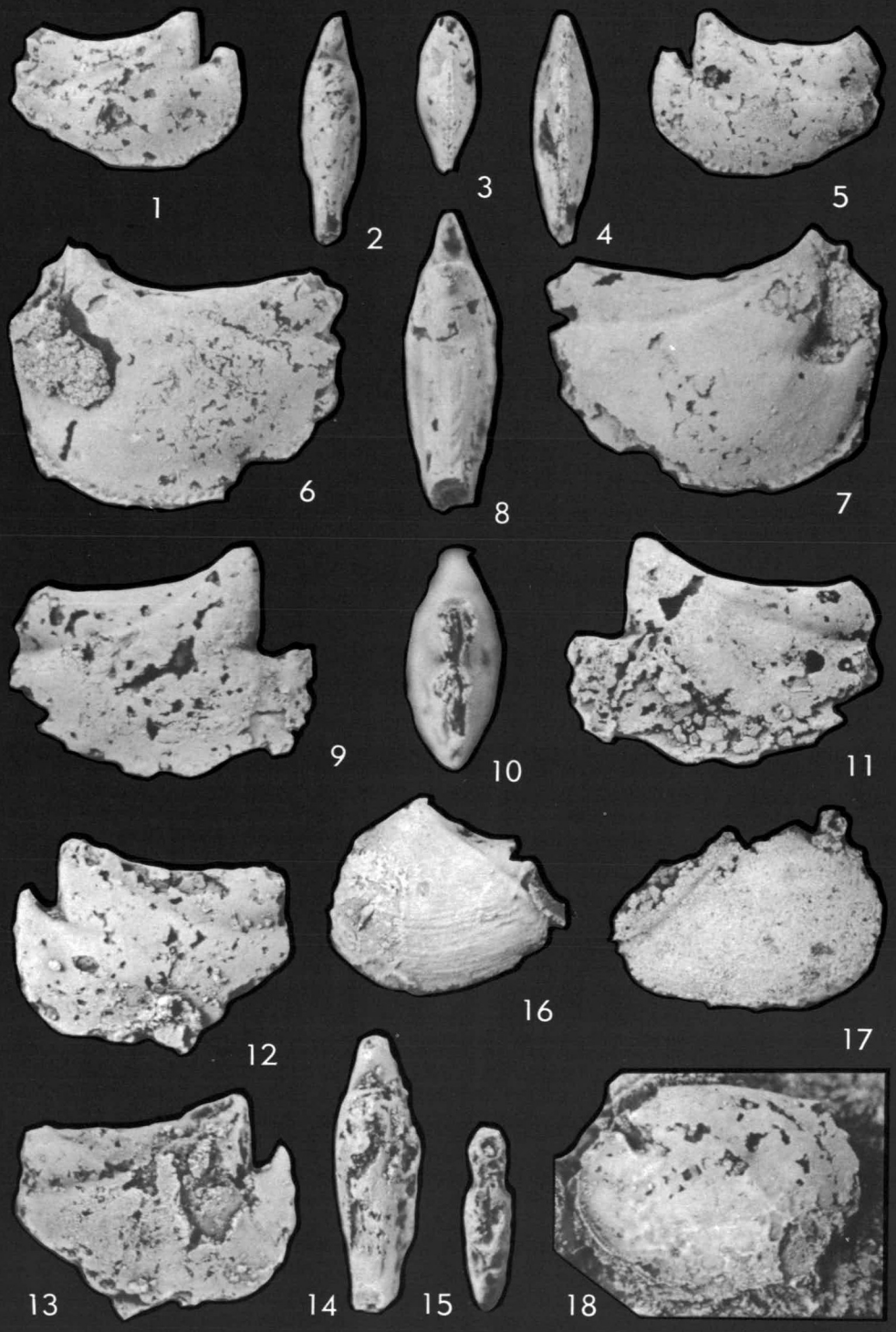

PLATE 13

Technophorus kempae sp. nov.
(p. 20)

Figs. 1-4 Right lateral, left lateral, dorsal, and posterior views of **holotype** (CPC 14796), showing rib, pegma, profile, and in Figure 4 the way in which the ribs of the two valves set off the dorsal part of the posterior end as a rostrum; internal mould, locality 84, X2.

Figs. 5-8 Posterior, dorsal, left lateral, and right lateral views of paratype (CPC 14797); internal mould, locality 84, X2.

Fig. 9 Right lateral view of paratype (CPC 14798); internal mould, locality 84, X2.

Fig. 10 Left lateral view of paratype (CPC 14799); internal mould, locality 84, X2.

Fig. 11 Left lateral view of paratype (CPC 14800); internal mould, locality 84, X2.

Fig. 12 Latex replica of left valve exterior, showing growth-lines. Paratype (CPC 14801), locality 2, X2.

Fig. 13 Right lateral view of paratype (CPC 14802), showing pegma and growth-lines; composite mould, locality 84, X3.

Fig. 14 Left lateral view of paratype (CPC 14803); internal mould, locality 2, X2.

Fig. 15 Right lateral view of paratype (CPC 14804); growth-lines can be seen on the external mould of the left valve visible through the hole near the midventral margin. Internal mould, locality 74, X2.

Fig. 16 Left lateral view of paratype (CPC 14805); internal mould, locality 73, X2.

Fig. 17 Left lateral view of paratype (CPC 14806); internal mould, locality 73, X2.

Plate 13

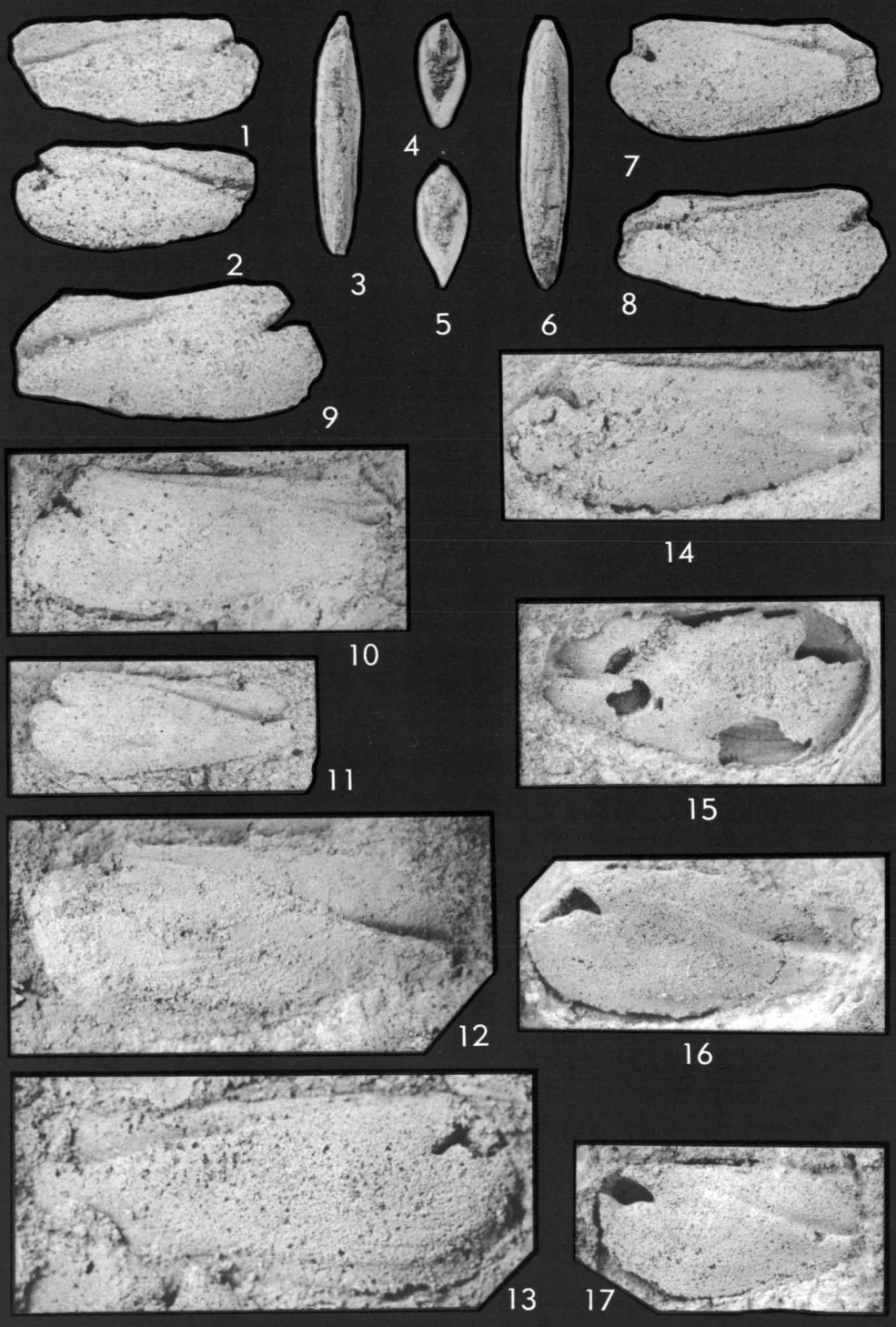

PLATE 14

Tolmachovia belfordi sp. nov.
(p. 25)

Fig. 1 Right lateral view of paratype (CPC 14807); internal mould, locality 84, X2.

Fig. 2 Right lateral view of paratype (CPC 14808), showing growth-lines; composite mould, locality 84, X2.

Fig. 3 Right lateral view of paratype (CPC 14809); internal mould, locality 84, X2.

Fig. 4 Right lateral view of paratype (CPC 14810); internal mould, locality 84, X2.

Fig. 5 Right lateral view of paratype (CPC 14811), showing dorsally extended rostrum; internal mould, locality 84, X2.

Fig. 6 Left lateral view of paratype (CPC 14812), showing rib and two pegmas; internal mould, locality 84, X2.

Fig. 7 Left lateral view of paratype (CPC 14813); internal mould, locality 84, X2.

Fig. 8 Left lateral view of paratype (CPC 14814); internal mould, locality 84, X2.

Figs. 9-10 Dorsal and right lateral views of **holotype** (CPC 14815), showing two pegmas, protoconch, and dorsal projection of structure in middle of posterior pegma; internal mould, locality 84; Figure 9, X3; Figure 10, X2.

Fig. 11 Right lateral view of paratype (CPC 14816); internal mould, locality 84, X2.

Figs. 12-13 Right lateral and dorsal views of paratype (CPC 14817); Figure 13 shows dorsal projection of structure in middle of posterior pegma; internal mould, locality 84; Figure 12, X2; Figure 13, X2.7.

Figs. 14-15 Right lateral and posterior views of paratype (CPC 14818); Figure 14 shows growth-lines and Figure 15 shows how the ribs of the two sides meet at the midline and separate off the dorsal part of the posterior end as a rostrum; composite mould, locality 84; Figure 14, X2; Figure 15, X5.

Figs. 16-18 Right lateral, posterior, and dorsal views of paratype (CPC 14819); internal mould, locality 84, X2.

Figs. 19-20 Right lateral and posterior views of paratype (CPC 14820), showing prominent dorsal extension of the rostrum; internal mould, locality 84, X2.

Fig. 21 Right lateral view of paratype (CPC 14821), showing the two pegmas, protoconch, and dorsally extended rostrum; internal mould, locality 84, X2.

Fig. 22 Left lateral view of paratype (CPC 14822), showing marginal denticles; internal mould, locality 84, X2.

Fig. 23 Exterior view of paratype (CPC 14823), showing growth-lines; external cast, locality 84, X2.

Fig. 24 Right lateral view of paratype (CPC 14824), showing two pegmas and marginal denticles; internal mould, locality 84, X2.

Fig. 25 Right lateral view of paratype (CPC 14825), showing marginal denticles extended dorsally as internal ribs; internal mould, locality 84, X2.5.

Fig. 26 Right lateral view of paratype (CPC 14826) showing two pegmas, protoconch, dorsal extension of rostrum, and marginal denticles; internal mould, locality 84, X2.

Fig. 27 Right lateral view of paratype (CPC 14827), showing growth-lines; external cast, locality 77, X2.

Fig. 28 Left lateral view of paratype (CPC 14828), showing protoconch and marginal denticles; internal mould, locality 84, X2.

Fig. 29 Right lateral view of paratype (CPC 14829); composite mould, locality 84, X2.

Fig. 30 Right lateral view of paratype (CPC 14830); composite mould, locality 84, X2.

Fig. 31 Right lateral view of paratype (CPC 14831), showing pegmas, protoconch, and marginal denticles extended dorsally as internal ribs; internal mould, locality 2, X2.

Plate 14

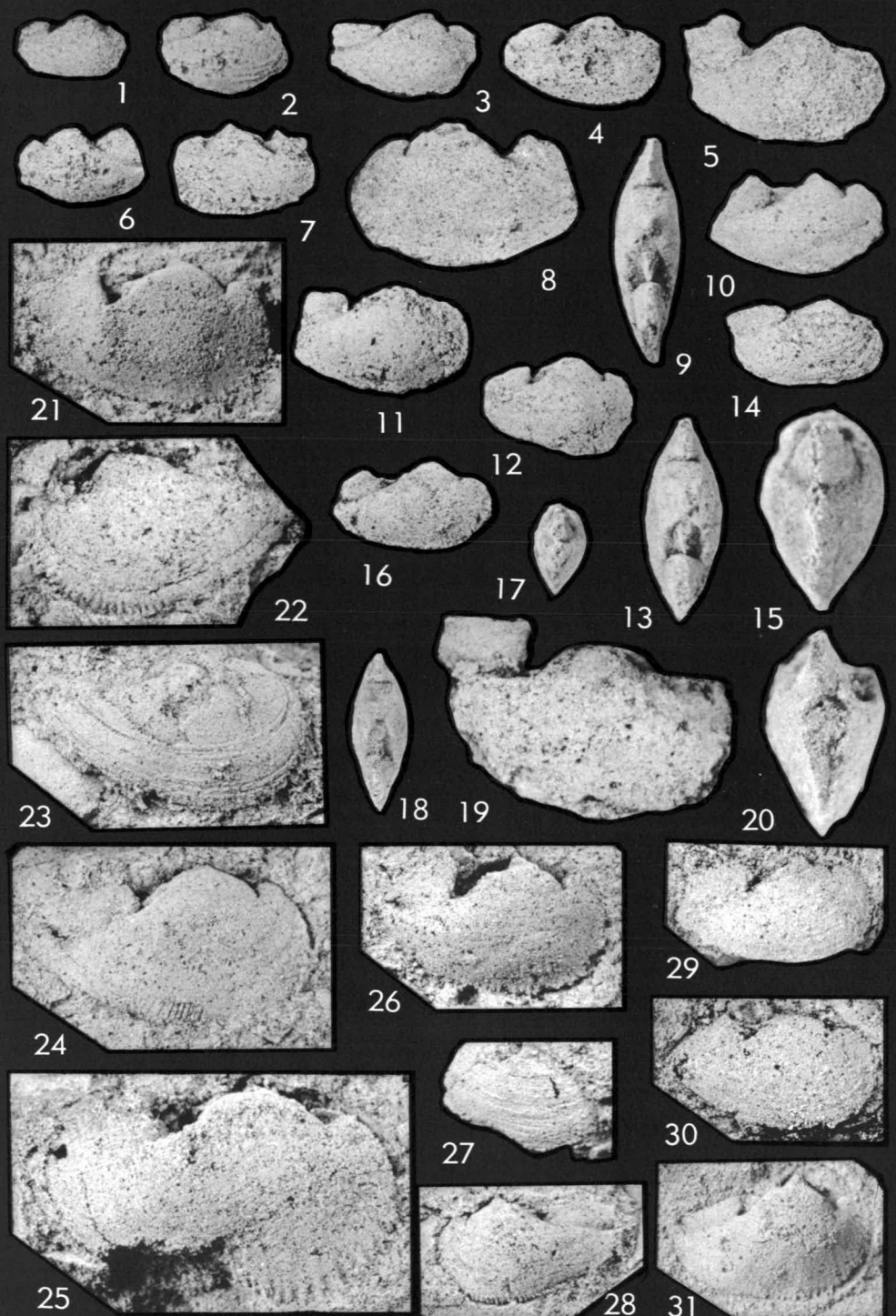
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PLATE 15

Pleuropegma plicatum gen. nov. et sp. nov.
(p. 25)
(All shelled specimens from locality 8.)

Fig. 1 Left lateral view of **holotype** (CPC 14832), showing profile, X5.

Figs. 2-3 Right lateral and dorsal views of paratype (CPC 14833), X5.

Fig. 4 Dorsal view of paratype (CPC 14834), X5.

Figs. 5, 7 Left lateral and dorsal views of paratype (CPC 14835), X5.

Fig. 6 Left lateral view of paratype (CPC 14836), X5.

Fig. 8 Right lateral view of paratype (CPC 14837), X5.

Pauropegma jelli (Pojeta & Runnegar), 1976
(p. 23)

Figs. 9-13 Right lateral, left lateral, dorsal, anterior, and ventral views of hypotype (CPC 14838), showing two pegmas; silicified internal mould, locality 33, X3.

Figs. 14-16 Posterior, right lateral, and anterior views of hypotype (CPC 14839), showing median and side muscle scars; silicified internal mould, locality 31, X3.

Figs. 17-18 Posterior and left lateral views of hypotype (CPC 14840); showing bilobed posterior gape, the dorsal part of which served as the rostral aperture, and growth-lines; silicified replica, locality 31, X3.

Oepikila cambrica (Runnegar & Pojeta), 1974
(p. 23)

Fig. 19 Right lateral view of shelled hypotype (CPC 14841), locality 8, X4.

Figs. 20-21 Part and counterpart of right valve, showing protoconch. **Holotype** (CPC 13953), locality 85, X10.

Plate 15

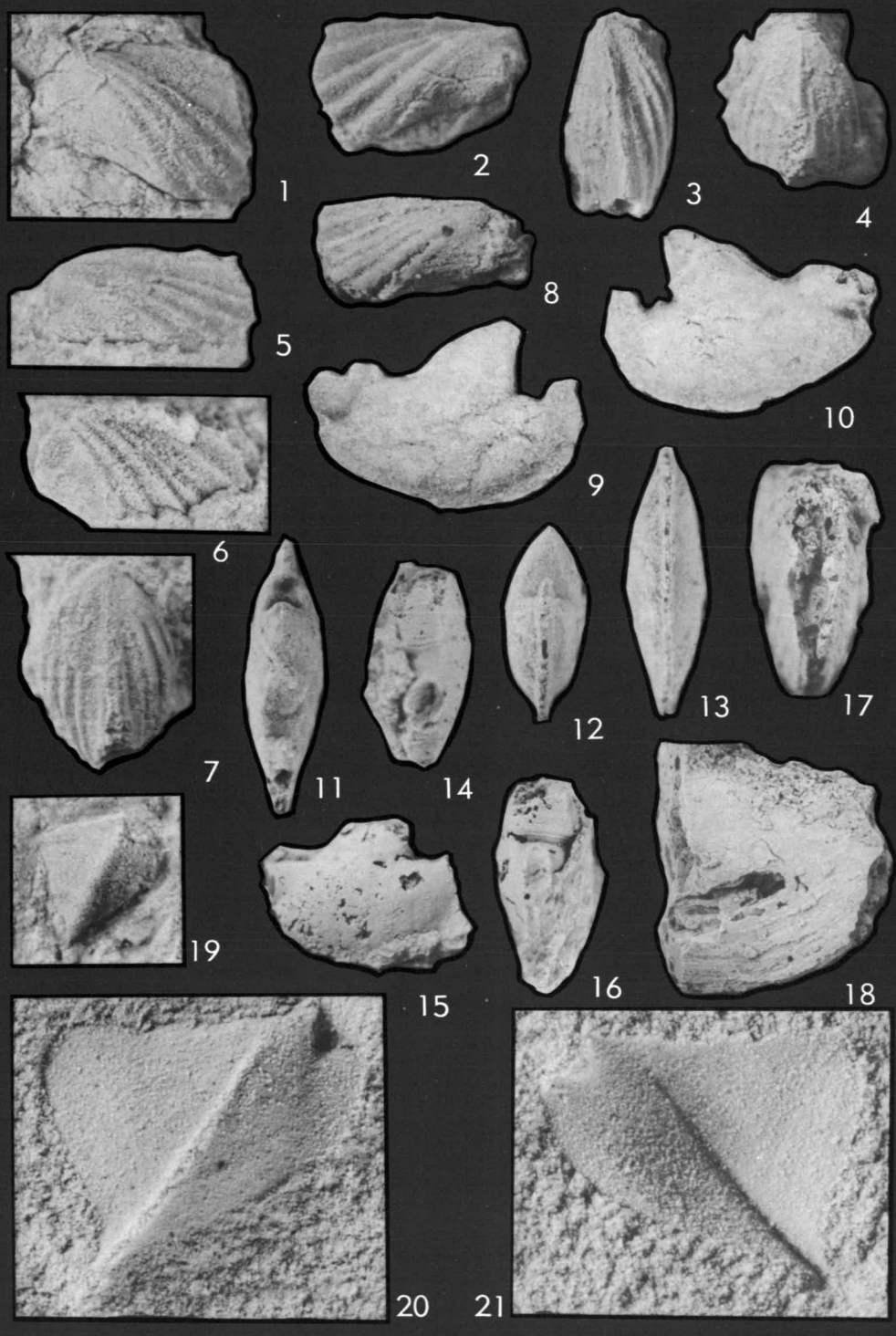

PLATE 16

Kimopegma pinnatum gen. nov. et sp.nov.
(p. 22)

Fig. 1 Right lateral view of paratype (CPC 14842), showing ornament and pegma; internal mould, locality 18, X4.

Fig. 2 Left lateral view of paratype (CPC 14843), showing ornament and pegma; internal mould, locality 4, X4.

Figs. 3-4 Latex replica and external mould of left valve showing ornament. Paratype (CPC 14844), locality 16, X3.

Fig. 5 Small slab with *Kimopegma pinnatum* (arrow) and *Cymatopegma semiplicatum*. Paratype (CPC 14845), all external moulds, locality 96, X4.

Figs. 6-7 Left lateral and right lateral views of paratype (CPC 14846), showing ornament and pegma; internal mould, locality 4, X4.

Fig. 8 Right lateral view of paratype (CPC 14847); internal mould, locality 4, X3.

Figs. 9-10 Latex replica and external mould of left valve showing lateral profile and ornament. **Holotype** (CPC 14848), locality 16, X3.

Plate 16


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PLATE 17

Pauropegma jelli (Pojeta & Runnegar), 1976
(p. 23)

Fig. 1 Right lateral view of hypotype (CPC 14849); silicified internal mould, locality 39, X3.

Fig. 2 Right lateral view of hypotype (CPC 14850), showing profile and pegmas; silicified internal mould, locality 38, X3.

Figs. 3-5 Right lateral, posterior, and anterior views of hypotype (CPC 14851), showing profile, pegmas, bilobed posterior gape, and anterior median muscle scar; silicified internal mould, locality 38, X3.

Figs. 6-8 Figures 6 and 8 are left lateral and anterior views of latex replica made from the inside of the silicified specimen shown in Figure 7. The replica shows the same conical umbonal filling and muscle scar as the natural internal moulds shown in Figures 1-5. Figure 7 left valve exterior, hypotype (CPC 14852), locality 95, X3.

Fig. 9 Anterior view of hypotype (CPC 14853), showing median muscle scar and gape; silicified internal mould, locality 38, X3.

Figs. 10-12 Figures 10 and 11 are right lateral and anterior views of latex replica made from the inside of the silicified specimen shown in Figure 12. The replica shows the same conical umbonal filling and muscle scar as the natural moulds shown in Figures 1-5. Figure 12 left valve exterior showing anterior transverse cleft in front of protoconch, hypotype (CPC 14854), locality 95, X3 (see Pl. 18, figs. 4-5).

Fig. 13 Dorsal view of hypotype (CPC 14855), showing protoconch and transverse clefts; silicified replica, locality 95, X3 (see Pl. 18, fig. 2).

Fig. 14 Left lateral view of hypotype (CPC 14856), showing profile and growth-lines; silicified replica, locality 95, X3.

Fig. 15 Right lateral view of hypotype (CPC 14857), showing profile, protoconch, and anterior transverse cleft; silicified replica, locality 95, X3 (see Pl. 18, figs. 11-12).

Fig. 16 Right lateral view of hypotype (CPC 14858), showing profile and growth-lines; silicified replica, locality 95, X3.

Plate 17

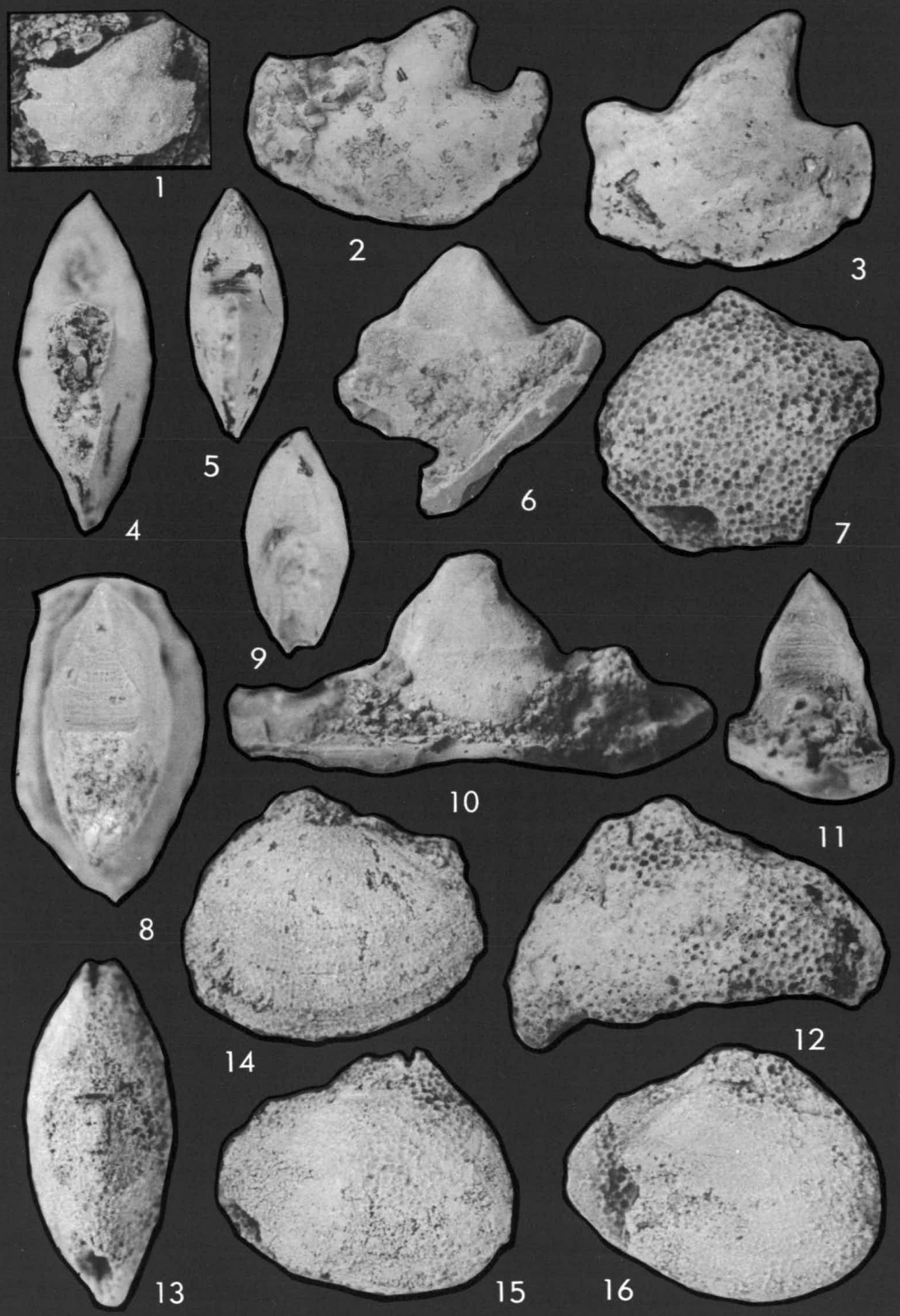

PLATE 18

Pauropegma jelli (Pojeta & Runnegar), 1976
(p. 23)

Fig. 1 Right lateral view of hypotype (CPC 14859), showing profile, growth-lines, and rib; silicified replica, locality 45, X3.

Fig. 2 Left lateral view of specimen seen in Pl. 17, fig. 13, showing protoconch, transverse clefts, growth-lines, posterior rib, and profile, X3.

Fig. 3 Right lateral view of hypotype (CPC 14860); silicified replica, locality 90, X3.

Figs. 4-5 Figure 4, exterior view of dorsum showing protoconch and transverse clefts; Figure 5, interior of dorsum showing conical umbonal cavity and massive anterior and posterior pegmas with muscle scars. Same specimen as that shown in Pl. 17, figs. 10-12, X3.

Fig. 6 Interior of dorsum showing conical umbonal cavity and massive anterior and posterior pegmas. Hypotype (CPC 14861); silicified replica, locality 90, X4.

Fig. 7 Interior of dorsum showing umbonal cavity and large anterior and posterior pegmas. Hypotype (CPC 14862); silicified replica, locality 90, X4.

Fig. 8 Posterior view of hypotype (CPC 14863), showing bilobed gape; dorsal part of gape serves as aperture for rostrum. Silicified replica, locality 90, X3.

Fig. 9 Left lateral view of hypotype (CPC 14864), showing growth-lines; silicified replica, locality 90, X3.

Fig. 10 Right lateral view of hypotype (CPC 14865), showing protoconch, anterior transverse cleft, and profile; silicified replica, locality 90, X3.

Figs. 11-12 Anterior and ventral views of specimen seen in Pl. 17, fig. 15, showing gapes, X3.

Figs. 13-14 View of inside of left valve, showing pegmas. In Figure 13, the ventral margin of the pegmas and the umbonal cavity are outlined in ink, showing what the dorsal margin of the internal mould would look like (compare Pl. 17, figs. 1-5). Hypotype (CPC 14866), silicified replica, locality 90, X3.

Fig. 15 Right lateral view of hypotype (CPC 14867), showing protoconch, anterior transverse cleft, and profile; silicified replica, locality 90, X3.

Fig. 16 Left lateral view of hypotype (CPC 14868), showing growth-lines; silicified replica, locality 90, X3.

Plate 18

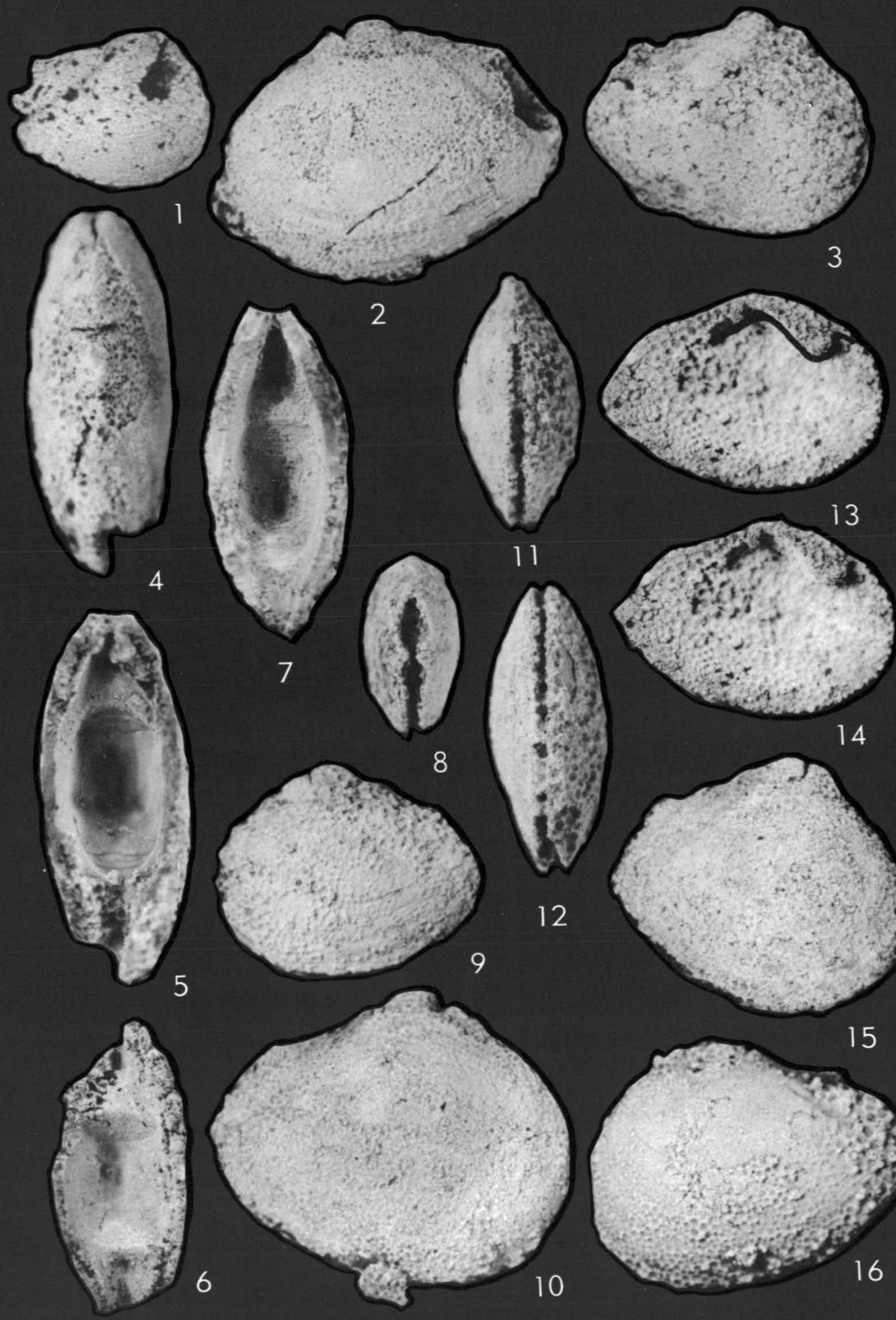

PLATE 19

Pauropegma jelli (Pojeta & Runnegar), 1976
(p. 23)

Fig. 1 Right lateral view of hypotype (CPC 14869), showing growth-lines and posterior rib; silicified replica, locality 90, X3.

Euchasma sp. A
(p. 28)

Fig. 2 Left lateral view showing ornament. CPC 14870, locality 53, X2.

Euchasma skwarkoi sp. nov.
(p. 28)

Fig. 3 Right lateral view of paratype (CPC 14871); latex replica of external mould preserved in chert, locality 88, X3.

Figs. 4-5 Latex replica and specimen showing anterior face with pallial line (?). Paratype (CPC 14872); internal mould preserved in chert, locality 91, X3.

Fig. 6 Latex replica of **holotype** (CPC 14873), showing ribs on both anterior and lateral sides. Right valve preserved as external mould in chert, locality 92, X3.2.

Fig. 7 Latex replica of paratype (CPC 14874). Right valve preserved as external mould in chert, locality 92, X3.2.

Fig. 8 Latex replica of paratype (CPC 14875). Right valve preserved as external mould in chert, locality 92, X3.2.

Fig. 9 Latex replica of paratype (CPC 14876), showing radial ribbing of anterior face. Right valve preserved as external mould in chert, locality 93, X3.

Fig. 10 Latex replica of articulated specimen. Paratype (CPC 14877), preserved as external mould in chert, locality 93, X3.

Fig. 11 Latex replica of articulated specimen. Paratype (CPC 14878), preserved as external mould in chert, locality 93, X3.

Plate 19

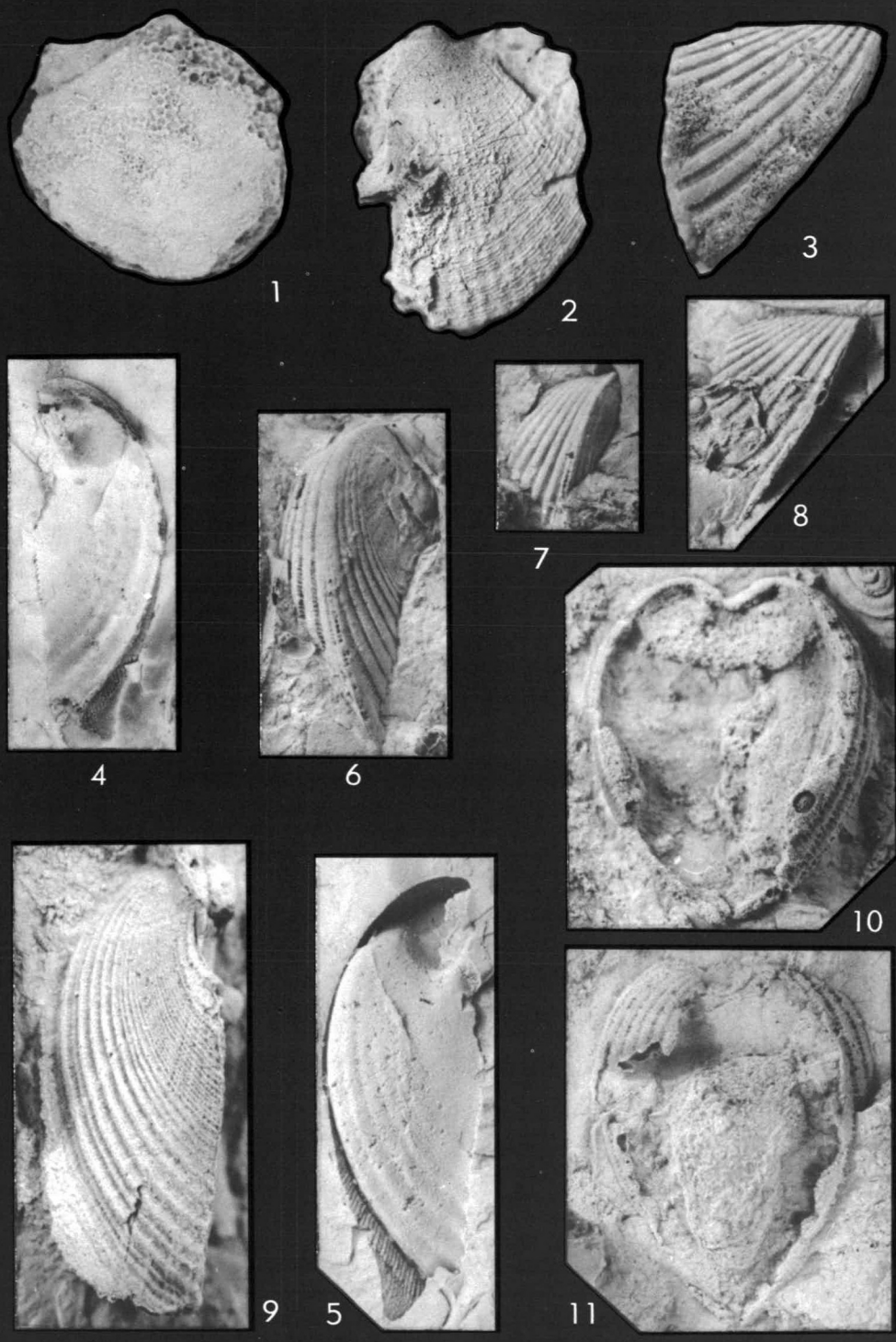

PLATE 20

Bransonia chapronierei sp. nov.
(p. 29)
(All specimens silicified replicas from locality 41.)

Figs. 1-4 Left lateral, anterior, posterior, and dorsal views of **holotype** (CPC 14879), X5.

Fig. 5 Right lateral view of paratype (CPC 14880), X5.

Figs. 6-7 Ventral and left lateral views of paratype (CPC 14881), X5.

Euchasma caseyi sp. nov.
(p. 27)
(All specimens silicified replicas.)

Figs. 8-10 Right lateral, posterior, and right posterolateral views of paratype (CPC 14882), showing ornament, rostral clefts, and rostral aperture, locality 28, X3.

Fig. 11 View of inside of left valve, showing pegma (arrow). Paratype (CPC 14883), locality 47, X3.

Fig. 12 Left lateral view of paratype (CPC 14884), locality 28, X3.

Fig. 13 Interior view of anterior end of shell showing posterior surface of pegma. Paratype (CPC 14885), locality 48, X3.

Fig. 14 Interior view of anterior end of shell, showing posterior surface of the pegma, which is broken away in the region of the circular part of the keyhole gape. Paratype (CPC 14886), locality 27, X3.

Fig. 15 Interior view of anterior end of shell showing posterior surface of pegma. Paratype (CPC 14887), locality 48, X3.

Plate 20

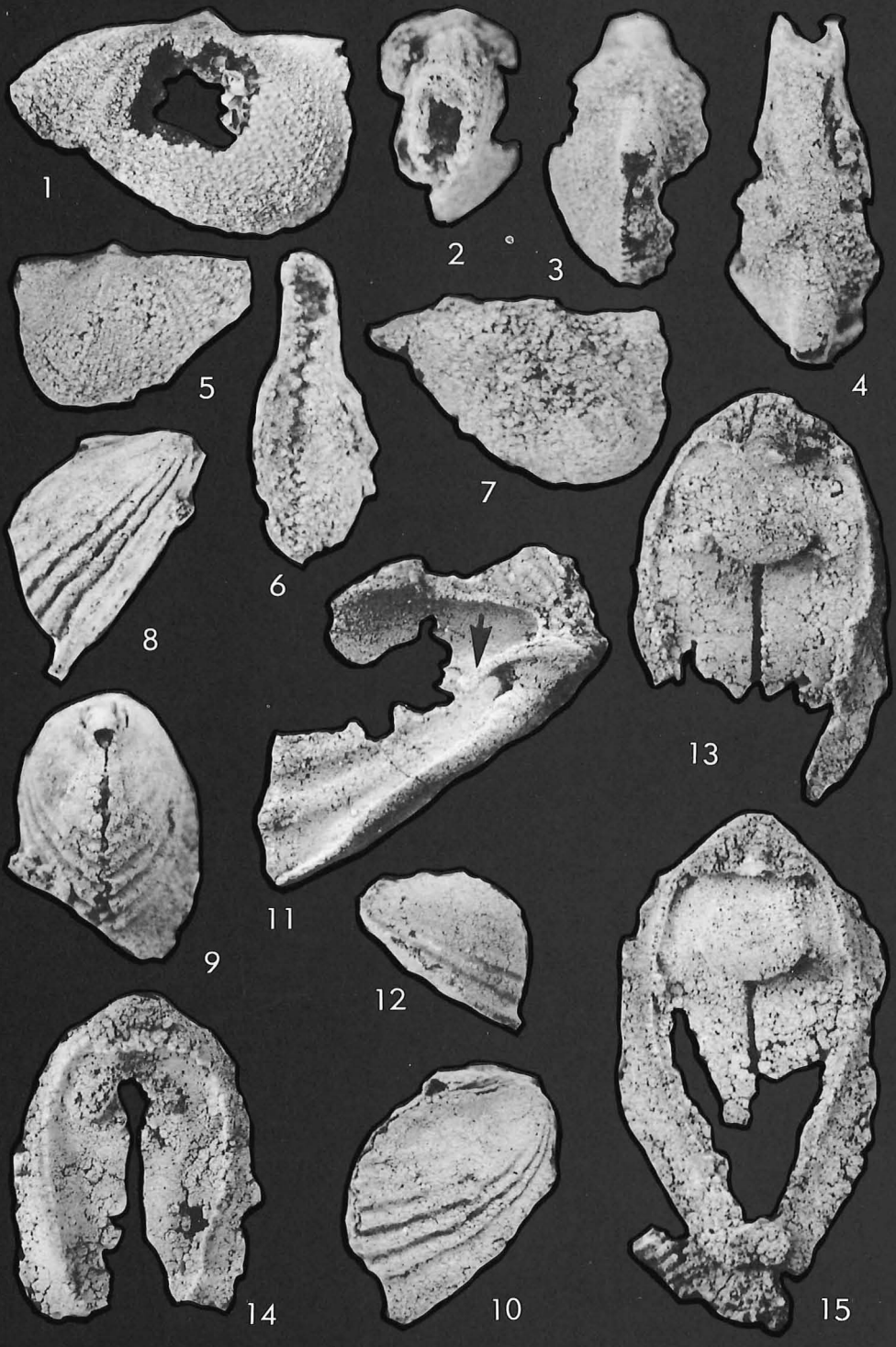

PLATE 21

Euchasma caseyi sp. nov.
(p. 27)
(All specimens silicified replicas.)

Figs. 1-5 Right lateral, anterior, left lateral, oblique posterior, and dorsal views of **holotype** (CPC 14888), showing ornament, profile, keyhole anterior gape, rostrum, and rostral clefts, locality 24, X3.

Fig. 6 Interior view of anterior end of shell showing posterior surface of pegma; lateral to anteriormost ribs on the right and left sides are fragments of the anteroventral flange. Paratype (CPC 14889), locality 48, X3.

Fig. 7 Dorsal view of paratype (CPC 14890), showing rostrum and rostral clefts, locality 48, X3.

Figs. 8-9 Right lateral and posterior views of paratype (CPC 14891), locality 28, X3. Small adhering specimen in Figure 9 is a paratype (CPC 14892).

Euchasma? sp. B
(p. 28)

Fig. 10 Posterior view, CPC 14893; silicified replica, locality 50, X3.

Eopteria sp. A
(p. 27)

Fig. 11 Right lateral view (CPC 14894), showing marginal denticles and growth-lines; internal mould in chert, locality 52, X3.

Plate 21

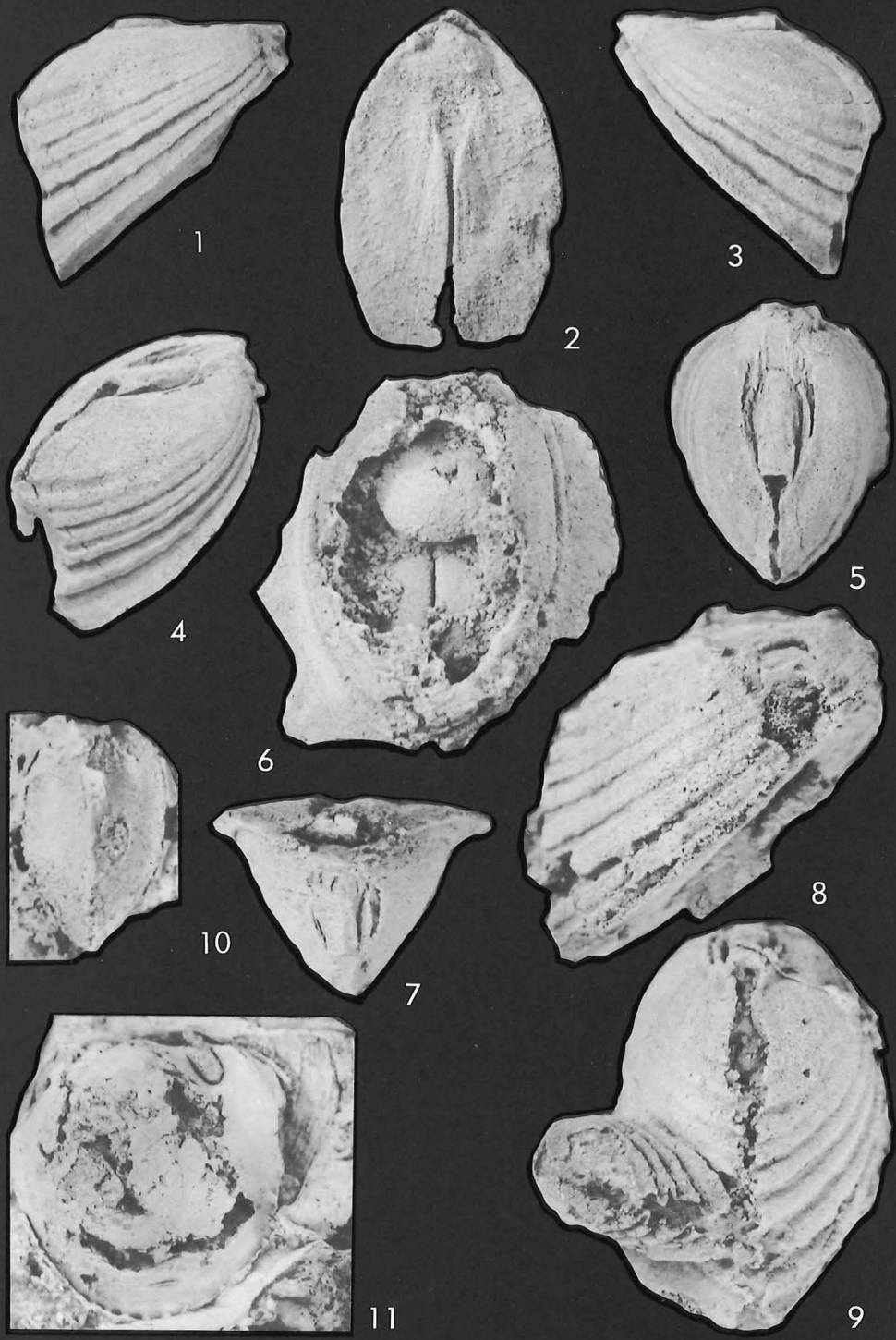

PLATE 22

Euchasma caseyi sp. nov.
(p. 27)
(All specimens silicified replicas.)

Fig. 1 Dorsal view of paratype (CPC 14895), showing rostrum, rostral clefts, and clefts around beak; locality 48, X3.

Figs. 2-3 Posterior and right lateral views of paratype (CPC 14896), showing flange and zigzag commissure of interlocking ribs; locality 48, X3.

Figs. 4-5 Anterior and posterodorsal views of paratype (CPC 14897), showing key-hole gape, rostrum, and rostral clefts; locality 47, X3.

Figs. 6-7 Dorsal and anterior views of paratype (CPC 14898), showing rostrum, rostral clefts, clefts around beak, and keyhole gape with marginal denticles; locality 48, X3.

Fig. 8 Posterior view of paratype (CPC 14900), showing rostrum and zigzag commissure of interlocking ribs; locality 24, X3.

Fig. 9 Posterior view of paratype (CPC 14899), showing anterior flange and zigzag commissure of interlocking ribs; locality 47, X3.

Plate 22

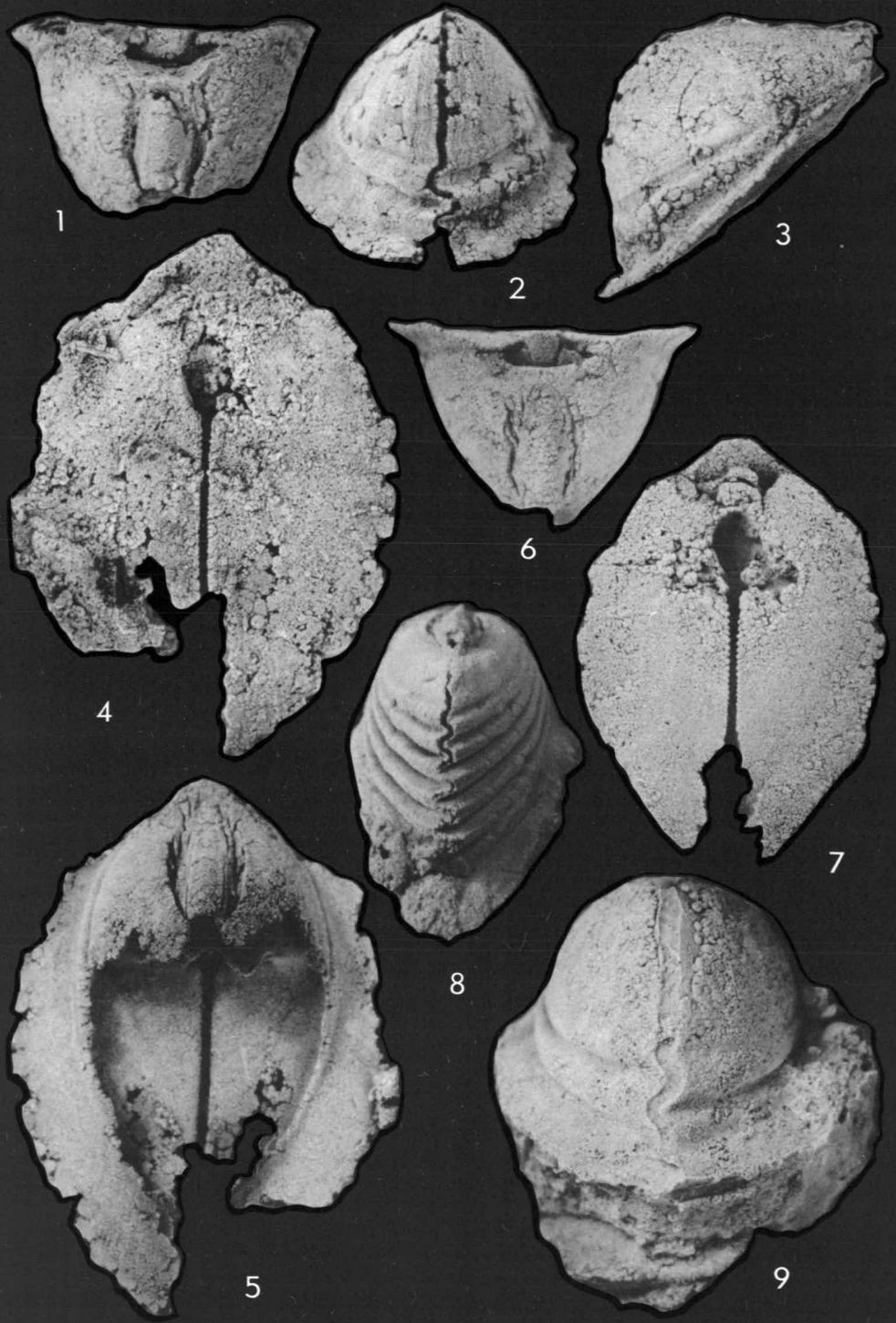

PLATE 23

Euchasma caseyi sp. nov.
(p. 27)
(All specimens silicified replicas.)

Fig. 1 Anterior view of paratype (CPC 14901), showing keyhole gape; locality 47, X3.

Fig. 2 Interior view of anterior end of shell, showing keyhole gape and remnants of pegma. Paratype (CPC 14902), locality 19, X3.

Fig. 3 Oblique dorsal view of paratype (CPC 14903), showing rostrum and rostral clefts; locality 48, X3.

Fig. 4 Anterior view of paratype (CPC 14904), showing keyhole gape with marginal denticles; locality 48, X3.

Fig. 5 Anterior view of paratype (CPC 14905), showing keyhole gape; locality 48, X3.

Figs. 6-7 Dorsal and anterior views of paratype (CPC 14906), showing rostrum, rostral clefts, clefts around beak, and keyhole gape; locality 48, X3.

Fig. 8 Anterior view of paratype (CPC 14907), showing keyhole gape; locality 48, X3.

Figs. 9-10 Dorsal and posterior views of paratype (CPC 14908), showing rostrum, rostral clefts, flange, and zigzag posterior commissure; locality 48, X3.

Plate 23

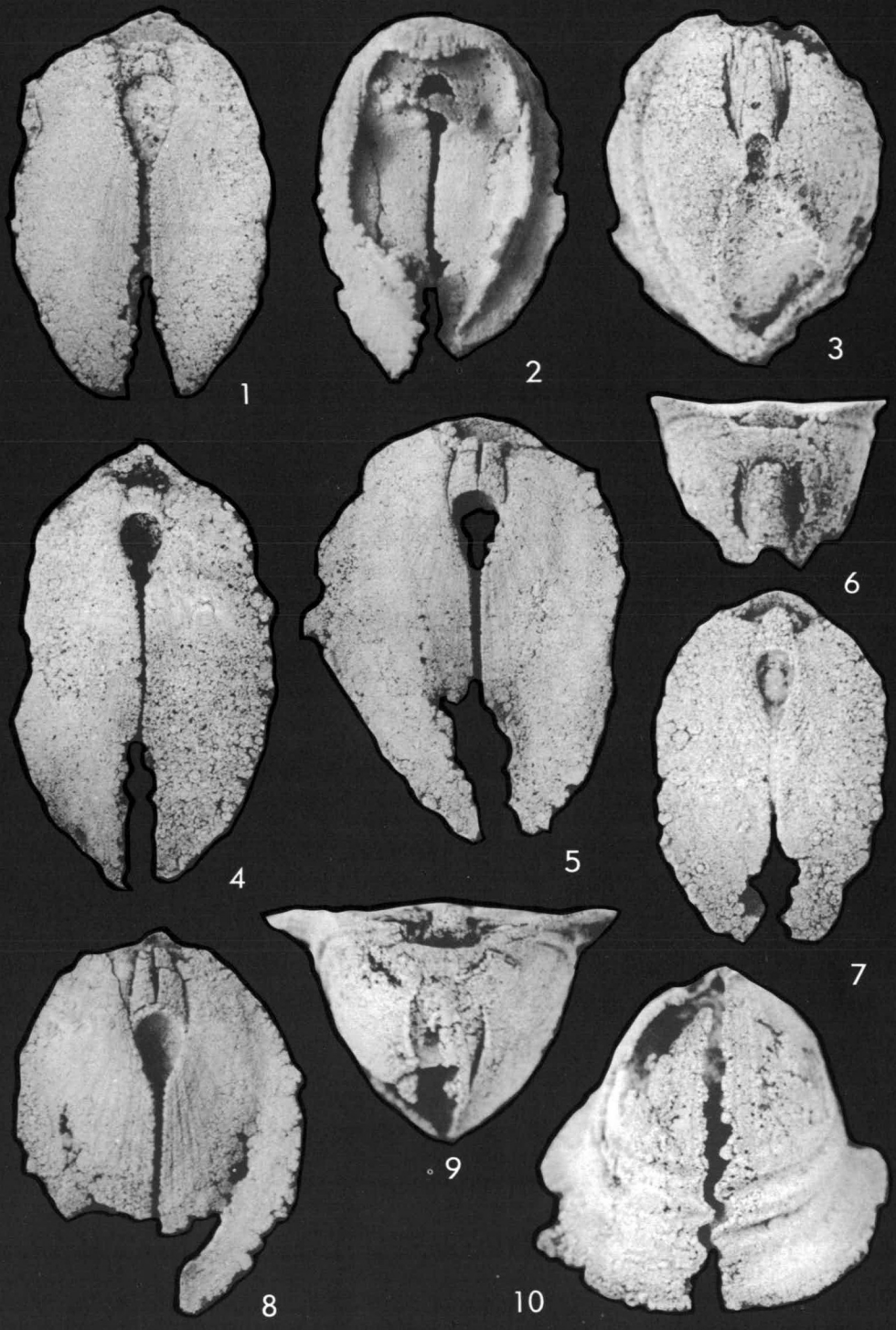

PLATE 24

Euchasma caseyi sp. nov.
(p. 27)
(All specimens silicified replicas.)

Figs. 1-2 Figure 1, interior view of anterior end of shell showing pallial line and pallial sinus on left side; Figure 2, same specimen rotated about 60° to show pallial sinus. Paratype (CPC 14909), locality 48, X3.

Fig. 3 Interior view of anterior end of shell, showing keyhole gape and marginal denticles. Paratype (CPC 14910), locality 48, X3.

Fig. 4 Interior view of anterior end of shell. Paratype (CPC 14911), locality 48, X3.

Fig. 5 Interior view of anterior end of shell. Paratype (CPC 14912), locality 48, X3.

Eopteria struszi sp. nov.
(p. 26)
(All specimens silicified replicas.)

Fig. 6 Anterior view of paratype (CPC 14913), showing gape and marginal denticles; locality 41, X4.

Fig. 7 Left lateral view of paratype (CPC 14914); locality 41, X4.

Figs. 8-9 Dorsal and right lateral views of paratype (CPC 14915); locality 41, X4.

Fig. 10 Left lateral view of paratype (CPC 14916); locality 41, X4.

Fig. 11 Interior view of anterodorsal part of shell, showing posterior surface of pegma. Paratype (CPC 14917), locality 41, X4.

Fig. 12 Right lateral view of paratype (CPC 14918); locality 41, X4.

Fig. 13 Left lateral view of paratype (CPC 14919); locality 41, X4.

Plate 24

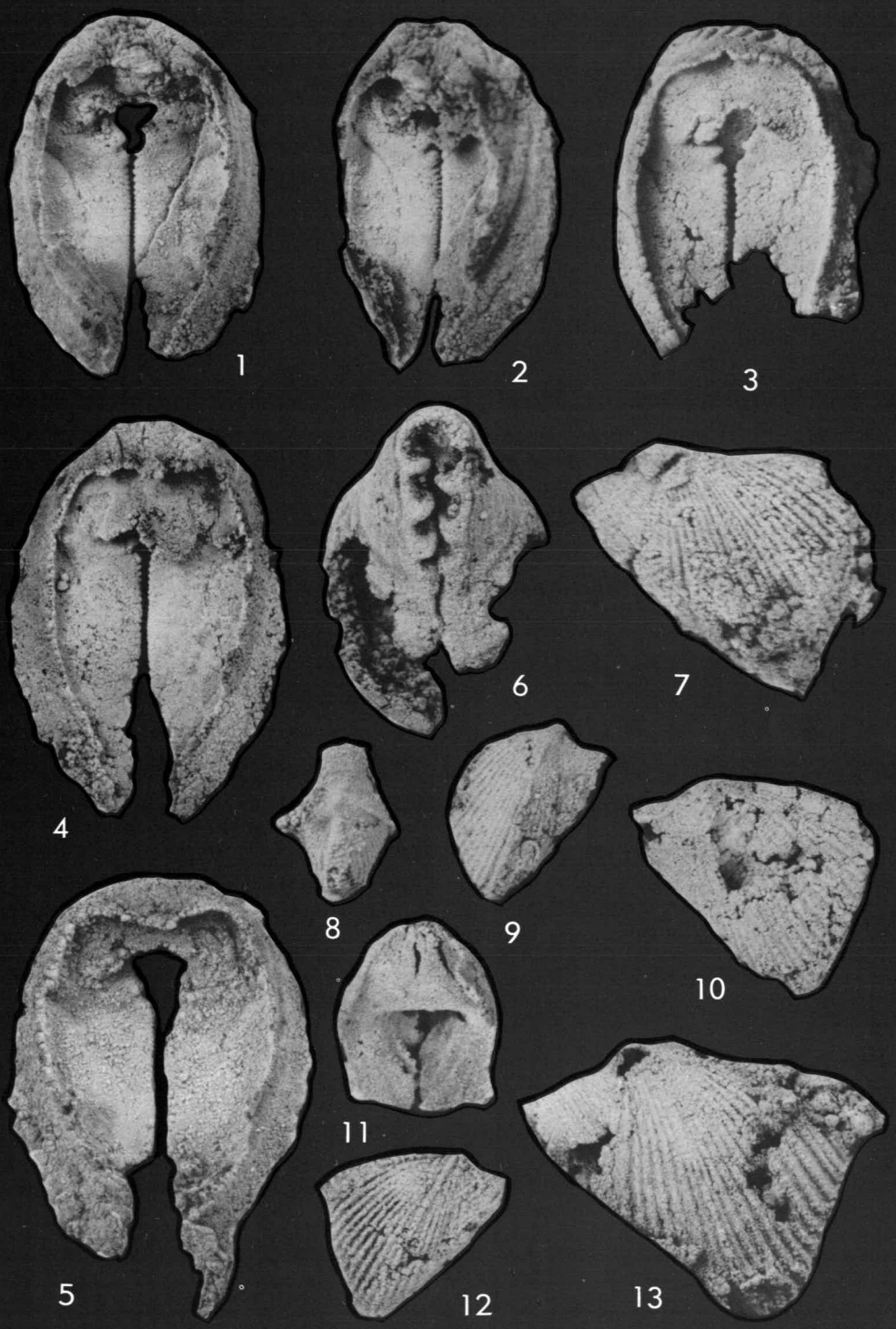

PLATE 25

Eopteria struszi sp. nov.
(p. 26)
(All specimens silicified replicas.)

Figs. 1-4 Posterior, ventral, anterior, and left lateral views of paratype (CPC 14920), showing shell gapes and profile; locality 47, X4.

Fig. 5 Interior view of anterior end of shell, showing posterior face of pegma. Paratype (CPC 14921), locality 47, X4.

Fig. 6 Dorsal view of paratype (CPC 14922), showing rostrum and longitudinal rostral clefts; locality 47, X4.

Fig. 7 Dorsal view of paratype (CPC 14923), showing rostrum and rostral clefts; locality 47, X4.

Fig. 8 Interior view of anterior end of shell, showing posterior face of pegma. Paratype (CPC 14924), locality 47, X4.

Figs. 9-10 Dorsal and right lateral views of paratype (CPC 14925), showing rostrum, rostral clefts, and profile; locality 48, X4.

Fig. 11 Interior view of anterior end, showing posterior face of pegma. Paratype (CPC 14926), locality 47, X4.

Fig. 12 Interior view of anterior end of shell showing posterior face of pegma. Paratype (CPC 14927), locality 48, X4.

Fig. 13 Interior of right valve, showing pegma and marginal denticles extended dorsally as internal ribs. Paratype (CPC 14928), locality 48, X4.

Fig. 14 Interior of right valve, showing marginal denticles. Paratype (CPC 14929), locality 47, X4.

Plate 25

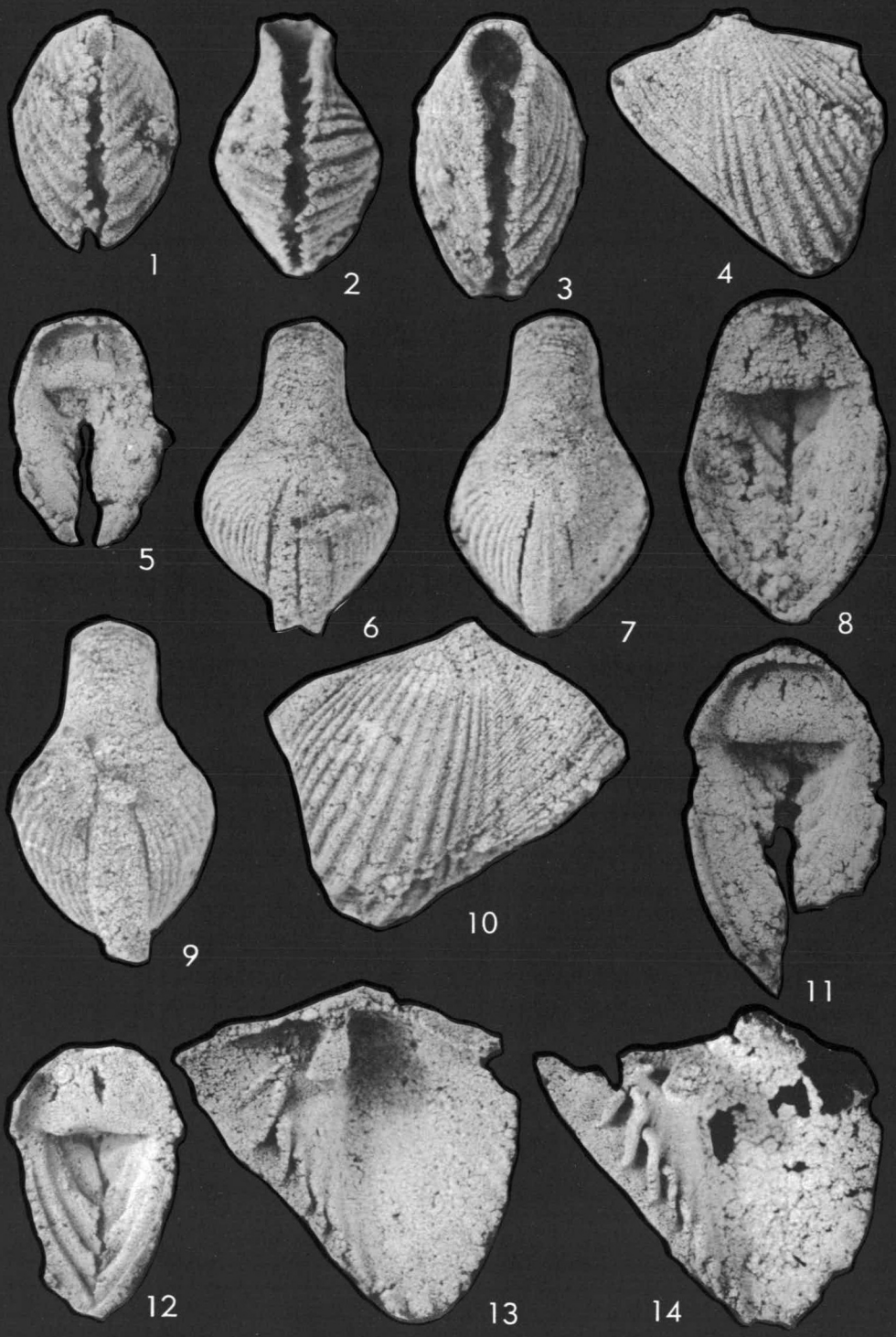

PLATE 26

Eopteria struszi sp. nov.
(p. 26)
(All specimens silicified replicas.)

Figs. 1-10 Growth series of left valves, X4. Paratypes (CPC 14930-14939), locality 47.

Fig. 11 Ventral view showing gape. **Holotype** (CPC 14940), locality 48, X4. (See Pl. 27, figs. 1-4).

Plate 26

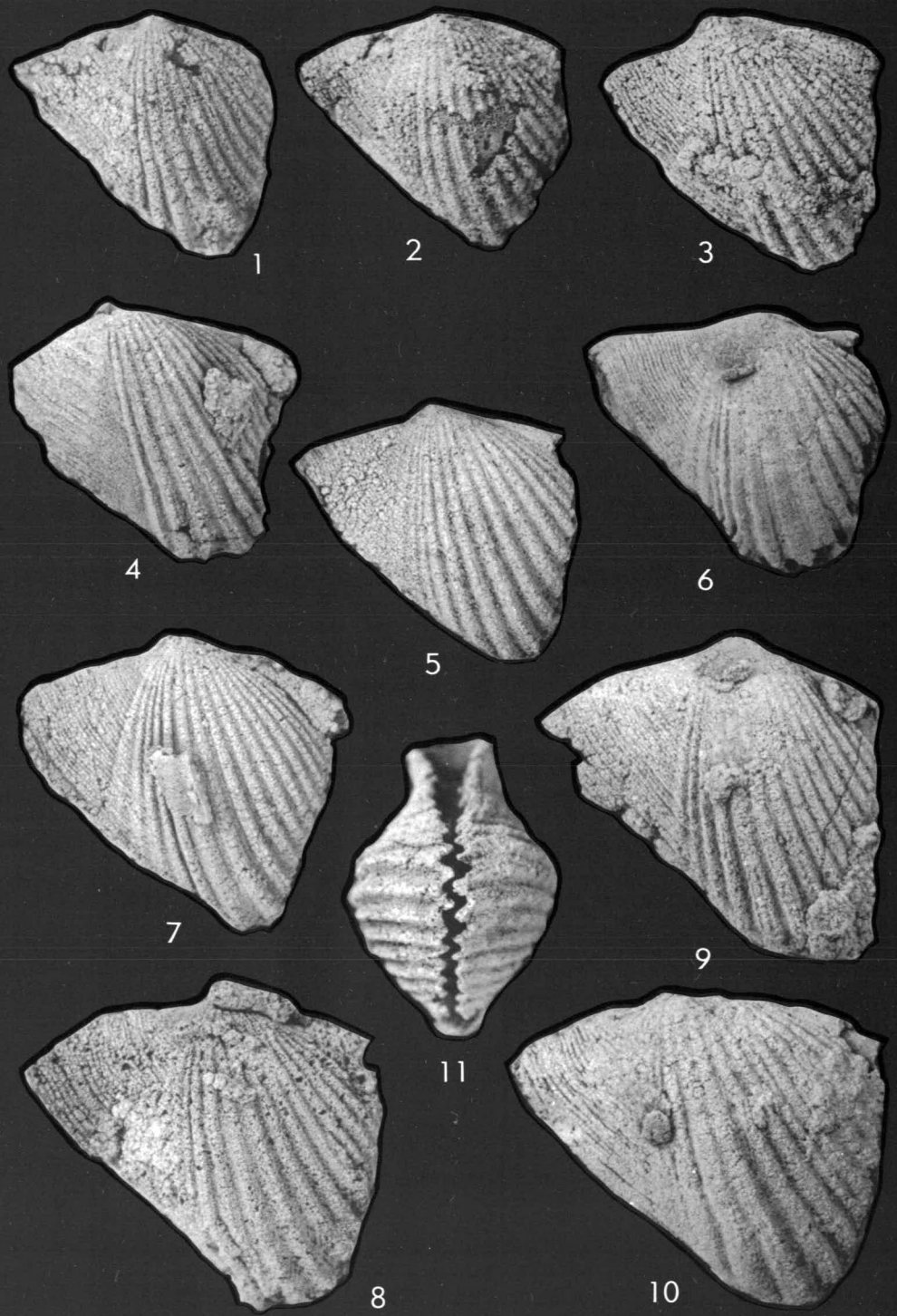

PLATE 27

Eopteria struszi sp. nov.
(p. 26)
(All specimens silicified replicas from locality 48.)

Figs. 1-4 Right lateral, anterior, dorsal, and posterior views of **holotype** (CPC 14940), showing profile, rostrum, and gapes, X4. (See Pl. 26, fig. 11.)

Figs. 5-11 Growth series of right valves, X4. Paratypes (CPC 14941-14947).

Plate 27