DEPARTMENT OF NATIONAL DEVELOPMENT & ENERGY
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

BULLETIN 175

DOLICHOMETOPID TRILOBITES OF QUEENSLAND, NORTHERN TERRITORY, AND NEW SOUTH WALES

by

A. A. ÖPIK

AUSTRALIAN GOVERNMENT PUBLISHING SERVICE
CANBERRA 1982

DEPARTMENT OF NATIONAL DEVELOPMENT & ENERGY

MINISTER: SENATOR THE HON. SIR JOHN CARRICK

SECRETARY: A. J. WOODS

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

DIRECTOR: R. W. R. RUTLAND

ASSISTANT DIRECTOR, GEOLOGICAL BRANCH: J. N. CASEY

Published for the Bureau of Mineral Resources, Geology & Geophysics by the Australian Government Publishing Service

ISSN 0084-7089

ISBN 0 642 06888 7

DATE OF ISSUE: 14 APR 1982

This Bulletin was edited by W. H. Oldham

Printed by Graphic Services Pty Ltd, 516-518 Grand Junction Road, Northfield, S.A. 5085

CONTENTS

SUMMARY

Stratigraphic and geographic distribution

In two Tables the temporal succession of 35 named species of dolichometopids and 17 forms with open nomenclature is shown; a scale of nine biostratigraphic operational units is apparent ranging from the Ordian to the top of the Middle Cambrian; this scale is quite close in phase with the previously employed essentially agnostid scale. Regarding genera, Ordian and Templetonian are marked by *Deiradonyx* nov., the Zone of *Ptychagnostus atavus* by *Horonastes* nov., the Zone of *Euagnostus opimus* by large-eyed *Fuchouia* species and *Itydeois* nov.; in the Zone of *Ptychagnostus punctuosus* appears *Eurodeois deois* (Walcott) and *Dolicholeptus* nov., and in the Zones of *Doryagnostus notalibrae* and *Goniagnostus nathorsti* the genera *Dolicholeptus, Eurodeois,* and *Sunia* prevail; in the Zone of *Leiopyge laevigata,* dolichometopids are rare except for *Fuchouia? bensoni,* a small-eyed *Fuchouia.* The geographic distribution is evident from the description of localities; most abundant are the dolichometopids in the Undilla Basin of Queensland, for which the Middle Cambrian sequence is almost complete and collections are numerous. The Northern Territory produced *Deiradonyx, Horonastes,* and *Fuchouia,* and New South Wales only a single species of *Deiradonyx.* The list of hitherto named Australian Corynexochida contains 16 species, of which seven belong to Dolichometopidae.

Palaeozoology

The order Corynexochida (attributable to R. C. Moore) and its affiliation with ptychopariids, which is controversial, are discussed; the family Dolichometopidae Angelin and its subfamilies are revised; the subfamily Bathyuriscinae Richter is reinstated for forms having the hypostoma and rostral shield fused, and Horonastinae nov. is established for forms in which these are not fused. The literature regarding the morphogenesis of Corynexochida is reviewed; the morphogenesis of *Fuchouia fecunda* sp. nov. is presented beginning with protaspides, and is summarised as a 'succession of characters'. The dolichometopid morphology (both new and little known characters) is discussed in alphabetic order, and in captions of text-figures.

Systematics

The genus name *Amphoton* Lorenz is restricted to its type species *A. steinmanni* whose structure is inconclusive. The name itself (see Glossary) is genitive and plural and therefore illegitimate, but can be retained as an artificial word.

Dolichometopidae(?) (family queried) contains a single species, *Parapoliella* nov.

Dolichometopidae (subfamily uncertain) accommodates the oldest forms—*Deiradonyx* nov. with four species (type species *D. barklyensis*) and *Sestrostega* (*S. tosta* nov.). These genera are not affiliated with each other.

The rest of the genera (except *Acontheus*) are attributed to the subfamily Horonastinae nov.

Genus *Horonastes* nov. (4 species, 2 named); the type is *H. eminens.*

Genus *Fuchouia* Resser & Endo, 1939 (7 species). *Fuchouia fecunda* nov. is described in great detail, including its morphogenesis.

Genus *Itydeois* nov. (4 species, 3 named); the type is *T. elegans* nov.; these forms possess a brim.

Genus *Dolicholeptus* nov. (5 species, 4 named); the type is *D. ansatus*; related apparently to *Fuchouia* of the *F. fecunda* group.

Genus *Undillia* nov. (3 species, 2 named); the type is *U. rustica* nov., with a long and tapering glabella.

Genus *Eurodeois* nov. (10 species, 6 named); the type is *Dolichometopus deois* Walcott; *Amphoton serotinum* Whitehouse and *A. spinigerum* Whitehouse are included; *spinigerum* is, however, inconclusive. Two groups are apparent: *Eu. deois* and *Eu. adelpha* nov. without genal spines, and the rest with genal spines.

Genus *Sunia* Kobayashi (10 new species, 7 of them named). *Sunia cornunda* nov. displays graphically five glabellar (six cephalic) metameres, a structure apparent in some other species of the genus, as well as in *Horonastes* and even in *Dolicholeptus.* About 180 specimens are illustrated in 32 plates, and elucidated in 34 text-figures.

INTRODUCTION

This Bulletin is the result of a palaeozoological and stratigraphic study of Australian species of the trilobite family Dolichometopidae, which constitutes a substantial part of the Middle Cambrian fauna.

The main result in stratigraphy is the discovery of a temporal sequence of some nine assemblages of taxa of dolichometopids constituting a scale of biostratigraphic operational units equal in value to zones and operational in geological dating of strata and faunas; and in palaeozoology-morphogenesis, morphological observations regarding the structure of the cephalon and the hitherto unsuspected diversity of the Australian dolichometopids.

The material from Queensland has been studied exhaustively; the dolichometopids from the Northern Territory, however, especially from Huckitta and Lucy Creek area, are in need of purposeful collecting; the same applies to central Australia and New South Wales.

Of the described forms *Deiradonyx toddi* comes from a collection made by the Amadeus Basin Geological Party; *Fuchouia labda* was collected by Mr J. N. Casey; *Fuchouia* sp. nov. aff. *atopa* by Mr M. A. Randal, and *Parapoliella* sp. nov. by the two last named —all of this Bureau; the rest of the material has been collected by the present author in the period 1948-1962; the whole material belongs to the Commonwealth Palaeontological Collection, whose type numbers are marked by the prefix CPC.

STRATIGRAPHIC DISTRIBUTION

The stratigraphic (temporal) sequence of the described dolichometopid taxa is summarised in Tables A and B. The tabulated sequence is based on the superpositional succession of strata and fossils associated with the dolichometopids; special attention has been paid to the agnostids—the markers of zones of the scale used by Öpik (1960). In the Tables this scale is, however, supplemented as follows:

(1) In column 9 the name 'Ordian' is introduced as a designation of the earliest Middle Cambrian stage established and described by Öpik (1968).

(2) In column 8 Templetonian means '*Ptychagnostus gibbus* and *Xystridura*' of the earlier chart taken together, for several reasons: (a) in available collections *Triplagnostus gibbus* occurs but is rare about halfway down the *Xystridura*-bearing sequences; (b) in Queensland the topmost Templetonian is devoid of polymerid trilobites including dolichometopids but abounds in agnostids of an assemblage with *Triplagnostus gibbus*; and (c) only *Deiradonyx* sp. aff. *collabrevis* is known from Queensland.

(3) In column 6, *Euagnostus opimus* Whitehouse is substituted for the previously used *Hypagnostus parvifrons* which is absent; nevertheless, it remains an alternative name for the zone.

(4) Column 4, the Zone of *Doryagnostus notalibrae* is the zone where *Ptychagnostus punctuosus* and *Goniagnostus nathorsti* overlap (see Öpik, 1979, p. 8).

(5) *Leiopyge laevigata* makes its appearance late in the Zone of *Goniagnostus nathorsti* (or *G. nathorsti* extends into the *L. laevigata* Zone).

The Upper Cambrian/Middle Cambrian 'Zone of Passage' and its fauna with *Alomataspis enodis* as well as the youngest known species of the order—*Corynexochus plumula* Whitehouse—were presented by Öpik (1967a, pp. 7-9).

Tables A and B together contain a scale of some nine species assemblages in a temporal succession arranged from right (column 9, the oldest) to left (column 1, the youngest); within most of the columns, however, no temporal sequence of species could be established with certainty. Nevertheless, in column 9 *Parapoliella* presumably antedates *Deiradonyx toddi*. The scale is a scale of distinctive biostratigraphic operational units (BSOUs)—subsidiary zones. These units are sufficiently close in phase with the agnostid zones to make a separate zonal nomenclature unnecessary. In overseas correlation these operational units are of quite restricted application owing to their apparently endemic composition. Of interest is the occurrence of *Eurodeois deois*

TABLE A: STRATIGRAPHIC DISTRIBUTION OF SPECIES DOWN TO THE ZONE OF PTYCHAGNOSTUS PUNCTUOSUS

	1	2	3	4	5
			UNDILLAN STAGE		
	U/M Cambrian zone of passage	Zone of *Leiopyge laevigata*	Zone of *Goniagnostus nathorsti*	Zone of *Doryagnostus notalibrae* (=*punctuosus* + *nathorsti*)	Zone of *Ptychagnostus punctuosus*
Alomataspis enodis Öpik	X				
Dolicholeptus kallalicus nov.		X			
'*Amphoton*'? *arta* Öpik		X			
Fuchouia? bensoni (Öpik)		X			
Sunia colainis nov.			X		
Sunia rutilata nov.			X		
Sunia cf. *rutilata*			X		
Sunia russa nov.			X		
Eurodeois anepsia nov.			X		
Eurodeois (or *Sunia?*) *spinigera* (Whitehouse)			X		
Sunia sp. indet., pygidium with reticulate veins			X		
Sunia idica nov.			X		
Sunia cornunda nov.				X	
Sunia elissa nov.				X	
Sunia lorenzi nov.				X	
Eurodeois adelpha nov.				X	
Eurodeois aff. *D. dirce* Walcott				X	
Eurodeois marginicrassa nov.				X	
Eurodeois sp., cf. *marginicrassa*				X	
Eurodeois serotina (Whitehouse)				X	
Eurodeois? sp. indet.				X	
Dolichometopidae, pygidium No. 3				X	
Dolichometopidae, pygidium No. 2				X	
Sunia sp. indet., pygidium No. 1				X	
Undillia rustica nov.				X	
Undillia sp. nov. A				X	
Dolicholeptus ansatus nov.				X	
Dolicholeptus cf. *ansatus*				X	X
Undillia lara nov.				X	
Dolicholeptus baiatus nov.				X	
Dolicholeptus licticallis nov.				X	X
Eurodeois deois (Walcott)					X
Eurodeois sp. nov. aff. *serotina*					X

(Walcott) late in the Zone of *Ptychagnostus punctuosis*; it is the paramount species of the *Amphoton* zone of northern China and Manchuria (Chang, 1957) which, however, covers a large interval as a genus-zone including *Sunia* as well. Inaccurate is also a correlation by means of genera: the Chinese *Fuchouia manchuriensis* (with small eyes) is much younger than *Fuchouia fecunda* and *F. labda* (with large eyes), and the *Sunia* subzone of Chang (based apparently on *Sunia typica* Kobayashi) is a possible and approximate equivalent of our *Goniagnostus nathorsti* zone. Further clues for a correlation with China are expected from the occurrence in Australia of such forms as *Lisania* and *Menocephalites* cf. *acantha* whose study, however, is not yet concluded. Some refinement of the scale of agnostid species, particularly of the Ptychagnostinae, is also in sight in a work in progress.

Table B: Stratigraphic distribution of species from the Zone of Euagnostus opimus down to the Ordian

	6	7	8	9	
	FLORAN		TEMPLE-TONIAN	ORDIAN	
	Zone of *Euagnostus opimus*	Zone of *Ptychagnostus atavus*			
Itydeois elegans nov.	X				
Itydeois vultuosa nov.	X				
Itydeois balli nov.	X				
Itydeois sp. nov. aff. *vultuosa*	X				
Fuchouia fecunda nov.	X				
Fuchouia sp. aff. *fecunda*	X				
Fuchouia atopa nov.	X				
Fuchouia sp. nov. aff. *atopa*	X				
Fuchouia morstonensis nov.	X				
Fuchouia labda nov.		X			
Horonastes satelles nov.		X			
Horonastes eminens nov.		X			
Horonastes sp. A (aff. *eminens*)		X			
Horonastes? sp. B (aff. *eminens*)		X			
Sestrostega tosta nov.			X		
Deiradonyx barklyensis nov.			X		
Deiradonyx collabrevis nov.			X		
Deiradonyx sp. aff. *collabrevis*			X		
Deiradonyx toddi nov.				X	
Parapoliella sp. nov.					X

GEOGRAPHIC DISTRIBUTION

Collecting sites are listed primarily by State and secondarily by 4-mile Sheet area (now known as the 1:250 000 mapping series).

Queensland

The collecting sites are marked on the 4-mile Geological Series sheets, which were issued separately and also as part of BMR Bulletin 51 (Carter, Brooks & Walker, 1951).

CAMOOWEAL Sheet area

Headwaters of Labortion Creek on Morstone station, collection marked 'C136'; *Parapoliella* sp. nov.; chert of Camooweal Dolomite. Site not marked on map.

M19. Lat. 19°3.27′, long. 138°32′. *Sunia* sp. indet. (pygidium with reticulate veins). Mail Change Limestone.

M30. Lat. 19°28′, long. 138°37.5′. *Dolicholeptus licticallis* sp. nov. (in V-creek Limestone) and *Eurodeois deois* (Walcott) (inferred top of Currant Bush Limestone).

M41. Lat. 19°27.5′, long. 138°37′; small butte of Split Rock Sandstone at Old Burketown road on a socle of limestone.

(a) *Sunia* indet., in Split Rock Sandstone; (b) *Dolicholeptus ansatus*, *Sunia* indet. pyg. No. 1, and *Eurodeois marginicrassa* sp. nov., limestone and chert laminae in limestone, close to the base of the Sandstone; (c) ribbed limestone outcrop with *Papyriaspis* etc.; (d) the oldest bed—about 0.3 km to northwest, a creek with vertical low banks in sandy marly limestone with ellipsoids: *Dolicholeptus licticallis* sp. nov., *Ptychagnostus punctuosus*, and other forms; total thickness of the V-Creek Limestone is only about 15 m (compare M130 and M141).

M52. Lat. 19°27′, long. 138°36.4′. Outcrops as in M41; V-Creek Limestone with *Eurodeois serotina* (Whitehouse), and Dolichometopidae pygidium No. 2.

M54. Lat. 19°37.5′, long. 138°38′. Marly grey limestone (V-Creek Limestone) in Douglas Creek. *Undillia rustica* sp. nov., *Dolicholeptus ansatus* sp. nov., *Sunia cornunda* sp. nov.

M57. Lat. 19°48′, long. 138°40′. Laminated marly to crumbly grey limestone (close to the top of V-Creek Limestone) in a stream bed. *Sunia cornunda* sp. nov. and abundant agnostids including *Goniagnostus nathorsti*.

M65. Lat. 19°24′, long. 138°31.4′. V-Creek Limestone interbed (an outlier?) on Age

Creek Formation. *Eurodeois marginicrassa* sp. nov., Damesellidae gen. nov. (Öpik, 1967a, p. 338).

M89. Lat. 19°28′, long. 138°33′; not shown on the map, but close to M418. A pod of calcite in V-Creek Limestone. *Eurodeois adelpha* sp. nov., *Eu.* aff. *Dolichometopus dirce* Walcott, *Eurodeois* sp., cf. *marginicrassa, Undillia* sp. nov. A, *Sunia elissa* sp. nov., Dolichemetopidae pygidium No. 3; *Dorypyge, Papyriaspis lanceola, Asthenopsis levior,* and agnostids.

M118. Lat. 19°34′, long. 138°47′. On the map the locality is erroneously marked 48 instead of 118; either early V-Creek, or late Currant Bush Limestone. *Dolicholeptus licticallis* sp. nov.

M123. Lat. 19°31′, long. 138°47.5′. Currant Bush Limestone interstratified with Age Creek Formation; outcrop in creek bed. *Itydeois elegans* sp. nov., *I. vultuosa* sp. nov.

M130. Lat. 19°35.5′, long. 138°48.5′. A small butte; Split Rock Sandstone, resting on a thin layer of ironstone (replacing the V-Creek Limestone; compare M41 and M141) over shale and limestone of the Currant Bush Limestone. In the ironstone: *Dolicholeptus ansatus* sp. nov., *Undillia* sp. nov. A., *Eurodeois marginicrassa* sp. nov. and *Eu. adelpha* sp. nov.

M133. Lat. 19°35′, long. 138°41′. Outlier of Split Rock Sandstone; *Sunia rutilata* sp. nov.

M136. Lat. 19°31′, long. 138°39′; dolomite of Age Creek Formation; *Sunia lorenzi* sp. nov., *Asthenopsis levior.*

M141. Lat. 19°39.5′, long. 138°48′. Split Rock Sandstone with *Sunia russa* sp. nov. and *Eurodeois anepsia* sp. nov. rests on a layer of brown siltstone (replacing the V-Creek Limestone; compare M41 and M130) with *Sunia cornunda* sp. nov.

M157. Lat. 19°35′, long. 138°35′ Currant Bush Limestone interstratified with Age Creek Formation. *Eurodeois* sp. nov. aff. *serotina.*

M160. Lat. 19°23.5′, long. 138°35.5′. Chert layer in Age Creek Formation. *Fuchouia morstonensis* sp. nov., *Itydeois* sp. nov. aff. *vultuosa, Dorypyge, Euagnostus opimus.*

M161. Lat. 19°27′, long. 138°31′. *Itydeois elegans* sp. nov. in limestone.

M176. Lat. 19°33′, long. 138°54.5′. Currant Bush Limestone at a sink hole; *Fuchouia* with short occipital spine, undescribed; *Itydeois* indet.; chert in sinkhole.

M409. Lat. 19°35.5′, long. 138°43.5′. V-Creek Limestone, at V-Creek, east bank. *Undillia lara* sp. nov.; *Dolicholeptus baiatus* sp. nov.

M412. Lat. 19°31′, long. 138°53′. Shale of Inca Formation at Chummy Bore. *Fuchouia* indet., undescribed.

M416. Lat. 19°32.8′, long. 138°35.7′. V-Creek Limestone. *Sunia cornunda* sp. nov., *Sunia idica* sp. nov.; *Asthenopsis levior* (complete specimens), *Goniagnostus nathorsti* (also complete).

M417. Lat. 19°57′, long. 138°29.5′. Split Rock on Wooroona Creek; close to it are also M296, M415, M343, M344, M349. *Eurodeois anepsia* sp. nov., *Eurodeois?* (or *Sunia?*) *spinigera* (Whitehouse), *Sunia* cf. *rutilata*; *Nepea narinosa, Nepea anoxys,* and several undescribed diverse trilobites.

MOUNT ISA Sheet area

M188. Lat. 20°06′, long. 138°48.5′. Small outcrops in a playa; Beetle Creek Formation, chert and silicified coquinoid limestone. *Sestrostega tosta* sp. nov.

M199. Lat. 20°08′, long. 138°14.5′. Shale of Inca Formation. *Fuchouia* sp. aff. *fecunda.*

M226. Lat. 20°59.5′, long. 138°31′. Silicified siltstone layer, Split Rock Sandstone. *Sunia colainis* sp. nov., *Sunia idica* sp. nov.; *Nepea narinosa* and some undescribed fossils.

M227. Lat. 20°09.5′, long. 138°31′. Chert of V-Creek Limestone; *Eurodeois*(?) sp. nov.

M247. Lat. 20°15′, long. 138°34′. V-Creek Limestone in the bed of Whistlers Creek. *Eurodeois marginicrassa* sp. nov., *Dolicholeptus* cf. *ansatus* (?sp. nov.); *Papyriaspis lanceola, Asthenopsis levior, Mapania angusta, Doryagnostus incertus, Goniagnostus nathorsti.*

M434. Lat. 20°44′, long. 139°15.5′. Beetle Creek Formation; siltstone (*Xystridura* coquinoid); *Deiradonyx* sp. aff. *collabrevis.*

DUCHESS Sheet area

D17, D19. *Fuchouia? bensoni* (Öpik, 1961)

D18. *'Amphoton'? arta.*

URANDANGI Sheet area

D54. Lat. 21°57.5′, long. 139°04′. Steamboat Sandstone (Öpik, 1967a), *Dolicholeptus kallalicus* sp. nov.

Northern Territory

ALICE SPRINGS Sheet area

AS33. Lat. 23°46′, long. 134°50′, at Gaylad Dam, *Deiradonyx toddi* sp. nov. For associated fauna see Öpik (1967b).

ALROY Sheet area

N27. About 27 km east from Alexandria homestead, on road to Gallipoli station. Silicified *Xystridura* coquinoid. *Deiradonyx barklyensis* sp. nov.; *Xystridura, Kootenia,* ptychopariids, *Pagetia.*

HUCKITTA Sheet area

H4. (Casey & Tomlinson, 1956). Bituminous limestone, *Fuchouia labda* sp. nov.

MOUNT DRUMMOND Sheet area

Border Waterhole area of Öpik, 1956, p. 10; also Öpik, 1960, and Carter & Öpik, 1961). Limestone attributed to Currant Bush Limestone; outcrops between Longtitudes 137°50′ and 138°15′, along Latitude 18°38′ (approximately).

M179. Lat. 18°38′, long. 137°56.3′. *Horonastes eminens* sp. nov., *Horonastes satelles* sp. nov., *Horonastes* sp. A (aff. *eminens*).

M180. 2.7 miles west of Longitude 138°00′. *Fuchouia fecunda* sp. nov., *Fuchouia atopa* sp. nov., *Fuchouia* sp. nov. aff. *atopa, Itydeois balli* sp. nov.

M186. Lat. 18°38.5′, long. 137°58′. Fossils as at M180.

M183. (Just outside Sheet area) Lat. 18°38′, long. 138°02′. *Horonastes?* sp. B (aff. *eminens*).

M377. (Just outside Sheet area). Lat. 18°38′, long. 138°03′. *Fuchouia atopa.*

BROKEN HILL Sheet area

New South Wales

Mount Wright, White Cliffs area. Lat. 31°10′, long. 142°20′. Stratigraphy discussed by Öpik (1967b). *Deiradonyx collabrevis* sp. nov. associated with *Xystridura* and *Pagetia.*

PREVIOUS RECORD OF CORYNEXOCHIDA IN AUSTRALIA

The hitherto described species of Australian corynexochids are as follows:

1. *Corynexochus plumula* Whitehouse, 1939 (vide Öpik, 1967a, p. 178).
2. *Amphoton spinigerum* Whitehouse, and
3. *Amphoton serotinum* Whitehouse; these two species are discussed also in the present Bulletin.
4. *Thielaspis thielei* (Chapman, 1911) and
5. *Thielaspis minima* (Chapman, 1911)
   The genus *Thielaspis* Thomas & Singleton (1956) was introduced by an indication of the type species — *Ptychoparia thielei* Chapman.
6. *Amphoton bensoni* Öpik, 1961; in the present paper it is referred to as *Fuchouia? bensoni* (Öpik).
7. *Amphoton? arta* Öpik, 1961
8. *Alomataspis enodis* Öpik, 1967
9. *Kootenia fergusoni* (Gregory)
10. *Kootenia modica* (Whitehouse, 1939)
11. *Kootenia?* cf. *incerta* (Rusconi), Öpik, 1967
12. *Olenoides tranans* Öpik, 1967
13. *Holteria arepo* Öpik, 1961
14. *Dorypyge tenella*
15. *Dorypyge corusca*
16. *Dorypyge decoris*—these three by Whitehouse, 1945
17. *Oryctocephalus discus* Whitehouse, 1939

The family Corynexochidae is represented by one species; seven species (Nos. 2-8) belong to Dolichometopidae, and nine (Nos. 9-17) belong to Dorypygidae. The total number of named species of the Dolichometopidae is now thirty-seven.

Undescribed species of *'Amphoton'*, *Fuchouia*, and *Corynexochus* have been reported from Victoria by Thomas & Singleton (1956, pp. 155, 156, and 161); in Tasmania the 'bathyuriscids' mentioned by Banks (1956, p. 189) refer to the occurrence of fragmentary material—possibly of *Fuchouia*-like forms; Whitehouse (1940, p. 45) recorded a *Fuchouia* in the sequence of the Undilla Basin; *Bathyuriscus* of Chapman (1929) refers to *Xystridura*—a genus of another order. Öpik's (1956, and later papers) *Fuchouia* includes also forms of *Dolicholeptus* nov. and *Amphoton-Undillia, Itydeois, Eurodeois,* and *Sunia* of the present Bulletin.

Order CORYNEXOCHIDA Moore, 1959

Moore (in Harrington & others, 1959, p. 0217) quoted Kobayashi, 1935 as the author of the Order Corynexochida ex Kobayashi's suborder Corynexochida, 1935. This action was taken in a bona fide reliance on the recommendations proposed for further discussions in the Copenhagen Decisions (1953) regarding the introduction of co-ordinate nomenclature for the ordinal group of taxa. These recommendations, however, remained ineffective as indicated in I.C.Z.N., 1961, p. X: 'the Code should not undertake regulations of the names of taxa in categories above the family-group'. Consequently, the order and suborder names are not co-ordinate, the names are independent from each other, each has its own date and author, not transferable to names of other ranks.

The Order Corynexochida Moore was introduced as a necessity in replacing Beecher's Orders Hypoparia, Opisthoparia, and Proparia and Jaekel's Miomera and Polymera by an alternative system of orders. At the same time the suborder Corynexochida Kobayashi 1935 still stands, being established as a taxon of the order Opisthoparia. It fits also Jaekel's Order Polymera which is still implemented by N. Tchernysheva (1960) and Suvorova (1964) although those authors omit suborders and operate with superfamilies, including the legitimate Corynexochoidea = Corynexochacea Angelin 1854.

The concept of the order Corynexochida Moore, 1959 covers seven families, but superfamilies and suborders are not included in it. Kobayashi (1962, p. 133), however, accommodated in the order Corynexochida Kobayashi 1935 (recte: Moore, 1959) four suborders, including the suborder 'Corynexochina nov.' (recte: Kobayashi, 1935). In passing, Kobayashi (op. cit.) ignored the co-ordinate system of nomenclature of the family group of taxa (for example, Corynexochacea nov.: recte Angelin, 1854; Komaspidacea nov.—should be Kobayashi, 1935, ex Komaspididae Kobayashi, 1935).

The following families of the Corynexochida have representatives in Australia: (1) Dorypygidae Kobayashi (*Dorypyge*, *Kootenia*, *Holteria*, *Olenoides*); (2) Oryctocephalidae Beecher, described by Shergold (1969); (3) Corynexochidae (*Corynexochus*, *Acontheus*); (4) Zacanthoididae (undescribed), and (5) Dolichometopidae, which constitutes the topic of this Bulletin.

The Order Corynexochida Moore covers seven families, of which the Dinesidae is, however, out of place. Of the remaining six families only one (Ogygopsididae) has no Australian representatives.

Family DOLICHMETOPIDAE Walcott, 1916

Originally Walcott established a subfamily —the Dolichometopidae, of the family Corynexochidae Angelin, 1854—and assigned to it two genera: *Dolichometopus* Angelin and *Bathyuriscus* Meek. *Dolichometopus* was presented as a large aggregate of 14 species; subsequent revisers, however, distributed most of these under different genera and only two —*Dolichometopus suecicus* Angelin 1854 (the type of the genus) and *D. acadicus* Matthew —remained in the genus. As discussed below under the heading of the genus *Dolichometopus* (q.v.), the known material of *D. suecicus* is still incomplete and so leaves open some aspects of the concepts of the genus and even of the family.

The first exhaustive review of the Dolichometopinae and its genera was published by Kobayashi (1942).

Subfamily DOLICHOMETOPINAE Walcott, 19.6

Genus *Dolichometopus* Angelin, 1854

Type species: *Dolichometopus suecicus* Angelin.

Westergaard (1948, pl. 3, fig. 14) illustrated the lectotype of *D. suecicus*. Only cranidia and pygidia are known, but the species is nevertheless sufficiently preserved to justify the family name Dolichometopidae; it is however insufficiently documented for a satisfactory comparison with the rest of the dolichometopids: (1) its pygidium is large, with five axial annulations and reminiscent of the North American *Glossopleura* and *Anoria*, but it is nevertheless peculiar in having a concentric ridge on its border. It is quite different from the smaller pygidia of the Australian and Asian forms, including *Dolichometopus? deois* Walcott; (2) the cranidial rim in *D. suecicus* is relatively large and reminiscent of *Eurodeois* and *Sunia*, but not of any of the American forms which have a narrow frontal border; this structure taken alone, however, is inconclusive as an indicator of affiliation; and (3) the rostral shield and the hypostoma of *suecicus* are unknown; if fused—a North American, and if separate—an Australian affinity would be acceptable; material evidence is needed to solve the dilemma.

To conclude, the generic name *Dolichometopus* adheres to its type species *Dolichometopus suecicus* Angelin, and *D. acadicus* Matthew is the only known congeneric species.

The subfamily Dolichometopinae Walcott is legitimate and valid but its concept remains obscure; its clarification depends on new and informative material regarding its cephalic ventral structures in the first place. No evidence is available regarding its synonymy with the subfamilies Bathyuriscinae, Glossopleurinae, and Horonastinae nov., although a possibility, depending on further research, exists that only one of these subfamilies may be a synonym.

Subfamily BATHYURISCINAE Richter, 1933

The subfamily Bathyuriscinae (ex Bathyuriscidae) postdates Dolichometopinae Walcott, 1916, and has been regarded therefore as a junior synonym of the latter; the subsequent subfamilies Ptarmiganiinae Resser, 1939 (not 1935 as quoted by recent authors), and the Glossopleurinae and Orriinae (both by Hupé, 1953) have no influence on the status of the Bathyuriscinae. The synonymy of the families Dolichometopidae and Bathyuriscidae should be accepted but the subfamilies Dolichometopinae and Bathuriscinae cannot be regarded as synonymous, as discussed earlier.

Diagnosis: the species of the subfamily Bathyuriscinae are distinguished by the fusion of the rostral shield into a single sclerite and by the weakly developed brimless frontal limb with a diminutive rim or border. In the subfamily Horonastinae nov., the hypostoma and the rostral shield are separate and the frontal limb is relatively long.

According to Rasetti (1952), and Harrington & others (1959, p. 0217), in all Corynexochida including the Dolichometopidae the rostral shield and the hypostoma are fused.

Excluded from the Bathyuriscinae (listed as Dolichometopidae in Harrington & others, op. cit.) are *Sunia, Amphoton, Fuchouia,* and *'Amphotonella'* (q.v.) and recognised are *Bathyuriscus, Bathyuriscidella, Athabaskia, Athabaskiella, Clavaspidella, Dolichometopsis, Ptarmigania, Corynexochides, Klotziella, Orria* and *Hemirhodon; Poliella, Wenchemnia* and *Parkaspis;* also recognised are *Glossopleura, Plypleuraspis, Auaria* and *Prosymphysurus,* which may constitute the separate subfamily Glossopleurinae Hupé. All these are North American forms not represented in southeastern Asia and Australia. Inconclusive are the Argentinian genera (for example *Asperocare*) and the Siberian *Poliellina.*

Subfamily HORONASTINAE nov.

Diagnosis: The species of the subfamily Horonastinae are distinguished by having the hypostoma and the rostral shield as separate sclerites, and by the variously but well developed frontal limb.

By the diagnostic characters the Horonastinae differ not only from the Dolichometopidae but also from the Corynexochida in general. The Horonastinae occur in Australia and southeastern Asia and are unknown in North America; on the generic and subfamily level the separation of the dolichometopids of these two regions is complete, but the Horonastinae are morphologically recognisable as Dolichometopidae and cannot be separated from that family. Consequently the order Corynexochida retains its unity, but the concept of that order (Moore, *in* Harrington & others, 1959) should be amplified accordingly: rostral plate fused with hypostoma, or separated from it, or rudimentary, or the cephalon consists either of four or of five separate sclerites. The pygidia in the Horonastinae: largest in *Fuchouia fecunda* (0.55-0.6), and smaller in Bathyuriscinae: most have been larger than *Fuchouia*; close in size to Horonastinae and *Poliella, Wenchemnia,* = early Bathyuriscidae.

The aggregate of the following genera constitutes the Horonastinae: *Deiradonyx* nov., *Sestrostega* nov., *Horonastes* nov., *Itydeois* nov., *Amphoton* Lorenz, *Eurodeois* nov., *Sunia* Kobayashi, *Fuchouia* Resser & Endo, *Dolicholeptus* nov., and *Alomataspis* Öpik.

AFFILIATION OF CORYNEXOCHIDA

Poliellina Poletaeva (Suvorova, *in* Tchernysheva, 1960, text-fig. 25, p. 74) is a genus of the order Corynexochida placed in the Dolichometopidae; this classification, however, is inconclusive, and at least a separate subfamily should be considered. By the way, the reconstruction of *Poliellina lermontovae* in Harrington & others (1959, p. 0225) (the same in

Kobayashi, 1942, pl. 4, fig. 5) is outdated. In all species of *Poliellina* the posterior glabellar furrows are transcurrent as in *Saukianda* R. & E. Richter, 1940 whose organisation is 'bathyuriscid' (Öpik, 1958, p. 35) and not, as generally assumed, redlichiid. I concur also with Suvorova (op. cit.) that *Parapoliella, Judaiella,* and probably *Jakutus* and *Bathyuriscellus* are corynexochoid trilobites; less probable is *Edelsteinaspis*, which, however, cannot be placed elsewhere. *Amgaspis* (Amgaspididae Tchernysheva, 1960) which is also included by its author in the superfamily Corynexochoidae, is rather peculiar in having a plump, tumid and tapering glabella and a crescentic rim, and should be regarded as incertae sedis (Harrington & others, 1959, p. 0513).

Robison (1967) suggested that corynexochids and ptychopariids 'are biologically closely related' and that major differences between their holaspides 'appear to result primarily from differential growth rates', while the protaspid morphology of *Bathyuriscus* (*Orria*) *fimbriatus* 'is similar to that of some ptychopariids'. Robison concludes that the 'current classifications of these trilobites need to be revised in order to reflect this relationship'.

The biological affinity of corynexochid and ptychopariid trilobites seems an unquestionable generality: all polymerid trilobites are affiliated, beginning their free life as similarly organised anaprotaspides, and reaching the stabilised holaspid maturity through the transitory growth stadia; a trilobite is recognisable at a glance in any of its instars. But the classification of trilobites—the comparative morphology—by the fact of the diversity of the differential growth rates inherent to species and taxonomic aggregates of species; the evaluation of similarities and dissimilarities in terms of systematics, remains a matter of subjective judgement. In passing, Walcott (1916, pp. 375-380) placed his *Ogygopsis* and *Orria* in the family Asaphidae on the basis of exoskeletal similarities; he also considered (op. cit., p. 380) as phylogenetically significant the resemblance between *Orria* (a quasi Asaphid) and *Bathyuriscus*. It occurs to me that *Ogygopsis* and *Orria* are in their external aspect much closer to asaphids than to *Crassifimbra*, the particular ptychopariid selected by Robison for comparison with *Bathyuriscus*.

Crassifimbra itself is hardly a ptychopariid; it belongs according to Öpik (1961, p. 143) to the Ellipsocephalidae, whose differential growth rate results in very narrow free cheeks (large in *Bathyuriscus*) and small posterolateral limbs (very long in *B. fimbriatus*); *Ptychoparia*, however, has the free cheeks and posterolateral limbs large and is better suited than *Crassifimbra* for a comparison with the Dolichometopidae. A requisite of the ptychopariids is the cranidial brim and its tendency to increase in length. The hitherto known dolichometopids are brimless, but in several Australian forms (*Fuchouia fecunda* sp. nov., *F. atopa* sp. nov., *Horonastes, Itydeois, Sestrostega*) only a holaspid brim is evident. To speculate, the brim in the Corynexochida is mostly suppressed, but still a potential structure.

The anaprotaspides of *Bathyuriscus fimbriatus* (Dolichometopidae) and of *Aphelaspis* (Ptychopariida), as shown by Robison (1967, text-fig. 4) are practically identical and their characters are an incomplete set of characters of the Polymera, of the class Trilobita; I presume that the embryo *in ovo* may show only some characters of the Phylum Arthropoda. The three pairs of the marginal spines of the protaspides designated 'fixigenal' by Palmer (1962) may have existed already at the onset of cephalisation, introduction of moulting and its essential facility—the sutures. These spines are indeed believed to be the earliest known and therefore fixigenal in reference to the morphogenetically subsequent meraspid and holaspid structures. In reference to the anaprotaspis itself, however, which consists of the future cephalic axial lobe (the future glabellar plus occipital lobe) surrounded by fused pleural lobes, these spines are marginal rudimentary pleural spines. They probably denote the rudimentary tips of macropleurae completely incorporated in the pleural lobes of the cephalon in polymerids as well as in some miomerids (*Oodiscus subgranulatus* Rasetti, 1966, pl. 1, fig. 4; *Acidiscus theristes* Rushton, 1966, p. 18). The position of the intercept of the margin by the suture in front of the 'anterior fixigenal spine' in anaprotaspides was hardly immutable: it is possible that this point of interception became subsequently displaced behind that spine, transforming the latter into a 'librigenal spine'.

The notion of the similarity of protaspides to each other is also evident from the frequent occurrence of the enlarged frontal glabellar lobe. In some mature dolichometopids its lateral prominence is sometimes masked by the speedy growth of the posterior part of the glabella, or it may be retained as, for example, in *Clavaspidella*, as well as in the Corynexochidae. In ptychopariids, however, the enlarged glabellar front can be seen only in the earliest instars after which its growth in all directions is greatly retarded; it can even be completely erased as, for example, in the Middle Cambrian Nepeidae. In some Ptychopariina the clavate form of the glabella can be suppressed already *in ovo*: for example, the protaspis of *Peltura scarabaeoides* (vide Whittington, 1958, pl. 38, figs. 1-7) has a tapering glabella and is quite disparate from *Crassifimbra, Aphelaspis, Bathyuriscus,* and *Fuchouia.* In passing, the corynoid glabella persists in the Dalmanitidae and Phacopidae as well. It appears that the characters of protaspides so far discussed can be exploited in phylogenetic contemplations but remain inconclusive regarding the taxonomy of higher ranks.

I presume that the general similarities of protaspides are referable (1) to the frequency of rudimentary structures, (2) to the conservation of early acquisitions (the expanded and fused glabellar front), and (3) to the necessity of developing a minimal set of structures adapted to a free existence. As regards some aspects of anatomy, the Dolichometopidae and Ptychopariida differ from each other in some cephalic and glandular structures: (1) In the Dolichometopidae the preocular part of the glabella is long—the modified frontal lobe of the protaspis with an extra pair of glabellar furrows; in the ptychopariids, however, this part of the glabella is short—abbreviated to rudimentary; (2) the Dolichometopidae beginning with the protaspis retain in holaspides five pairs of glabellar furrows, and consequently they possess six cephalic segments including the occipital lobe; in the ptychopariids, however, the full set of four pairs of glabellar furrows together with the occipital lobe indicate five cephalic segments in the holaspis; and (3) in the Dolichometopidae a postcephalic segment has one pair of caecal veins, but two pairs (Öpik, 1961a) are present in the ptychopariids. Nevertheless, in other Corynexochida, as for example in the Dorypygidae and Oryctocephalidae, the glabellar front is shorter than in the dolichometopids and only four pairs of glabellar furrows, as in the ptychopariids, are detectable yet; the structure of the caecal apparatus in these forms is still unknown. It is, however, fair to assume as a possibility that the number of glabellar furrows and the length of the frontal part of the glabella have been subject to reduction in some of the Corynexochida; in absence of proof, however, the classificatory significance of these characters remains inconclusive regarding the degree of affiliation of the Ptychopariida and Corynexochida.

It seems therefore practicable to resort, if needed, to the comprehensive order Polymera Jaekel and to present it as an aggregate of affiliated suborders or even of superfamilies.

I think that the classifications of the polymerid trilobites offer an alternative designated to present the affiliation of the diverse stocks; this is possible by operating with the comprehensive order Polymera Jaekel subclassified into superfamilies and, if desired, suborders.

The ordinal classification adopted in the Treatise of R. C. Moore (1959) is also operational and I employ it for the following reasons: (1) the orders and suborders are reasonably small aggregates of species and genera and capable of receiving supplementary taxa without losing in lucidity; (2) they are of good service in presenting material of open nomenclature regarding a diversity of names; (3) they are convenient in presenting phylogenetic considerations; and (4) the basis of the classification is holaspid morphology in the first place.

DOLICHOMETOPID MORPHOGENESIS REVIEWED

The published record of early instars of Corynexochida is brief. Walcott (1913; 1916) illustrated meraspid cranidia of *Dolichometopus deois* Walcott and *Corynexochus minor* (Walcott) including a complete specimen with three segments in the thorax. Poulsen (1958) described three meraspid cranidia of *Mendospidella digesta* (Leanza) (Dolichometopidae). Suvorova (1964) described early instars of *Chilometopus artus* (Ptarmiganiinae; in my opinion, Corynexochidae) including several protaspides; she also described early instars of *Corynexochus felix*, and of several forms of Oryctocephalidae (*Oryctocara, Oryctocephalops, Cheiruroides,* and *Inicanella*). Robison (1967) described and illustrated a growth series of his *Bathyuriscus* (*Orria*) *fimbriatus*, starting with anaprotaspides. Finally, Rasetti (1967) published a growth series of *Corynexochides? expansus* beginning with metaprotaspides similar to *Fuchouia fecunda.*

Regarding the systematics of the Corynexochida the data in those papers allow for the following interpretations: (1) In the Oryctocephalidae the preocular part of the glabella is relatively short from the beginning, its frontal expansion disappears early in the meraspid period, and the fifth (preocular) pair of the glabellar furrows is absent; it appears therefore that the Oryctocephalidae are more closely affiliated with the Dorypygidae than with the Corynexochidae and Dolichometopidae. (2) *Corynexochus, Chilometopus*—the Corynexochidae constitute an aggregate of conservative species in retaining throughout their life history the clavate (corynoid) shape of the glabella which reflects the initial expanded frontal lobe of the protaspis. In these forms, however, the glabellar relief is rather undeveloped and the presence or absence of the fifth furrows remains inconclusive; but four pairs can be discerned in some forms; some of the Dolichometopidae share the clavate glabella with the corynexochids. (3) Of the Dolichometopidae, *D.? deois* Walcott (1913) (see under *Eurodeois deois*, this Bulletin) is effaced in maturity, but retains a slightly expanded glabellar front which is well expressed in the two meraspid cranidia (Walcott's pl. 22, figs. 1d, 1e) comparable with Poulsen's (op. cit.) *Mendospidella*, and Suvorova's *Chilometopus* and *Corynexochus felix*. The illustrations of these specimens, however, are inconclusive regarding the structure of the frontal lobe and the presence of its lateral furrows. (4) In *Bathyuriscus* (*Orria*) *fimbriatus* Robison (op. cit., pl. 24) silicification has obscured the finer detail of the frontal structure of the protaspides and the meraspid cranidia; the author, however, observed the presence of two pairs of fossulae; the anterior fossulae indicate the presence of a fifth pair of glabellar furrows, or at least, a composite structure of the preocular glabella. By analogy with *Sunia cornunda* (Text-fig. 30) the presence of a fifth foremost pair of glabellar furrows in *Bathyuriscus* is most probable. To note, external obliteration of glabellar furrows cannot be interpreted in terms of absence of a segment, or of organs supported by the furrows. The Dolichometopidae are conservative in retaining the foremost glabellar furrows of the protaspis; but regarding the shape of the glabella they are subject to modifications: (1) as in the Corynexochidae, the clavate form is retained in the holaspid period in some forms (*Clavaspidella, Prosymphysurus, Deiradonyx* nov.); or (2) it is of a lesser emphasis as in *Bathyuriscus, Glossopleura, Eurodeois* (q.v.) and some others; or (3) a parallel sided glabella is developed as in *Horonastes* nov. and *Undillia* nov. Whatever the holaspid glabellar shape may be, the affiliation of the species of the Dolichometopidae is testified by the clavate or corynoid glabella of their instars of the early meraspid period.

MORPHOLOGY

In the Text-figures, especially 3, 6, 8, 9, 24, 26, 30, and 32, the letter symbols refer to the morphological features employed in the descriptions of the taxa and specimens.

The morphology of dolichometopid trilobites is well known since Walcott's (1916) monograph and is in no need of repetition. For a general orientation in the present paper the reconstruction of the exoskeleton of *Fuchouia fecunda*, Text-figure 8, should be sufficient. Furthermore, the structure of segments of the thorax is evident in Plate 23, fig. 5 and Plate 17, fig. 4; the diversity of the free cheeks is apparent from Text-figure 32, Plate 5, fig. 4, Plate 10, fig. 3, Plate 14, fig. 2, Plate 19, fig. 4 and Plate 20, fig. 5; of the pygidia—from Plate 1, fig. 3, Plate 5, fig. 1, and Plate 26, figs. 1 and 5; and of hypostoma —Plate 5, fig. 3, Plate 18, fig. 5, and Plate 26, fig. 6. The cephala (or only cranidia) and their morphogenetic transformation are presented in diagrams in the text.

The above-mentioned sclerites can serve in determining whether new material of the same or of undescribed taxa belongs to the Dolichometopidae or not; of course, the rest of the described specimens can serve for the same purpose with advantage.

A uniform order is adopted in the descriptions, starting with less, and concluding with more often preserved parts; the cephala are described in the following order: outline; free cheek; posterior sutures and posterolateral limb; anterior sutures, frontal sutures and limb—cranidial border; palpebral lobes and interocular cheeks; occipital lobe and furrow; and, finally, glabella. Cranidial structures are defined in terms of glabellar width and length because the length of the cephalon includes the occipital lobe which is too often incomplete or even lost. To note, the glabellar width is taken on the transverse level of measured distances: for example, the distance of the posterior tips of the palpebral lobes refers to the glabellar width on the level of these tips, and that of the interocular cheeks, on the level across their maximal width. In the pygidium its length without the articulating lobe is quite essential because that lobe is not always there.

Morphological observations that are scattered in the taxonomic descriptions and that refer to various little known structures of the dolichometopids are presented below in alphabetic order—as adopted previously (Öpik, 1967a, p. 52).

Alae: hitherto unknown in dolichometopids, alae are weakly developed in *Deiradonyx barklyensis* nov. and in *Horonastes eminens* nov.; see also under 'bacculae'.

Anterior knobs: small knobs flanking the glabellar front of *Sunia cornunda* nov., *S. lorenzi* nov., and *S. elissa* nov.; also apparently present in *Dolichometopus suecicus* Angelin (Westergaard, 1948, pl. 3, fig. 14) and in several other trilobites (Öpik, 1967a). Their function is unknown.

Anterolateral knobs: a pair of small protections at the anterolateral ends of the frontal border of protaspis (q.v.) of *Fuchouia fecunda* interpreted as reduced cranidial spines; similar but displaced projections in *Undillia, Sunia cornunda,* and possibly *Eurodeois serotina.*

Antiplectrum: a non-segmental extension of the pygidial terminus.

Axial spines: axial spines occur on the occipital lobe and the segments of the thorax; on the pygidium they are missing or indicated by rather low nodes; such a node develops into a spine when the transitory segment is incorporated in the thorax. The spines may have functioned as a composite stabilising dorsal fin (see descriptions of *Fuchouia fecunda*).

Bacculae: 'Swellings flanking the glabellar rear' and homologous with alae (Öpik, 1967a, p. 53) and known (op. cit.) in genera of diverse families. Not mentioned were *Callavia burri* Walcott (1910, pl. 28, figs. 9, 10) of Olenellidae, *Bathyuriscidella* Rasetti (1948, pl. 47, figs. 17, 19) of Dolichometopidae, *Fieldaspis* Rasetti, 1951, and *Churkinia* Palmer, 1968.

Bacculae are present in protaspides (Text-fig. 9) of *Fuchouia fecunda,* but disappear in the course of meraspid morphogenesis.

Baccular ridges: these are a pair of oblique straight ridges seen in the protocephalon of protaspides (Text-fig. 9) arising at the bacculae. They are presumably homologues of the fixigenal crests (cretes fixigenales) described by Hupé (1952) in his *Fallotaspis* (Olenellidae).

Brim: Itydeois (q.v.) is prominent in having its frontal limb consisting of a brim and a rim; a brim is also weakly indicated in *Horonastes, Fuchouia, Sestrostega,* and some other forms; the Dolichometopidae of the Northern Hemisphere are brimless.

Caeca: In most of the polymerid trilobites two pairs of caecal veins belong to a segment (Öpik, 1961) but in the Australian dolichometopids only one—the propleural pair—is evident. See also 'principal vein'.

Clavate glabella: a glabella with a more or less abruptly expanded frontal part as for example in protaspides (q.v.).

Corynoid glabella: an evenly forward expanding glabella.

Cushions (pleural): triangular swellings on the adaxial floor of pleural furrows of the thorax and pygidium reminiscent of the extended ends of the occipital lobe in dolichometopids; pleural cushions occur also among trilobites of other families.

Dorsal fin: see under axial spines.

Exorbitant margin: lateral cephalic margin of the common semicircular outline; it occurs in *Eurodeois, Itydeois,* and *Undillia,* but also in some other unrelated trilobites, as for example *Maladia* and *Nileus.*

Festoons: abaxial swellings of pygidial pleural ribs composing a peripheral garland in *Fuchouia* and *Acontheus.*

Fixigenal spine: I use the term intergenal in reference to the spine borne close to the tip of the posterolateral limb; the designations 'fixigena' and fixigenal' are, however, retained in quotations; see under 'posterolateral limb' and 'interocular cheek'. In passing, 'free cheek' is used in lieu of 'librigena'.

Fossulae: two pairs of small pits close to the flanks of the glabellar front; the anterior fossulae may be placed in some forms at the anterolateral corners of the glabella.

Frontal limb: pleural part of the cranidium laterally defined by the anterior sutures; sometimes called also the frontal area. Its main part is the frontal border; when convex it is the rim; the border may be subdivided into a rim and a brim.

Frontal recess: the occurrence of a median recess (notch) in the glabellar front seems a generality in trilobites, including agnostids; it marks presumably a mesentery; reduced in some, in others it can be developed as a bilobation. The recess is common in Australian dolichometopids (see *Horonastes satelles* sp. nov.).

Fulcra: Pleural fulcra and geniculation are prominent in dolichometopids and in all Corynexochida, from their earliest appearance; secondary reduction of fulcra is nevertheless apparent in *Orria* (Robison, 1967; *Bathyuriscus fimbriatus*). The recess can be accompanied or replaced by a tiny node.

Glabellar node: A median node is evident on the second glabellar lobe (annulus) of the protaspis and early meraspides of *Fuchouia fecunda*; it is homologous (by position and probably by function) with the median node of agnostids as well as some polymerids (Ceratopygidae, *Hedinaspis*, and several asaphids).

Inbent margin of free cheek: in *Sunia* (see Text-fig. 30) and *Dolicholeptus* (Text-fig. 20), as different from the exorbitant margin (q.v.) in Text-figures 24, 26, 28, and 29.

Intergenal spines: the modern term is 'fixigenal spines' (q.v.); these spines, however, are not homologues of the fixigenal spines of anaprotaspides in terms of Palmer (1962), and are interpreted here as rudiments of pleurae (macropleurae) of the pre-cephalisation period. The intergenal spines are also pleural, are present in the metaprotaspis of *Fuchouia fecunda* (q.v.), and are retained in the holaspid period of morphogenesis in most forms with the exception of *Dolicholeptus*.

Interocular cheek: The interocular cheeks are a substantial part of the pleural cephalic structure; their lateral extent is defined in the rear by the fulcral points, in the middle by the palpebral lobes, and in front by the ocular ridges; externally they may be featureless, or have a relief of interocular swells (*Sunia lorenzi, Itydeois vultuosa*, etc.), bacculae, and baccular ridges. Their posterior margin (between the fulcra and axial furrows) is the articulating cephalic margin and is devoid of a doublure. In the literature the interocular cheek is commonly referred to as the 'fixigena' of which it is a major part; see also under 'posterolateral limb'.

Irregular scleritisation in the pygidial terminus in *Fuchouia fecunda* (Pl. 11, fig. 9) and in *Dolicholeptus licticallis* (Pl. 17, fig. 5): 'a reniform window over a patch of the test retained from the preceding exuvia'; the new test, of course, could not spread laterally over, as though secreted from, a piece of sclerite retained from the preceding stadium; the left-over piece may adhere to the new test below it—a reasonable explanation which, however, is ruled out by the abrupt edge of the frame not diving under the left-over piece; a controlling transverse section, however, would involve the sacrifice of another specimen. The whole structure is the result of a localised failure of moulting; the event is casual, because it is followed by a normal successful moult.

Marginal furrows: the posterior (posterolateral) marginal furrows, sometimes called also the pleuro-occipital furrows, have 'blind ends' not crossing the posterior sutures in the Dolichometopids (see *Corynexochus plumula* Whitehouse, in Öpik, 1967a, p. 178); this structure is also apparent in meraspides of *Fuchouia fecunda.*

Median glabellar node: see glabellar node.

Number of cephalic metameres: Six cephalic metameres are evident in the dolichometopids, as indicated for example in *Horonastes eminens* nov. and *Sunia cornunda* nov.; the absence of external expression of the foremost (fifth) glabellar furrows and lobes is no indication of a reduction of corresponding organs although such a reduction under the cover of the hypostoma is a possibility.

A pair of lateral glabellar furrows or a single transcurrent furrow together with the lobe behind belong to a single segment (metamere) as evident from the structure of isolated segments of the thorax and the occipital lobe-and-furrow. The foremost (fifth) glabellar furrow and the fifth lobe behind are regarded therefore as a structural unit. The part of the glabella in front of the sixth cephalic segment may represent either a reduced or an undeveloped metamere devoid(?) of appendages.

Ornament: The ornament in Dolichometopidae consists of granulosity (pustulosity) on a punctate test; some secondary punctation arises apparently through wearing-off of hollow pustules. See also Walcott (1916, p. 331).

Pits in occipital lobe: see *Undillia rustica* nov.

Plectrum: the plectrum is a rearward extension of the cranidial rim in front of the glabella; it is present in *Fuchouia fecunda* and *Dolicholeptus*. For detail see Öpik (1967a, p. 58).

Posterolateral limb: The posterolateral limb is defined by the posterior suture and the rear cranidial margin between the suture and the fulcrum (W, Text-fig. 30); it is a free pleural structure equipped with a doublure passing into the doublure of the free cheek; compare interocular cheek. In sutureless forms a posterolateral limb is not differentiated; in ellipsocephalids and protolenids the larger part of the post-ocular cephalic pleural lobe homologous with the posterolateral limb is included in the free cheek; in dolichometopids and ptychopariids the same part is included in the cranidium as an extremely long posterolateral limb.

Principal vein: a prominent caecal vein of the free cheek in diverse trilobites (Öpik, 1967a, pp. 60 and 172); present in *Fuchouia fecunda* (Pl. 10, fig. 3) and *Sunia lorenzi* (Text-fig. 32).

Propleural vein: see under 'caeca'.

Prosopon of unknown anatomy: bacculae, baccular ridges, cushions, interocular swellings, subsidiary lobules, lateral knobs, glabellar node.

Subocular ridge: a low ridge on the free cheek, about parallel with the eye in *Deiradonyx barklyensis* nov.; a similar structure is evident in some species of *Albertella* Walcott.

Subsidiary lobules: a pair of small and low lobules at the flanks of the glabella in *Itydeois elegans* and *Sunia lorenzi* spp. nov., at either the posterior or second glabellar lobe.

Swells of interocular cheeks: see 'interocular cheek'.

Thickness of the test: In most of the Australian dolichometopids the test is thin and the rigidity of the cephalon is maintained by the framework of deep furrows; in two forms, however (*Undillia lara* sp. nov. and *Dolicholeptus baiatus* sp. nov.) the test is visibly thick.

Transcurrent furrows: In some species (for example *Sunia cornunda*) the posterior glabellar furrows in the holaspides are connected by a weak (vestigial) transverse depression; in some older forms, as for example *Poliellina* Poletaeva, it is well impressed. As a rule, the glabellar furrows are completely transcurrent in protaspides; consequently in the course of morphogenesis they are modified differently in different forms and the retention of the transcurrent structure can be regarded as a primitive character.

SYSTEMATICS

Family Dolichometopidae(?)

Genus **Parapoliella** Tchernysheva, 1956

N. Tchernysheva (1956) established the genus *Parapoliella* in reference to Lermontova's paradigm of specimens of *Olenoides obrutchevi*, 1925, and Suvorova (1964, pl. 2, fig. 1) re-illustrated one of Lermontova's specimens and designated it as the lectotype. A reconstruction of *P. obrutchevi* was also given by Suvorova (see footnote in Tchernysheva, 1960, p. 73) who remarked that *Parapoliella* 'must be placed in the family Yakutidae' rather than in Dolichometopidae, but she still retained it in the superfamily Corynexochoidea.

I think, however, that *Parapoliella* (*P. obrutchevi* in the first place) may represent a separate subfamily of, or even a family related to, the dolichometopids; hence the queried classificaion ?Dolichometopidae is employed here. The reasons for doubt are (1) the very small pygidium, (2) the large number of thirteen segments in the thorax, (3) the prominent granulosity of the test, and (4) the absence of pleural cushions in *Parapoliella obrutchevi*. Its cranidial design however (large posterolateral limbs, relatively narrow front, oblique palpebral lobes with rear tips remote from the glabella, and glabella with parallel flanks but tending towards an expansion of its frontal lobe) is dolichometopid. Less similar are the species with a tapering glabella (as for example, *P. sulcata* Tchernysheva).

Three species, all Siberian, have been attributed to *Parapoliella*; their age, according to Tchernysheva (1960) is the Lower Cambrian Lena stage; it is Ordian in Australian terms.

Parapoliella sp. nov.

Plate 1, fig. 7; Text-figure 1

Material: The available material consists of three fragmentary cranidia in a piece of chert ('ribbon stone') recovered from a collection singed in a fire.

Description: The best preserved cranidium is 5.0 mm long. The posterolateral limb is triangular and large, but its tip in the picture is still immersed in the matrix; some 2 mm of it was subsequently prepared out. The rim is damaged, but its marginal convex and narrow form is partly preserved in the other cranidium. The palpebral lobe is relatively wide (wider than in *P. obrutchevi*), about 0.35x the glabellar length, and less oblique than in the known species. The glabella is almost rectangular (as in *P. obrutchevi*), and bears apparently four pairs of furrows. The front slopes down steeply, but is relatively long as seen in the second specimen. The general appearance of the cranidium compares well with the lectotype of *P. obrutchevi* (Suvorova, 1964, pl. 2, fig. 1) whose glabella is, however, narrower than in our cranidium.

Occurrence and age: The piece of chert with *Parapoliella* was collected by Messrs J. N. Casey and G. Brown at the head of Labortion Creek, Camooweal Sheet area, at an outcrop of Camooweal Dolomite. The chert itself is a 'ribbon stone' of that Dolomite. The age is Ordian.

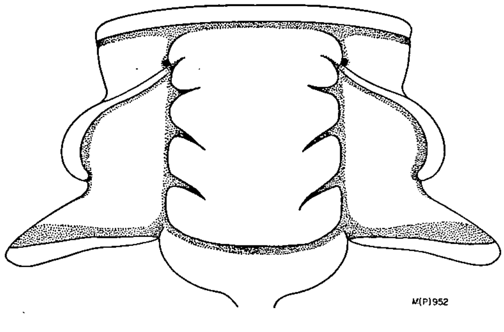


Fig. 1. ***Parapoliella*** **sp. nov., reconstruction of cranidium.**

Family Dolichometopidae Walcott, 1916

Subfamily uncertain

Genus **Deiradonyx** nov.

The type species of the genus is *Deiradonyx barklyensis* nov.

Diagnosis: The name *Deiradonyx* refers to species of Dolichometopidae with a well developed frontal rim, deep frontal (preglabellar) furrow, evenly forward-expanding straight-sided glabella, large subpentagonal occipital lobe with a short marginal median spine, and small semi-elliptical spineless pygidium with two annulations and a bulbous terminus and a narrow border.

Differential diagnosis: Poliella Walcott 1916 is also distinguished by its small pygidium with two axial annulations, but it is elliptical and not semi-elliptical as in *Deiradonyx*; furthermore, the occipital lobe in *Poliella* is simpler, the flanks of the glabella are concave (as in *Bathyuriscus*) and the rim is very narrow and, where present, quite flat, as for example in *Poliella prima* (Walcott) — according to Rasetti (1951, p. 172; pl. 12, fig. 10). Closer than *Poliella* is the new *Horonastes* as discussed under that genus.

The convex, well developed rim and the nearly straight flanks of the glabella of *Deiradonyx* are comparable with *Prozacanthoides* Resser, 1937 (Rasetti, in Harrington & others, 1959, p. 0229) and with the Zacanthoididae rather than with the Dolichometopidae; nevertheless by its remaining characters *Deiradonyx* is still a dolichometopid trilobite. In passing, Rasetti's (1951, p. 139) remarks on the arbitrary separation of the Dolichometopidae and the Zacanthoididae from each other are once more supported by the structure of *Deiradonyx*.

The following characters of *Deiradonyx* deserve mentioning: (1) alae in *D. barklyensis,* which are also evident in *Horonastes eminens* nov.; (2) ocular ridges and the relatively wide distance of the anterior palpebral tips from the axial furrows: (3) the subocular fold or ridge in the free cheek of *D. barklyensis,* reminiscent of *Albertella bosworthi* (Walcott, 1908, pl. 1, fig. 4; 1917, pl. 7, figs. 3 and 3b; Rasetti, 1951, pl. 17); a similar ridge is also evident in *Bathyuriscellus robustus* (Lermontova in N. Tchernysheva, 1960, p. 73); (4) the intergenal spines, a generality in Australian Dolichometopidae; (5) transcurrent rear glabellar furrows in *D. toddi*, reminiscent of *Poliellina*, and *Saukianda*; (6) the extreme marginal position of the occipital spine, a structure reminiscent of some species of *Redlichia*, some ellipsocephalids, *Callavia*, *Fallotaspis*, and others; (7) peculiar is the pygidium of *D. barklyensis* with its very prominent axial lobe.

The following species of *Deiradonyx* are described here: (1) *D. barklyensis*, (2) *D. collabrevis*, (3) *D.* sp. aff. *collabrevis*—all three of Templetonian age, and (4) *D. toddi*, whose age is Ordian.

Deiradonyx barklyensis sp. nov.

Plate 1, figs. 1-4; Text-figures 2, 3

Material: Illustrated are two cranidia and two pygidia selected from a large number of specimens; furthermore, the free cheek incorporated in the reconstruction of the cephalon in Text-figure 3 is not illustrated separately. The matrix is silica and quartz filling the space between the trilobite tests of the coquinoid rock; incrustations of quartz were also removed from the surface of the illustrated specimens.

Holotype: The cranidium Plate 1, figure 1, CPC 18812 is selected as the holotype; it is decorticated but is more photogenic than other available specimens; it was recovered from a collection singed in a fire.

Diagnosis: Deiradonyx barklyensis nov. is a species having a relatively long glabella with a narrow rear, spatulate posterolateral limbs, and a relatively long occipital lobe; it is distinguished by the lateral constriction of the glabella in front of the eyes, wide interocular cheeks, and the relatively large distance of the palpebral tips from the axial furrows.

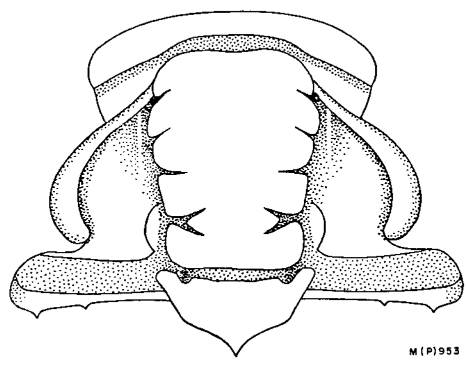


Fig. 2. ***Deiradonyx barklyensis*** **sp. nov., diagram of the holotype cranidium, Plate 1, fig. 1.**

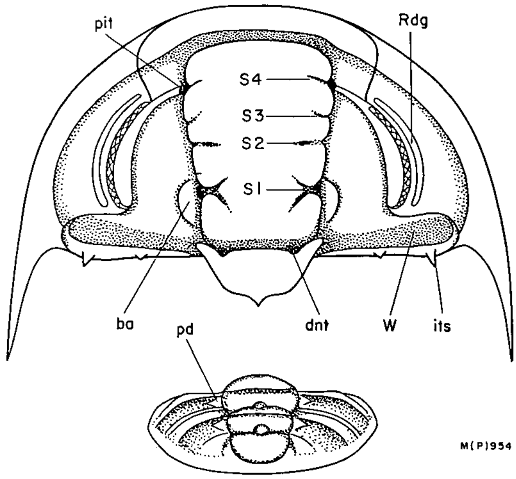


Fig. 3. ***Deiradonyx barklyensis*** **sp. nov., composite diagram; ba—ala; dmt—occipital dent; its—intergenal spine; pd—pleural cushion; pit—posterior fossula; Rdg—subocular ridge on free cheek; S1-S4—glabellar furrows; W—posterolateral limb. The size of the pygidium is inconclusive: a somewhat larger ridge is another possibility.**

Differential diagnosis: In *Deiradonyx toddi* sp. nov. the posterolateral limbs are also spatulate and the glabella long and not narrow but broad in the rear, the interocular cheeks are narrower than in *D. barklyensis*, and the palpebral lobes are closer to the axial furrows; in *D. collabrevis* sp. nov. the rear of the glabella is also narrow as in *D. barklyensis*, but the glabella itself is short and plump, the occipital lobe is short, the posterolateral limbs are not spatulate but triangular, the interocular cheeks are narrow, and the palpebral lobes are close to the glabella. Furthermore, in *D. toddi* and *D. collabrevis* the glabella in front of the eyes is evenly rounded and not constricted as in *D. barklyensis*.

Description: The cephalon is semicircular and moderately arched and has a well developed relief of furrows and lobes. The free cheeks are equipped with moderate undeflected and only slightly advanced genal spines; the border is somewhat convex and well defined by the marginal furrow. Close to, and parallel with, the eye there is a narrow subocular low ridge or fold on each cheek. The anterior sutures diverge slightly; almost straight in front of the eyes they turn within the rim in short curves adaxially. The cranidial front is 0.75x the width across the palpebral lobes. The posterior sutures are slightly sinuous, diametrical, and reach the posterior margin on short cedariform hairpin curves. The posterolateral limbs are spatulate with rounded extremities. The posterolateral furrow is wide and well defined; the posterolateral border is narrow and the marginal intergenal spines are short. These are not preserved in the illustrated cranidia but their presence is evident in an otherwise fragmentary cranidium not illustrated. The frontal area, about 0.2 of the glabellar length, is brimless; the rim is moderately convex, widens abruptly but slightly on the flanks, and the marginal furrow is quite deep.

The palpebral lobes are oblique, crescentic, 0.55-0.6 of the glabellar length, and are continued into the oblique ocular ridges; the palpebral lobes are far apart, the distance of the anterior tips being 0.25×, and of the posterior tips 0.7× the glabellar width from the axial furrows. The interocular cheeks are slightly convex, almost horizontal and wide: the width together with the palpebral lobe is about 0.8×, and in the other cranidium (also shown in Text-fig. 3) about 0.75× the glabellar width. Weakly developed smooth alae are barely discernible flanking the glabellar rear; the anterior part of each interocular cheek carries a short genal bar close to the axial furrow (see also *D. toddi*, Pl. 1, fig. 5).

The occipital furrow is narrow and distinct. The occipital lobe is relatively large (about 0.3× glabellar length), subpentagonal, wider than the glabella, with drawn-out forward-curving extremities, and its anterior margin is dented. Its rear margin bears a short retral claw-like median spine.

The axial furrows are deep, surround the glabella and merge with the frontal marginal furrow. The glabellar flanks are nearly straight: behind the rear glabellar furrows the flanks are subparallel, and then diverge forward till the ocular ridges, where the glabella is the widest, about 1.3× its width at the rear. In front of the ocular ridges the glabella is abruptly contracted although the flanking anterior pits remain indiscernible. The glabellar front is bluntly rounded and in some specimens (the holotype) it has a weak median indentation. In general, the forward-expanding glabella can be described as moderately corynoid in shape. The glabella is moderately arched transversely and elevated above the subhorizontal interocular cheeks; longitudinally its posterior part slopes in a gentle curve whose steepness increases rapidly toward the front and well down from the level of the interocular cheeks—a condition common to all dolichometopids. The glabella of *D. barklyensis* appears in plan as long as 1.3× its rear width, and its chordal length is even somewhat larger. Four pairs of glabellar furrows are present; the posterior (first) furrows are bifurcate and the third are very shallow as in several other dolichometopids; the glabellar lobes are somewhat turned.

The pygidium is small, but not less than an estimated 0.3-0.35× cephalic length. It is transverse semi-elliptical and relatively short, with a length of about 0.4× its width. The anterior, articulating margin is straight, the fulcral points are far apart, at a distance of 0.8× the shield's width from each other; the articulating facets are relatively large; the border is narrow but distinct and the margin is spineless. The pleural lobes are only slightly convex, almost flat, with two pairs of channel-like pleural furrows and only one (anterior) pair of interpleural grooves. The axial lobe is prominent, well elevated over the pleurae, about 0.4 of the shield's width, and reaching the border. Two axial annulations and the bulbous rounded terminus are defined by strong and deep transverse furrows. The axial annulations have a claw-like short median spine each at the rear margin, and the non-functional articulating half-ring of the second annulation is exposed.

The test of *Deiradonyx barklyensis* is densely and minutely punctate.

Comment on illustrated specimens

All available material has been collected at site N27, in the Alroy Sheet area, Northern Territory, some 25 km east from Alexandria homestead at the road to Gallipoli station, in a veneer of a silicified coquinoid resting on the slope of an inlier of Precambrian sandstone.

The holotype cranidium (Plate 1, fig. 1, Text-fig. 2) is 3.9-4.0 mm long; its rim and the palpebral lobes are slightly flattened; it is decorticated, the pustules on its surface are casts of punctae (the test is not granulose but punctate) and the furrows, especially the posterolateral furrows, are wider than externally. The photograph is taken in the plane of the palpebral lobes, and the glabella appears shorter than in the next specimen.

The cranidium Plate 1, fig. 2, CPC 18813 is 5.3 mm long and larger than the holotype. The test is in parts preserved, and is punctate;

in the photograph the front of the specimen is rotated up with the result that the glabella appears more slender and the interocular cheeks narrower than in the holotype; for the same reason the downward geniculated posterolateral limb seems advanced; on the left side of the glabellar front some test is missing and quartz crystals of the matrix are exposed. The rim is undeformed and shows its moderate convexity, the rear of the glabella is flanked by the smooth alae. On the right, the occipital lobe of another, immersed, specimen is emerging.

The (singed) pygidium Plate 1, fig. 3, CPC 18814 is 1.4 mm long and 3.5 mm wide; the border and the spineless margin are preserved; It is an internal cast rough with the casts of the punctae. The top part of the terminus is lost.

The (singed) fragmentary pygidium Plate 1, fig. 4, CPC 18815 is 2.2 mm long; its axial lobe with its bulbous terminus is intact; the non-functional articulating half-ring of the second annulation, as in the previous pygidium, is exposed and the fulcral point of the anterior margin and the right side facet are visible.

Occurrence and age: Deiradonyx barklyensis sp. nov. has been found only at site N27 in the Northern Territory as described above; the coquinoid in which the species is abundant can be regarded as the basal stratum of the Alexandria beds; the age is Templetonian, and close to the beginning of that stage. The associated fauna contains *Xystridura lauta* Öpik, *Kootenia*, a form of Ptychopariidae, an abundance of shields of a relatively large unnamed *Pagetia*, *Peronopsis* (very rare), a *'Helicionella'* (probably *Oelandia*) and a profusion of plates of eocrinoids.

Deiradonyx collabrevis sp. nov.

Plate 2, fig. 1; Text-figure 4

Material: The only material is the illustrated cranidium; its matrix is a soft and friable marl.

Holotype: The illustrated cranidium, CPC 18819, is the holotype.

Diagnosis: Deiradonyx collabrevis nov. is a species with a narrow glabellar rear, narrow interocular cheeks, with palpebral lobes close to the glabella, and an evenly rounded (not contracted) glabella in front of the eyes; it is distinguished by its short and plump glabella, short occipital lobe, simple long and arcuate posterior glabellar furrows, and triangular (not spatulate) posterolateral limbs.

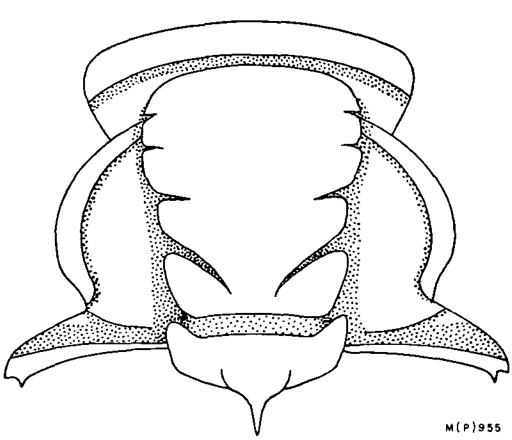


Fig. 4. *Deiradonyx collabrevis* **sp. nov., holotype cranidium restored.**

Differential diagnosis: the differences of *D. collabrevis* from *D. barklyensis* nov. and from *D. toddi* nov. are discussed in the diagnoses of those species.

Description: The holotype cranidium, including the rim but without the occipital spine, is 6.00 mm long; most of the rim is lost, but a part of it is preserved on the right anterolateral corner of the cranidium; this is sufficient for a reconstruction of the whole frontal area (Text-fig. 4). A brim is absent. The test is fractured and parts of it are lost.

The anterior sutures are moderately divergent, straight, and cut the rim in short curves. The frontal cranidial area, about 0.7 of the width across the palpebral lobes, is relatively narrow. The posterior sutures diverge strongly and delineate triangular posterolateral limbs—quite different from *Deiradonyx barklyensis* and *toddi* but not unlike the posterolateral limbs of *Sunia cornunda* sp. nov. (q.v.). The posterolateral marginal furrow is broad and relatively deep. The intergenal spines, close to the tips of the posterolateral limbs, are somewhat short.

The palpebral lobes are long, about 0.65× glabellar length. The anterior palpebral tips are close to the axial furrows, the distance being 0.13× glabellar width; close also are the posterior tips—0.4× glabellar width. The interocular cheek is narrow—0.45× without and 0.55× with the palpebral lobes. The short ocular ridges are prominent. The occipital lobe is relatively short—not quite 0.2× glabellar length; and the median spine rises from a broad base. The occipital furrow is well defined and straight, and the tips of the occipital lobe are turned forward.

The axial furrows are narrow and deep. The glabellar flanks are straight and diverge evenly towards the ocular ridges, and the glabellar front is bluntly rounded. The glabella is corynoid, widest between the ocular ridges, about 1.27-1.3× its rear width; it is also prominently convex and short, as long as about 1.1× its maximal width. Four pairs of glabellar furrows are evident; the posterior furrows curve backward, almost reaching the occipital furrow isolating the posterior lobes, which are slightly tumid.

The test is punctate.

Occurrence and age: Deiradonyx collabrevis sp. nov. comes from an unnamed formation west of Mount Wright, Broken Hill Sheet area, New South Wales (see Öpik, 1967b); associated fossils are *Xystridura fracta* Öpik, *Pagetia,* and *Kootenia* indet.; the age is early Templetonian.

Deiradonyx toddi sp. nov.

Plate 1, figs. 5, 6

Material: Illustrated are two cranidia selected from a small supply of less well preserved specimens; the matrix is black smelly phanerocrystalline limestone.

Holotype: The larger and better cranidium, Plate 1, fig. 6, CPC 18817, is selected as the holotype.

Diagnosis: Deiradonyx toddi nov. is a species with a long glabella, spatulate posterolateral limbs, a relatively long occipital lobe, narrow interocular cheek, palpebral lobes placed close to the axial furrows, and evenly rounded (not contracted) glabellar flanks in front of the eyes; distinguished by its broad glabellar rear and furcate posterior glabellar furrows which are somewhat transcurrent (joined across the glabella).

Differential diagnosis: D. toddi recalls *Deiradonyx barklyensis* by its long glabella, long occipital lobe, and spatulate posterolateral limbs, but differs by its evenly rounded glabellar front, narrow interocular cheeks, and by the position of the palpebral lobes close to the axial furrows; it also recalls *D. collabrevis* by its narrow interocular cheeks, the position of the palpebral lobes, the narrowness of its interocular cheeks, and evenly rounded front, but differs in having a longer glabella, a longer occipital lobe, spatulate posterolateral limbs (triangular in *collabrevis*) and a different structure of the posterior glabellar furrows. *D. toddi* differs from both *barklyensis* and *collabrevis* by its broad glabellar rear, only slightly diverging axial furrows and, therefore, a less well developed corynoid shape of the glabella. The broadness of the glabellar rear and of the occipital lobe are indicative of an axial lobe of the thorax wider than in the other two species.

Description: The holotype cranidium (Pl. 1, fig. 6) is 5.5 mm long without the occipital spine. The anterior sutures diverge quite strongly and the frontal limb of the cranidium, of about 0.85 of its width across the palpebral lobes, is wider than in the other two species. The rim moderately convex on top slopes steeply into the marginal furrow which is unusually deep. The posterior sutures diverge diametrically, then curve forward before turning evenly back to cut the posterior margin. The posterolateral limbs are spatulate and have expanded extremities; the posterolateral marginal furrows are abaxially expanded channels; small intergenal spines are also evident, but ill preserved.

The palpebral lobes are convex and well defined by the palpebral furrows, and about 0.65 of glabellar length—quite large; their anterior tips are placed at about 0.2× and the rear tips at 0.4× the glabellar width from the axial furrows, and therefore very close to the glabella as seen also in *Deiradonyx collabrevis* nov. The interocular cheeks are visibly tumid but narrow—without palpebral lobes 0.4×, and with palpebral lobes 0.6×, the glabellar width. The occipital lobe, 0.3 of glabellar length, is as long as in *barklyensis*; it is carinate and bears the drawn-out marginal median spine (claw); the occipital furrow is narrow and deep.

The axial furrows are deep and merge in front with the marginal furrow. The flanks of the glabella are straight and its front is bluntly rounded. It is broad in the rear, widens forward and attains its greatest marginal width, about 1.1× the width of the rear, on the level of the anterior palpebral tips. The posterior glabellar furrows are deep abaxially and bifurcate; the branches cross the glabella, but are very shallow and enclose a transverse elliptical lobe. The second furrows are simple, short and distinct, and the two anterior pairs of furrows are shallow. The test is punctate, including the rim and the palpebral lobes and the middle large part of the occipital lobe, whose sides, however, are impunctate.

The other illustrated cranidium, Plate 1, fig. 5, CPC 18816, is about 5.0 mm long and smaller than the holotype. Its relief is somewhat subdued, and the glabellar furrows are relatively shallow indicating, apparently, some variability within the species.

The genal bars on the anterior part of the interocular cheeks, close to the axial furrows are quite prominent, more than in the holotype of *D. barklyensis*. Similar bars occur in *Centropleura* (Öpik, 1961b, text-fig. 37, p. 114), in *Liostracina* (Öpik, 1967a) and in some other forms which all are unrelated to each other.

Occurrence and age: Deiradonyx toddi sp. nov. comes from locality AS33, Alice Springs Sheet area; its age is Ordian. For detailed information regarding the associated fauna of AS33 see Öpik (1967b).

Deiradonyx sp. aff. **collabrevis**

Plate 2, fig. 2

The illustrated fragmentary cranidium, CPC 18820, is 3.5 mm long together with the rim which is preserved on the right anterolateral corner. The well expressed corynoid shape of the glabella is reminiscent of *D. barklyensis* and *D. collabrevis*; the glabellar front, however, is unconstricted and the posterolateral limbs appear triangular, favouring a comparison with *collabrevis*. But the free cheeks are wider, the posterior palpebral tips are farther apart, and the glabella seems longer than in *collabrevis*, thus indicating a species different from the latter. The structure of the glabellar furrows, however, and the loss of the occipital lobe in the specimen in hand necessitate an open species nomenclature.

The free cheek of a *Pagetia* broke the roof of the glabella.

Occurrence and age: The illustrated specimen comes from the Beetle Creek Formation, May Downs, Mount Isa Sheet area of Queensland, locality M434; the same form has been recorded in collections from Beetle Creek itself. The age is Templetonian.

Genus **Sestrostega** nov.

The type species of *Sestrostega* is *S. tosta* nov.; it is a monotypical genus.

Diagnosis: Sestrostega refers to Dolichometopidae combining (1) a forward expanding (clavate) glabella with concave flanks and imperceptible glabellar furrows and (2) a frontal area consisting of a convex brim and a flat rim.

Differential diagnosis: The shape of the glabella is remotely reminiscent of some Siberian species of *Chilometopus* lacking glabellar furrows but having a well developed punctation as described by Suvorova (1964); in these forms the frontal border is, however, very narrow and not differentiated into a brim and a rim. Even more different is *Chilometopus* Rusconi, 1952, with a very narrow rim, 'practically cylindrical glabella' (Poulsen, 1958, p. 8) and well impressed glabellar furrows. Further comment is given under *Itydeois* (q.v.).

Sestrostega tosta sp. nov.

Plate 2, figs. 3, 4; Text-figure 5

Material: The available material consists of two cranidia, of which one buried in the silica of the matrix shows only its frontal part. The rock is a coquinoid of trilobite tests transformed into quartz.

Holotype: The exposed cranidium, CPC 18821, is the holotype; its frontal margin is damaged, but its structure is evident in the associated fragment of a larger cranidium.

Diagnosis (supplementary to the diagnosis of the genus): The diagnostic characters of the species *S. tosta* are (1) the long palpebral lobes, angulate in the middle; (2) the distinct and evenly narrow occipital furrow; (3) the well developed punctation of the test; and (4) the proportions of the cranidium.

Description: The holotype cranidium is 7.0 mm long to the tip of the occipital spine; the associated fragment represents a cranidium about 12 mm long. The anterior sutures diverge moderately and are slightly convex; the posterior sutures are directed diametrically to each other, delineating narrow spatulate posterolateral limbs; these are abruptly geniculate and possess intergenal spines close to the tips. The posterolateral marginal furrow is narrow, distinct, and peters out before reaching the posterolateral tip. The frontal area, about 0.23-0.25 of glabellar length, consists of an almost flat rim and a convex brim separated from each other by a shallow furrow; the frontal margin is evenly arched in plan as well as upward.

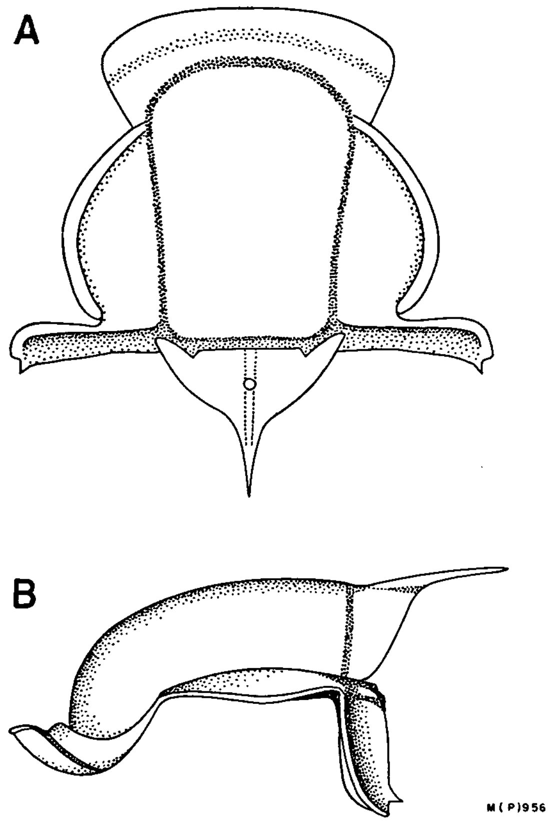


Fig. 5. ***Sestrostega tosta*** **sp. nov., holotype cranidium restored.**

The palpebral lobes are long, with their posterior tips level with the glabellar rear; the anterior tips, well apart, are close to the axial furrows, and the ocular ridges are therefore short. The palpebral furrows are narrow but distinct, with an angulate change of direction in the middle. The interocular cheek is slightly convex and about 0.5 of the glabellar width.

The triangular occipital lobe is relatively large, weakly carinate, and the median spine of its margin is flat and does not rise above the longitudinal profile. A tiny subcentral node is also discernible on the occipital lobe; the occipital dents are short. The occipital furrow is narrow—a rare structure in the dolichometopids.

The axial furrows are shallow but surround the glabella without interruptions. The glabellar flanks are concave and the glabella expands forward to about 1.3× its rear width; in plan its length is about 1.7× its rear width; it is a 'regular dolichometopid' moderately clavate glabella. Glabellar furrows are undeveloped but are indicated by four pairs of indistinct smooth spots which suppress the punctation of the test.

Occurrence and age: Sestrostega tosta gen. nov. et sp. nov. comes from locality M188, on the Barkly Highway, Mount Isa Sheet area. The outcrops (in a sandy playa) of chert, siliceous siltstone, and pods of silicified coquinoids, are attributed to the Beetle Creek Formation; associated fossils are *Xystridura templetonensis* (Chapman), *Pagetia* sp., *Lyriaspis sigillum* Whitehouse (abundant), another form of Ptychopariidae, and a *'Helcionella'*; the age is Templetonian.

Subfamily HORONASTINAE nov.

Genus **Horonastes** nov.

The type species of *Horonastes* is *H. eminens* nov.

Diagnosis: Horonastes refers to Dolichometopidae with a rim and a short convex (angulate) brim, narrow palpebral lobes, two pairs of fossulae, five pairs of glabellar furrows, and narrow free cheeks; distinguished by its evenly broad (not clavate or corynoid) glabella and the hypostoma having a flat marginal flange in its posterior part and not the usual prominent raised border.

Furthermore, the cephalon is parabolic (not semicircular or semielliptic), the genal spines are triangular and flat, alae are present, the axial spines are short, and the pygidium is small, with two well developed axial annulations and a slightly convex and sloping border.

The two named species of *Horonastes* (*eminens* and *satelles*) share the pygidium and the hypostoma, which cannot be used in their discrimination; the structure of these shields is therefore of a superspecific significance.

Four species belong to *Horonastes:* (1) the type of the genus—*H. eminens* sp. nov; (2) *H. satelles* sp. nov.; (3) *Horonastes* sp. A (aff. *eminens*) and (4) *Horonastes?* sp. B (aff. *eminens*). Of these *H.* sp. A is distinguished by its long frontal area; *Horonastes?* sp. B has a slightly corynoid (clavate) glabella and a flat brim, and offers the following two possibilities: (1) it may represent a generic group different from, but related to, *Horonastes*, or (2) when definitely included in *Horonastes* the diagnosis of that genus should be modified accordingly. The material in hand, however, is insufficient for a definite conclusion.

Differential diagnosis: Within the Order Corynexochida only in *Corynexochus* itself does the hypostoma have a flat convex flange but no raised border, as in *Horonastes*; in *Horonastes*, however, the rostral shield and the hypostoma are separate sclerites and are not fused into a single unit as in *Corynexochus* and in all Dolichometopidae and Zacanthoididae of the Northern Hemisphere.

Two pairs of fossulae are evident in several dolichometopids, as for example in *Sunia cornunda* sp. nov. (q.v.) and *Bathyuriscus* (Robison, 1964, p. 534), but none is evident in *Deiradonyx* nov. The absence of fossulae is, however, an unreliable taxonomic character, affected by the quality of the material and by the degree of emphasis in the development of these very small features. Five pairs of glabellar furrows occur also in *Sunia cornunda*; the usual number so far recorded in the literature is four. In *Sunia* the pygidium is larger than in *Horonastes*, the axial spines are very long, and a brim is absent; *Eurodeois* differs from *Horonastes* by the same characters and by its exorbitant free cheeks. The narrowness of the palpebral lobes and the presence of a brim are shared by *Horonastes* and *Itydeois*; in the latter, however, the brim is flat, the pygidium is larger, and the cheeks are exorbitant.

In *Fuchouia fecunda* nov. a brim develops in maturity, but otherwise its difference from *Horonastes* is recognisable at a glance. In several other dolichometopids, as in *Horonastes*, the glabellar flanks are subparallel; it is, however, significant that the glabellar front in *Horonastes* is about as wide as in the corynoid or clavate forms which have a slender postocular part of the glabella; *Horonastes*, however, is peculiar in having in maturity the glabellar rear broad as well, and structurally reminiscent of *Deiradonyx toddi* sp. nov. The free cheek is narrow as in *Glossopleura* and *Anoria* in which, however, the suture cuts the rear cephalic margin not at the base of the genal spine as in *Horonastes*, but at a fair distance from it. The pygidium of *Horonastes* is as small as in *Deiradonyx barklyensis* but is structurally different; it recalls also the pygidium of *Undillia rustica* sp. nov., whose axial lobe, however, and the caudal shield itself are longer. *U. rustica* also has short spines, but its frontal area, free cheeks, glabella, and hypostoma differ structurally from *Horonastes* in the following ways: (1) the frontal area is flat and undivided, (2) the free cheek is broad and exorbitant, (3) the glabella is slender and tapering forward, and (4) the hypostoma has no flange but a rather prominent border.

Horonastes eminens sp. nov.

Plate 4; Plate 5, figs. 1-6; Text-figure 6

Material: The described and illustrated material consists of:

5 cranidia (selected from a total of about 40)
1 rostral shield

1 free cheek (selected from a total of 10)
1 hypostoma (selected from a total of 7)
3 pygidia (selected from a total of 25)

Furthermore, the middle part of the thorax has been used in the descriptions but not illustrated. Most of the material (all from a single site, M179) is fragmentary, fractured, or crushed. The matrix is grey sandy and hard limestone.

Holotype: The cranidium Plate 5, fig. 2, CPC 18838 has its test complete and is therefore selected as the holotype.

Diagnosis: Horonastes eminens sp. nov. has a relatively short frontal area, about 0.18-0.2 of the glabellar length; the frontal area is subdivided into a brim and a convex rim by a broad furrow with blind ends not reaching the sutures; its glabellar furrows are conspicuously deep; in the pygidium the second axial annulation has a V-shaped retral peak on its posterior margin, with a node in the angle.

Differential diagnosis: H. eminens and *Horonastes* sp. A (aff. *eminens*) share a similar cranidial structure, but in sp. A the frontal area, being 0.28-0.3 of the glabellar length, is visibly longer than in *H. eminens*.

Horonastes satelles nov. has a concave rim (convex is *eminens*) and narrower interocular cheeks.

Description: Horonastes eminens nov. may have attained an estimated 40 mm in length—an average size for a dolichometopid trilobite. The number of segments in the thorax is, however, unknown; a fair guess is about 8 or 9, but more than 10 would be an over-estimation. The cephalon (reconstructed in Text-fig. 6) is parabolic in outline, of a prominent convexity in its transverse profile. The pygidium is small, estimated 0.3-0.35 of the cephalic length. The axial lobe is arched above the pleurae, the pleural fulcra are prominent,

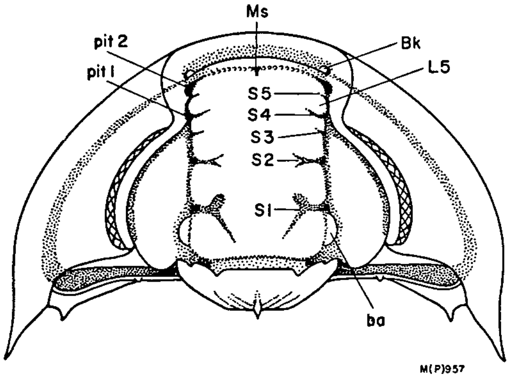


Fig. 6. ***Horonastes eminens*** **sp. nov., composite diagram of cephalon. ba—ala; Bk—interocular knob on border; L5—the fifth glabellar lobe; Ms —frontal glabellar recess (compare Text-fig. 5); pit 1—posterior fossula; pit 2—anterior fossula; S1-S5—glabellar furrows. L5 and S5 are the foremost lobe and furrows of the fifth (foremost) metamere.**

and the articulating pleural facets are well developed indicating good articulation, and alertness in swimming and walking alike.

The free cheek is narrow and reminiscent in this aspect of *Glossopleura* and *Anoria* in which the posterior suture cuts the margin at a distance from the genal spine greater than in *Horonastes eminens*. In its narrowness it also recalls *Fuchouia labda* sp. nov. (q.v.). The cheek is punctate and even externally delicately venulose; stronger oblique veins are developed on the posterior part of the border. The border itself is relatively wide and the marginal furrow is shallow. The lateral margin is evenly and gently curved, but at the spine the curvature is stronger and somewhat exorbitant. The doublure (seen in an unillustrated specimen) is very narrow, about half the width of the border; at the exorbitant part a narrow flange is evident externally and on the doublure, and the ventral side of the genal spine is part of that flange, and not a direct continuation of the convex doublure. The genal spine is triangular, flat, and short, with a small drawn-out point. The posterior sutures are almost diametrical and slightly sinuous, and delineate long and narrow spatulate posterolateral limbs sloping down from the fulcral geniculation. The distal intergenal spines are short. The posterolateral marginal furrow is a broad channel bounded in the rear by an elevated ridge or vein which runs close to the margin.

The anterior sutures diverge only slightly, creating quite narrow lateral wings of the frontal limb. The limb is short, in plan some 0.17-0.18 and along its slope 0.2 of the glabellar length. Its structure is seen best in Plate 4, figs. 2-2b: (1) the margin is arched evenly forward; (2) the rim is moderately convex; (3) the brim slopes forward and is crested or angulate; and (4) the marginal furrow separating the rim from the brim is broad and has its end blind and in line with the glabellar flanks.

The palpebral furrows are narrow and well defined; the palpebral lobes are narrow, arcuate, and long, and slightly variable, about 0.7-0.75 of the glabellar length; their anterior tips are very close to the axial furrows (at the distance of the width of the palpebral lobe), and the posterior tips are placed at a variable distance of 0.4× to 0.5× the glabellar width; the interocular cheeks are moderately wide—together with the palpebral lobes 0.6 of the glabellar width; they are moderately swollen and the swelling intrudes the adaxial part of the posterolateral furrows—a structure seen in most of the dolichometopids of this Bulletin.

The occipital lobe is wide, about 1.3-1.35 of the glabellar width, and about 0.20-0.24 of its length, crescentic and somewhat truncate in the rear; the occipital spine is short, marginal, and an extension of a weak median carina; two pairs of indentations are apparent in its front; a chevron of rugulosity is occasionally visible on the middle rear of the occipital lobe. The occipital furrow is well defined in front and rear, quite deep, and relatively narrow.

The axial furrows flanking the glabella are well impressed, but the frontal, circumglabellar furrow is developed only as a faint line and an abrupt change of slope from the steep glabellar front to the gently sloping brim.

Along the axial furrows the following features are visible: (1) the alae; these are small elongate semi-elliptical spots at the posterior glabellar lobe; (2) posterior fossulae (commonly called anterior pits)—small impressions at the adaxial ends of the ocular ridges; and (3) the anterior fossulae—elongate depressions at the anterolateral corners of the glabella.

The glabella, as wide as 0.64× (Pl. 5, fig. 5) to 0.7× (in larger specimens) its length, and equally wide fore and aft, has a bluntly rounded front with a shallow median notch (Pl. 4, fig. 2b). The flanks of the glabella are, however, not straight but very gently concave about the second glabellar furrows; its width there is 0.9× the width of the rear (or front) of the glabella. In anterior profile the glabella is evenly convex. Sagittally it is evenly arched sloping forward to its quite steep front.

Five pairs of glabellar furrows are evident in *Horonastes eminens*. In young specimens (Pl. 5, fig. 5) these furrows are short and weak, but in mature specimens they are conspicuous: (1) the posterior furrows are broad and deep, but adaxially bifurcate with shallow branches; the posterior branches tend to meet across the glabella; (2) the second furrows are somewhat weaker than the first; (3) the third furrows, behind the palpebral tips are relatively weak and short—a frequent structure in the dolichometopids; (4) the fourth furrows are narrow, simple, and slanting toward the ocular ridges—an arrangement seen in diverse trilobites; (5) the fifth furrows are inconspicuous and close to the glabellar front; they are well visible in frontal view in Plate 4, fig. 2b. Further comment on the fifth glabellar furrows is found in the descriptions of *Fuchouia fecunda* sp. nov. (morphogenesis) and of *Sunia cornunda* sp. nov.

The lobes between the furrows are moderately tumid. Muscle spots are often visible at the adaxial ends of the glabellar furrows. The rostral shield is mentioned in the comment on the holotype. In the hypostoma the marginal flange has a pair of short lateral spines on a level with the rear of the maculae; these are quite prominent, obliquely set nodes. The frontal border is vertical as in other Australian dolichometopids.

The cranidial test is smooth, and punctate; the punctation is generally obscure, but still visible on the occipital lobe and in the middle of the posterior part of the glabella.

As regards the structure of the thorax the following observations are available: (1) the axial lobe carries short reclined marginal median spines and its test is densely and minutely granulose; (2) connected with the axial annulations triangular cushions extend into the pleural furrows, which are broad; (3) pleural fulcra are prominent, at a distance of 0.5 of the axial width from the axial furrows; the same relative distance is evident in the cranidium and the pygidium; (4) facets, extending to the fulcra, are well developed; and (5) the pleural tips are short, more or less retral spines.

The pygidium which is attributable either to *eminens* or *satelles* is transverse semi-elliptical to almost semicircular (larger shields), with a length between 0.4× and 0.48× the width. The rear is slightly emarginate; marginal spines are absent with the single exception of Plate 4, fig. 4 which shows rudimentary anterolateral spines. The articulating half-ring is large and convex; the fulcra are placed at the distance of 0.45-0.5 of the width of the axial lobe from the axial furrows, and the facets are well developed. The border is quite wide and, when unflattened, slightly convex and outward sloping. The doublure is narrow, visibly narrower than the border—as in the free cheek. The pleural lobes are only slightly convex. Three pairs of broad, channel-like pleural furrows with adaxial triangular cushions are distinct; two anterior interpleural partitions are indicated as fused delicate ridges; three pairs of propleural branching caecal veins are well developed internally on a background of delicate reticulation. Reticulate veins prevail also around the terminus, and obscure veins are visible on the posterior part of the border.

Each pleura has only one (propleural) vein, and opisthopleural veins are absent.

The axial lobe rises well above the pleurae, tapers moderately and almost reaches the marginal furrow. In the anterior annulation a low marginal spine, or even a transverse crust, overhangs the exposed non-functional half-ring of the second segment; the second annulation is V-shaped in the rear, with a node in the angle; and the third annulation is short and incomplete being indicated by weak lateral furrows. The terminus is short and prominent. The pygidial test is probably punctate on the pleurae and minutely granulose on the axial lobe.

Morphogenesis (Pl. 5, figs. 5, 6)

In the 'comment on illustrated specimens' the cranidia are described in an arrangement leading to morphogenetic conclusions. The early meraspides of *Horonastes eminens* and *Fuchouia fecunda* are rather similar to each other; in these the clavate shape of the glabella is a generality of 'larval' Corynexochida. The frontal area develops in both forms simultaneously, but with the difference of a plectrum in *F. fecunda* and a continuous marginal furrow in *H. eminens*. There are differences, however, in the development of the glabella: in *F. fecunda* the glabella remains slender in maturity, whereas in *H. eminens* it gains in width; the glabellar furrows appear in *F. fecunda* in the late meraspides, but remain undeveloped and become vestigial in maturity, whereas in *H. eminens* these furrows gain in emphasis in holaspid instars. Furthermore, bacculae are a transient feature in 'larval' *F. fecunda*, corresponding to alae of the mature *H. eminens.*

Comment on illustrated specimens

All specimens belong to the collections from a single site (M179). The cranidia (below) commented upon are arranged according to decreasing size; the smallest is Plate 5, fig. 6.

The cranidium Plate 4, fig. 1, CPC 18833 is 13.0 mm long and the largest in the paradigm. The glabella, as wide as 0.7× its length, is broader than in the smaller specimens and its flanks are almost imperceptibly concave; the interocular cheeks are visibly tumid, and the small alae close to the rear glabellar lobes are indicated; the front of the occipital lobe has two pairs of dents, and a chevron of rugulosity in the rear.

The holotype cranidium, Plate 5, fig. 2, is 11.4 mm long. Its glabella, about 0.65 of its length, is slightly narrower than in the largest specimen. On the left, an isolated rostral shield is exposed, showing terraced lines. The cranidium is complete with both posterolateral limbs.

The cranidium Plate 4, fig. 2, CPC 18834 is 11.0 mm long. At the adaxial ends of the glabellar furrows, slightly depressed 'muscle spots' are developed; the anterior fossulae are large, but the posterior ones are barely indicated. In frontal view the foremost fifth pair of glabellar furrows, the frontal notch, and the transverse roof-like profile of the glabella are evident. The glabella's front is slightly wider than its rear.

The cranidium Plate 5, fig. 5, CPC 18841 is 4.5 mm long. The glabellar furrows are weak, and the glabella is parallel sided; the frontal area is, however, fully developed, with its relatively flat rim and convex brim separated from each other by the channel-line marginal furrow with blind ends.

The immature early meraspid cranidium Plate 5, fig. 6, CPC 18842 is 1.0 mm long. The rim is convex and no brim is apparent; the glabella, rather wide in front, is corynoid to clavate; the glabellar furrows are small pits, connected by transcurrent metameric depressions; the second and third glabellar lobes carry a tiny median node each—all features seen also in *Fuchouia fecunda* Plate 12, fig. 10, which is of the same size. The posterior (adocular) fossulae are very deep and the test is minutely granulose.

The hypostoma Plate 5, fig. 3, CPC 18839 is 4.3 mm long. Note the marginal flange in its posterior part, the prominent maculae, the angular margin in the middle part, and the somewhat obscure ornament.

The free cheek Plate 5, fig. 4, CPC 18840 is 12.0 mm long to the tip of the genal spine. Obliquely directed veins are present on the border in proximity to the genal spine, the rim is punctate, and the rest is delicately venulose and punctate.

The pygidium Plate 4, fig. 3, CPC 18835 is 4.0 mm long without the articulating half-ring. It is associated with the cranidium Plate 4, fig. 1. The rear is slightly emarginate; the doublure is narrow lining the border. The test is preserved, and the external relief is therefore less prominent than in peeled specimens. It is also slightly flattened. On the right, the base of a small marginal spine of the anterior segment is evident.

The pygidium Plate 4, fig. 4, CPC 18836 is also 4.0 mm long without, and 4.6 mm with, the articulating half-ring; the test is absent. Only the anterior interpleural 'groove' (fused, and ridge-like) is evident; behind it stands out the prominent propleural vein of the second segment.

The pygidium Plate 5, fig. 1, CPC 18837 is 5.5 mm without, and 6.2 mm with, the articulating half-ring; it is decorticated, but only little flattened showing the mild convexity of the border. Two pairs of fused interpleural partitions are evident and three pleurae are equipped with branching propleural veins. Around the terminus only reticulate veins are developed; obscure veins are present even on the posterior part of the border. The two axial annulations are well developed and the retral peak of the margin of the second annulation is stronger than in the smaller pygidia. In the terminus a third short annulation is indicated by a pair of shallow depressions disconnected in the middle.

Occurrence and age: Horonastes eminens sp. nov. has been found only at site M179, in the Mount Drummond Sheet area, Northern Territory.

The rock is a grey, sandy and smelly limestone attributed to the Currant Bush Limestone; its age is the Zone of *Ptychagnostus atavus.*

Horonastes satelles sp. nov.

Plate 31, figs. 2, 3; Plate 32, figs. 1, 2; Text-figure 7

Material: Illustrated are one free cheek, a rostral shield, and three cranidia selected from a total of about 15 specimens, most of which are crushed and incomplete.

Holotype: The largest cranidium, Plate 31, figs. 2a-c, is selected as the holotype; its test is worn, but it is unflattened with a well preserved general relief.

Diagnosis: Horonastes satelles is distinguished by its concave and slightly upturned rim, narrow interocular cheeks, and carinate glabella.

Differential diagnosis: see under *H. eminens.*

Description: The hypostomata, rostral shields,

Fig. 7. *Horonastes satelles* **sp. nov., same specimen as Plate 32, fig. 1. Note the delicate preglabellar ridge with a node on each end and the frontal recess (notch) with its low median node.**

and pygidia associated with the cranidia of *Horonastes satelles* nov. cannot be distinguished from *H. eminens* (q.v.); equally similar are the longitudinal profile, the course of the cephalic sutures, the shape of the posterolateral limbs, and the short, small size of the posterolateral limbs, and the short, small size of the occipital spine and the axial spines of the thorax as well as the structure of the pleurae. The description that follows refers therefore to structural dissimilarities between *H. satelles* and the more fully described *H. eminens.*

The free cheek of *H. satelles* is also relatively narrow, but has an evenly curving margin and undeflected short genal spine and lacks the exorbitant curvature seen in *eminens.*

The frontal area, variable from 0.16-2.0 of glabellar length and close to that of *eminens*, has its rim concave—almost completely replaced by the rather wide marginal furrow; the ends of that concave channel are, however, blind (as in *eminens*) and the extremities of the frontal limb at the sutures are convex, about as convex as the border of the free cheeks. The brim is angulate and crested and has a prominent node on each of its ends that are also present in *Horonastes* sp. A, but barely indicated in *eminens.* The palpebral lobes, around 0.75 of the glabellar length, are relatively narrow and flat and close to *eminens*; the interocular cheek together with the palpebral lobe is 0.5 of the glabellar width; without the palpebral lobe it is 0.43-0.45 of the glabellar width; it is visibly narrower than in *eminens.* The axial furrows are deep, but alae are invisible and the fossulae are vestigial. The occiptal lobe is only slightly wider than the glabellar rear, and has only one pair of dents (*eminens* has two pairs). The flanks of the glabella are almost imperceptibly concave; its width (in front and rear) is 0.7× its length—the glabella is somewhat plumper than in *eminens.* The glabellar crest (compare Plate 31, fig. 2b with Plate 4, fig. 2b of *eminens*) is not rounded but almost angulate and carinate and the front has a notch whose structure is described in the comment below. The glabellar furrows (five pairs are also evident) are relatively short, and weaker than in *eminens.* The cranidial test is quite thick, as seen in the decorticated specimen Plate 32, fig. 1. The test is especially thick along the furrows which are gaping wide in internal casts, but narrow externally.

Comment on illustrated specimens

The holotype cranidium, Plate 31, fig. 2, CPC 18987, is 11.0 mm long. Sand grains of the matrix create a quasi granulosity. The left posterolateral limb is preserved; the convexity of the interocular cheeks is evident in frontal view, and the concavity of the rim in lateral view.

The cranidium Plate 31, fig. 3, CPC 18988 is 7.0 mm long. It is flattened, but has its punctate test preserved. The rear part of the occipital lobe is lost. The glabellar flanks are slightly concave.

The cranidium Plate 32, fig. 1, CPC 18989 is 8.8 mm long. It is decorticated and the sand grains of the matrix are just visible. The weak carina bifurcates forwards and flanks the triangular frontal notch. The proximal short ends of the caecal veins fringe the glabellar front.

The free cheek Plate 32, fig. 2, CPC 18990 is 8.8 mm long; it is associated with an isolated rostral shield in a cluster of four crushed cranidia of *H. satelles;* visible is a small cranidium preserving its tiny occipital spine.

Occurrence and age: Horonastes satelles nov. comes from the limestone at site M179 in the Mount Drummond Sheet area, Northern Territory, and is associated with *H. eminens.* The sequence is attributed to the Currant Bush Limestone and the age is the Zone of *Ptychagnostus atavus.* Details of the occurrence are given under *H. eminens.*

Horonastes sp. A (aff. **eminens**)

Plate 5, fig. 7

The material consists of the illustrated cranidium, CPC 18843, 8.4 mm long. It differs from *H. eminens* by its visibly longer frontal area, about 0.28-0.3, and somewhat longer palpebral lobes, about 0.75 of glabellar length. Furthermore the glabellar front is wider than the rear, and the rugosity of the occipital lobe is relatively strong.

Occurrence and age: The specimen comes from the Northern Territory site M179—the same as of *Horonastes eminens*; the rock is attributed to the Currant Bush Limestone; the age is the Zone of *Ptychagnostus atavus.*

Horonastes? sp. B (aff. **eminens**)

Plate 5, fig. 8

The material consists of the illustrated crandium, CPC 18844, 5.4 mm long. It differs from *Horonastes* gen. nov. by its relatively flat rim, open (not blind) ends of the frontal furrow, strongly concave glabellar flanks, and the wide glabellar front, about 1.2× its rear width. The glabella is also long, the rear width being only 0.58× the length, and the glabellar furrows are rather weak. The ornament consists of punctae and scattered granules. The structure of the rim and of the occipital lobe recalls *Horonastes,* but the glabella recalls *Eurodeois deois* (Walcott) and even *Sestrostega* nov. The generic classification of *H.?* sp. B as *Horonastes* (or any other genus) is therefore queried.

Occurrence and age: Horonastes? sp. B (aff. *eminens*) comes from site M183, Lawn Hill Sheet area, Queensland (listed under Mount Drummond, Northern Territory in the Geographic Distribution table). The matrix is grey limestone attributed to the Currant Bush Limestone; the age is the Zone of *Ptychagnostus atavus* (early part) or even late *Triplagnostus gibbus* Zone (Templetonian).

Genus **Fuchouia** Resser & Endo, 1937

The type species of *Fuchouia* is *Bathyuriscus manchuriensis* Walcott, 1911 (also 1913; 1916).

The pygidial structure is diagnostic in the first place in the identification of this genus: (1) the pygidium is relatively large, (2) its axis is long, (3) the pleural furrows and ribs are swept rearward, reaching close to the margin, (4) the border is very narrow or even obscure, and (5) the doublure is extremely narrow. In the cephalon the margin of the free cheek is evenly curved (not exorbitant), but the frontal area may be brimless, or have a plectrate brim, and the glabella varies from species to species; it can have parallel or concave flanks, an expanded front, vestigial as well as impressed lateral furrows. Glabellar flanks convex in plan occur only as an accidental and unique deformation in a cranidium of *F. manchuriensis* (Walcott, 1911, pl. 16, fig. 4; 1913, pl. 23, fig. 2; 1916, pl. 49, fig. 46); the glabella of this cranidium figures in the currently published reconstructions (Kobayashi, 1942, pl. 3, fig. 7; Harrington & others, 1959, p. 0223, fig. 163-10a) and in the diagnosis of *Fuchouia* by Suvorova (1964, p. 48) which reads: 'the glabella has outward convex flanks'. The glabella of *Fuchouia manchuriensis,* however, is corynoid in immaturity (Kobayashi, 1942) and retains a slightly expanded front even in the largest known specimens.

The known species of *Fuchouia* can be grouped according to the length of the palpebral lobes as follows:

Group A. Palpebral lobes short (less than 0.5 of glabellar length): the Asian *Fuchouia manchuriensis*, *F. quadrata* Resser & Endo, *F. chiai* Lu, *F. spinosa* Chang, and the Australian *F.? bensoni* (Öpik).

Group B. Palpebral lobes of medium length (0.5-0.55 of the glabella): only one species—*F. atopa* nov.

Group C. Palpebral lobes long: *Fuchouia fecunda* nov., *F. morstonensis* nov., *F. labda* nov.

The species of group A (with short eyes), are younger than the Australian species of groups B and C. The late Middle Cambrian age of the Asian species is evident from the charts of Chang (1957).

Fuchouia has been regarded hitherto (Kobayashi, 1942; Harrington & others, 1959) as a subgenus of *Amphoton*; '*Amphoton*' in this context means, however, *Dolichometopus deois* Walcott (*Eurodeois deois* in this Bulletin) and not *Amphoton* Lorenz (q.v.). *Eurodeois* differs from *Fuchouia* by its pygidium and by the exorbitant cephalic flanks, and both are regarded here as separate genera, each in its own right. Nevertheless, they are affiliated, having a similar hypostomal structure and not very different glabellar structure.

No type specimen has been designated either for *manchuriensis* or for *quadrata*. Resser & Endo (op. cit.) mention as the 'holotype' of *manchuriensis* Walcott's specimen USNM 57587; there are, however, three cranidia and two pygidia in the piece of shale with that number, and one is the abovementioned cranidium with the convex glabellar flanks. Of *Fuchouia quadrata* Resser & Endo, four specimens are illustrated in their pl. 39, figs. 1-4 and designated as paratypes; the free cheek fig. 3 is not dolichometopid at all; the cranidium, fig. 1 is fragmentary, and the cranidium fig. 2 is a *Fuchouia* with short palpebral lobes and well impressed glabellar furrows; and fig. 4 is a well preserved *Fuchouia* pygidium with five axial annulations.

Fuchouia fecunda sp. nov.

Plates 6-8; Plate 9, fig. 1; Plate 10, figs 3, 4; Plates 11-13; Text-figures 8a-17

Material: The material presented here consists of 36 specimens comprising five more or less complete exoskeletons, three free cheeks, two hypostomata, eleven pygidia, twelve cranidia, and two protaspides. This unusually large number of specimens of a single species is necessary (1) for the taxonomic description involving holaspides and a number of meraspid instars, and (2) for the presentation of the morphogenesis of the trilobite from the protaspis to the holaspis. The morphogenesis is presented separately under its own heading. The specimens were selected from an ample supply of material.

Holotype: The complete exoskeleton Plate 7, figs. 1a & 1b, CPC 18847 is available in both counterparts; of the other specimens two are somewhat incomplete and the third (Pl. 7, fig. 2) is a meraspis with seven segments in the thorax.

Diagnosis: Fuchouia fecunda sp. nov. possessess a rim and a plectrate brim, slightly concave glabellar flanks, a slightly expanded glabellar front, almost obsolete short glabellar furrows, moderate axial spines in the occipital lobe and thorax, nine (in latest meraspis, eight) segments in the thorax, a pygidium slightly longer than half the cephalon with four (in latest meraspis, five) axial annulations, and is distinguished by long palpebral lobes (0.7 of glabellar length) and festooned periphery of the pygidium. The following specimens enumerated in the comment (below) represent *F. fecunda*: the complete specimens 1-5; specimen 11 (cranidium); specimens 16-19 (cranidia); specimens 20-29 (pygidia); and specimens 6-9 (free cheeks and hypostomata); also the protaspides and meraspid cranidia that are described in the section on morphogenesis.

Differential diagnosis: see *F. labda* sp. nov., *morstonensis* sp. nov., and *atopa* sp. nov.; other species are discussed in the description of the genus *Fuchouia.*

Description: The structure of *Fuchouia fecunda* as a whole is presented in Text-figure 8; the flattened end of the exoskeletons Plate 6 and Plate 7 served as sources for the reconstruction, which is drawn in disregard of the slope of the free pleurae, posterolateral limbs, and free cheeks. This slope is relatively steep and the body, especially the cephalon with the undeformed convexity, should be approximately as narrow as the anterior margin of the pygidium. The less flattened specimen (Pl. 8, figs. 4, 4a, 4b) gives an idea of what was the true convexity of the trilobite.

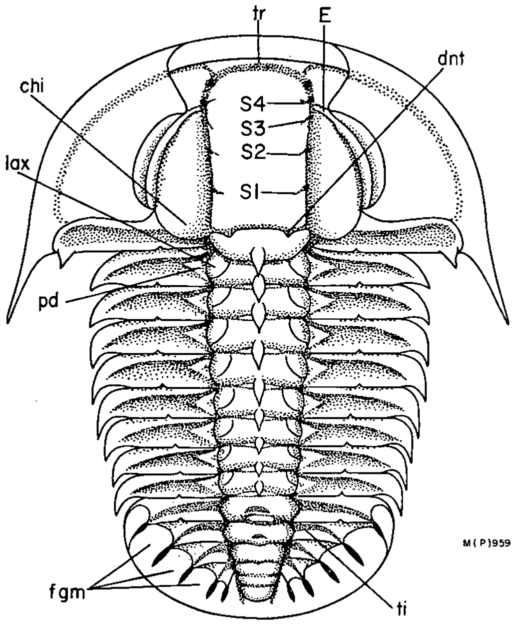


Fig. 8. ***Fuchouia fecunda*** **sp. nov., holaspid morphology; pygidial axial lobe with four annulations. chi—swollen rear of interocular cheek; dnt—occipital dent; E—ocular ridge, horizontal; fi—interpleural partition in pygidium; fgm—peripheral garland of festoons in pygidium; lax—lateral lobule of the axis of the thorax; pd—pleural cushion; S1-S4—glabellar furrows (vestigial); tr—plectrum.**

Fuchouia fecunda is a small trilobite, with the earliest holaspides some 17-18 mm long, and attaining twice that length (about 35 mm) in the largest known specimens, as evident from the large pygidium, specimen 29. The cephalon is large, as long as seven of the nine segments of the thorax; the pygidium is also relatively large, about 0.55-0.6× the length of the cephalon, and the largest among the the Horonastinae; it is a little longer than in *Eurodeois deois* (Walcott), but visibly shorter than in several Bathyuriscinae (*Bathyuriscus, Klotziella, Athabaskia Glossopleura, Orria*).

The axial lobe is prominent, the pleural fulcra, facets, and geniculation are well developed and indicate flexibility, agility, and strength. Structural adaptation for coiling is apparent although no coiled specimens of dolichometopids have been found as yet; no congruence of the pygidium and the anterior half of the cephalon is apparent, but such congruence is demonstrable in a projection of a body retaining its convexity. It should be noted that the cephalon is rather convex, and that the convexity of the thorax gradually decreases in the caudal direction. The axial spines are prominent, but of a moderate length when compared with *Sunia cornunda* sp. nov. and *Dolicholeptus ansatus* gen. et sp. nov. (q.v.). The spines develop in the thorax in its newly incorporated segments; in the pygidium the segments, fixed or transistory, have only inconspicuous median nodes. These spines are hardly 'organs', but once present they may have served in passive defence. The medially arranged spines on the crest of the streamlined *F. fecunda* functioned as a rigid and composite dorsal fin in swimming, as well as in resting on the sea bottom, facing the current. The mode of life is discussed separately below.

The free cheek (specimens 6-8) is large, reminiscent of half of a broad crescent with the acute end clipped off; the genal spine, moderate in length, is slightly deflected; the curvature of the margin is even, without any exorbitance, the border is evenly wide and almost flat; the ocular base is low and defined by a shallow furrow; the subocular area is moderately swollen and covered by delicate radiating veins; the principal vein (specimen 8), a generality in many different trilobites, runs obliquely from the midpoint of the ocular base to the border; the border is minutely punctate and lineate. The posterior sutures are diametrical, sinuous, and cut the rear cephalic margin close to the base of the genal spine. The posterolateral limbs are spatulate, moderately widened distally, narrow and long, and interocular spines are placed close to their tips. The posterolateral furrows are wide but constricted abaxially by the rear swelling of the interocular cheeks, and peter out almost completely without crossing the sutures; the structure of these furrows is apparently similar in all Horonastinae.

The anterior sutures (specimens 3, 4, and 11) cut the rim in short curves, but within the brim these are straight and moderately divergent—still more divergent than in *Sunia, Undillia*, and the rest; the frontal limb is therefore also relatively wide, reminiscent of *Deiradonyx* gen. nov. and some Zacanthoididae; it is about 0.2-0.23 (variable) of the glabellar length and consists of an almost flat rim and broadly plectrate brim; the plectrum is defined in its rear by a faint line.

The palpebral lobes are long (0.7 of the glabella), curved, but not quite arcuate, with anterior tips separated from the glabella by short and horizontal ocular ridges, and the posterior tips at a distance of 0.6× glabellar width from the axial furrows.

An inconspicuous wriggle in the anterior part of the palpebral lobe coincides with a slight emargination of the edge of the interocular cheek as observed also in *F. atopa* sp. nov. (q.v.). The palpebral furrows are evenly deep and narrow. The interocular cheek, together with the palpebral lobe is as wide as 0.77×, and without that lobe about 0.6× the glabellar width; it is moderately swollen and its posterior swelling intrudes the adaxial part of the pleuro-occipital furrow.

The occipital furrow is nearly straight, and moderately deep; the occipital lobe, about 0.22-0.24 of the glabellar length, has a straight rear, slightly forward-swept extremities and one or two (specimen 11) pairs of dents in its frontal margin; the occipital spine is slender and marginal (specimen 1).

The axial furrows are narrow and deep and surround the glabella, and of the two pairs of fossulae the posterior pair (specimen 17) is usually the strongest. The glabellar flanks are concave, the frontal part is well rounded and slightly expanded (corynoid): the width in the rear is about 0.6× and in the front about 0.7× the glabellar length; and the whole in its shape is reminiscent of the glabella of *Eurodeois deois* (Text-fig. 28), but also of *Sestrostega* gen. nov.; it is the 'dolichometopid' shape—recurrent, but differently emphasised in diverse species of the family.

The transverse and longitudinal (specimen 1) profiles of the cranidium of *Fuchouia fecunda* are identical with the better illustrated *F. atopa*, Plate 9, figs. 3b and 3c: transversely the glabella is well arched and elevated above the cheeks, and longitudinally it slopes forward in an even curve and contacts the brim well below the level of the palpebral lobes; this slope coincides with the slope of the frontal limb in front of the eyes.

The glabellar furrows are obsolete, or almost so, in late meraspides and in holaspides; they are reduced gradually as discussed below in the section on morphogenesis. The ventral doublure is very narrow in all tagmata; the rostral shield is separated from the cranidium by the marginal suture and from the hypostoma by the hypostomal suture; the hypostoma is described below in the comment on specimen 9. The cephalic ornament consists of a dense and minute pustulosity (Pl. 13, fig. 3a; specimen 17) and minute punctation (specimen 10); the border is delicately lineate (free cheeks, specimens 6-9).

The pygidium is briefly described in the diagnosis, and its relative size in the second paragraph of this description, and in the comment on specimens 20-21 (Pl. 11); it is also compared with the pygidium of *F. atopa* sp. nov. The series of pygidia, Plate 11, illustrating the morphogenesis of that shield, indicates that isolated pygidia out of their morphogenetic context may be misleading taxonomically. In brief, the maturing and mature pygidia of *Fuchouia fecunda* are subtriangular in outline, are slightly wider than twice the length, have gently sloping pleural lobes and a long and slender axial lobe with five annulations in late meraspides, and four in holaspides; the periphery is ornate with festoons; these are also present in *Dolicholeptus*—especially in an immature specimen of *Dolicholeptus licticallis* sp. nov. (q.v.).

Mode of life: Fuchouia fecunda left behind moults of its larvae and of all possible instars in large numbers in the limestone sequence preserved in the eastern part of the Mount Drummond and the western part of the Lawn Hill Sheet areas. This seaway was well populated by polymerids (*Penarosa retifera*, anomocarids, and ptychopariids) and miomerids (*Pagetia*, *Peronopsis*, *Hypagnostus*, and *Euagnostus*) and by a countless abundance of phosphatic brachiopods dwelling on the sea-floor. It was a euphotic and relatively quiet marine environment. The fossils are especially abundant in silty and sandy limestone containing little or no organic matter. The sequence, however, lacks uniformity: erratic interbeds of bituminous limestone are also present in which rare and scattered remains of *Fuchouia fecunda* have been found. It appears therefore that places of accumulating organic matter deficient in oxygen were not favoured by the trilobite; consequently *Fuchouia fecunda* was a habitant of aerated waters close above the sea-floor. This is consistent with the observations regarding the distribution of animal life in Middle Cambrian time in the Undilla Basin: the Inca Formation, presumably a bituminous sequence, abounds in pelagic agnostids but is practically devoid of polymerid trilobites, a single pygidium of a *Fuchouia* (*F.* sp. aff. *fecunda*, q.v.) excepted; in the same basin the Currant Bush Limestone, a temporal equivalent of the Inca Formation, contains all the agnostids of the Inca Formation as well as a diversity of polymerid trilobites.

To conclude, *Fuchouia fecunda* was a small but strong trilobite populating selected habitats mostly above the sea-floor, and was quite sensitive to overdoses of organic matter and the concomitant lack of oxygen.

Comment on illustrated specimens

All specimens except number 28 come from collecting site M180; all material has been collected from a limestone sequence attributed to the Currant Bush Limestone, within a thickness of about three metres. The arrangement is in sets of specimens:

I. Complete exoskeletons
II. Free cheeks, hypostomata, and ornament
III. Isolated cranidia
IV. Pygidia

The specimens are numbered to facilitate cross-reference in the descriptive text. The texts describing sets I and III are arranged in order of decreasing size, but set IV is in the opposite order; however, these texts are compiled for reading either forwards or in reverse.

Set I. COMPLETE EXOSKELETONS

Specimens 1-4 in this set and the cranidium specimen 11 of Set III all have glabellar flanks concave, glabellar front expanded, and no glabellar furrows; the meraspid pygidium has five, and the holaspid pygidium four axial annulations (see set IV).

Specimen 1. The fragmentary holaspid exoskeleton Plate 8, figs. 4 & 4b CPC 18853 is 14 mm long as preserved; its original length was an estimated 17.0 mm. It is disturbed by a longitudinal fracture (a calcite vein); slightly compressed laterally, the glabella appears slender. The axial spines are exposed; eight segments of the thorax are evident and the ninth (posterior) is lost. The pygidial rear is emarginate and its axis has four annulations—a holaspid pygidium; it is 3.0 mm long, and shorter than the pygidium of the meraspis, specimen 2; consequently, the loss of the fifth segment to the thorax was not compensated by an increase in length (compare specimen 21).

Specimen 2. The exoskeleton Plate 6, fig. 1, CPC 18845, an external mould, is 16 mm long; the pygidium, 4 mm long, has five annulations in the axis and is only slightly shorter than the pygidium specimen 25 with four annulations, a holaspis. Specimen 2 is therefore a latest meraspis, to become a holaspis in the next instar. Associated are two early meraspid cranidia, one on the left, another close to the front.

Specimen 3. The holotype exoskeleton, Plate 7, figs. 1a & 1b, CPC 18847, is 14 mm long. It has eight segments in the thorax, five axial pygidial annulations, and a slightly clavate glabella with concave flanks; it represents a latest meraspis, but as an instar possibly preceding that of Plate 6, fig. 1. Length of palpebral lobe is 0.7 of glabella; glabellar rear width = 0.6×, and frontal width = 0.72× the glabellar length. The pygidium is 0.55 of the cephalic length. More than one instar with seven to eight segments should be present between this and the smaller specimen 4.

Specimen 4. The exoskeleton Plate 7, fig. 2, CPC 18848 is 9.0 mm long; it is a late meraspis with seven segments in the thorax. The cephalon is 3.5 mm long (see specimen 17). The pygidium has five axial annulations, but is only 0.5× the length of the cephalon. The glabella is visibly clavate; its width increases from 0.55× the length at the rear to 0.7× at the front.

Specimen 5. The exoskeleton Plate 7, fig. 3 and Plate 12, fig. 8, CPC 18849, is 1.7 mm long—a very small meraspis; but it has already five free segments out of the nine of a holaspis; in its pygidium the pleurae of three more segments are apparent: these are transitory and should be incorporated in the thorax; the final ninth segment is not yet present; festoons are absent.

Set II. FREE CHEEKS, HYPOSTOMATA, AND ORNAMENT

Specimen 6. The free cheek Plate 8, fig. 1, CPC 18850 is 8.8 mm long, of a late meraspis; the genal spine lost its tip. The border carried delicate, crowded and wavy lines; the caecal veins are faint.

Specimen 7. The free cheek Plate 8, fig. 2, CPC 18851 is 6 mm long to the tip of the genal spine which is slightly deflected; it belongs to a meraspis.

Specimen 8. The free cheek Plate 10, fig. 3, CPC 18860 is 12.0 mm long (without the genal spine) and belongs to a holaspis; the principal genal vein is visible.

Specimen 9. The two hypostomata Plate 8, fig. 3, CPC 18852 are damaged; they are 5.0

mm long; the structure is the same as in *Eurodeois* and *Sunia*: the anterior border is deflected ventrally, the flanks and front are surrounded by a frame (ridge), and lateral and posterolateral spines are indicated.

Specimen 10. The cranidial fragment Plate 13, fig. 4; it is associated with the cranidium specimen 18, Plate 13, fig. 3, CPC 18884. The fragment is punctate and the punctae are, presumably, accentuated through abrasion. Compare specimens 16 and 17.

Set III. Isolated Cranidia

Specimen 11. The cranidium in Plate 8, fig. 5, CPC 18854 is 10.0 mm long and quite large; it is, however, similar to the smaller specimen 1 (whose cranidium is about 7.0 mm long); the palpebral lobes are 0.7×, the glabellar rear is 0.6×, and the glabellar front 0.7× the glabellar length. Two pairs of occipital dents are apparent.

Specimen 16. The cranidium Plate 9, fig. 1, CPC 18855 is 5.0 mm long; it represents an instar smaller than the holotype (specimen 3), but larger than the meraspis with seven segments (specimen 4). The papillae are worn off and the punctation is exposed.

Specimen 17. The cranidium Plate 13, fig. 3 CPC 18884 is 3.3 mm long and close to the meraspis specimen 4. It is deformed (the occipital lobe laterally compressed and the rim uplifted), but has preserved its velvet-like pustulose ornament; the muscle spots are smooth, the posterior fossula in fig. 3a is well impressed, and the ocular ridge is horizontal.

Specimen 18. The cranidium Plate 13, fig. 2, CPC 18883 is 2.6 mm long, and almost undistorted (compare the distorted specimen 19, which is of the same size). It possibly combines with the pygidium specimen 20. The brim is narrower than in the larger cranidia but the plectrum is discernible. Other characters of the species—the palpebral lobes 0.7 of glabellar length, the absence of glabellar furrows, and the papillate ornament preserved on the interocular cheeks—are already present. It is associated with the fragment specimen 10.

Specimen 19. The cranidium Plate 13, fig. 1, CPC 18882 is 2.5 mm long—the same as specimen 18. The glabella seems slender, being laterally distorted. Three pairs of glabellar furrows are indicated as dark muscle spots against the papillate test.

Set IV. Isolated Pygidia

The illustrations of the pygidia (Pl. 11) and the text are arranged in order of increasing size. In the measurements of length the articulating half-ring is excluded.

Some of the pygidia are matched, but only approximately, with cranidia of sets I and II, in consideration of data from the three exoskeletons, as tabulated below:

Specimen No.	2	3	4	5
CPC No.	18845	18847	18848	18849
Length of exoskeleton	16 mm	14 mm	9 mm	1.7 mm
Length of cephalon	7.0 mm	6.0 mm	3.5 mm	1.0 mm
Length of pygidium	4.0 mm	3.3 mm	1.7 mm	
Pyg./Ceph. ratio	0.57	0.55	0.5	
Pyg./Exosk. ratio	0.25	0.23	0.2	
Ceph./Exosk. ratio	0.44	0.43	0.4	
Thoracic segments	8	8	7	

Pygidia of instars in the interval of the specimen 4 with seven segments and length 9.0 mm, and specimen 5 with five free segments and length only 1.7 mm, cannot be placed safely in the absence of control from complete exoskeletons. Of the two pygidia belonging to that interval, specimen 20, 1.0 mm long, corresponds approximately to specimen 18, which is 2.6 mm in length; but there is ample scope for more than one instar each of meraspides having five, six, and seven segments in the thorax.

The pygidia and cranidia cannot be matched accurately because the material presented here was selected regarding its state of preservation in search for diverse sizes; furthermore, the cephalon increased in length from instar to instar, but pygidial growth, as discussed under the specimens 1, 21, and 25, was intermittent owing to the release of a segment to the thorax from time to time, and the loss in length was compensated in the subsequent instars.

Specimen 20. The pygidium Plate 11, fig. 1, CPC 18862 is 1.0 mm long and about twice as wide. Specimen 18 (cranidium) corresponds or is close to it. The axial lobe has five annulations, of which not less than three are transitory; the pleural furrows cut the margin and in the anterior pleurae have acute tips (pleural tips of the thorax *in statu nascendi*). There is hardly a doublure present behind the terminus.

Specimen 21. The pygidium Plate 11, fig. 2, CPC 18863 is 1.15 mm long; the axial lobe has four annulations, while the fifth seen in specimen 20 has become incorporated in the thorax; the shield is relatively wide (about 2.6× its length) because the loss of the anterior segment to the thorax is not yet compensated by a new metamere.

The festoons along the margin are indicated, but are depressed. In the next instar, which is not available, a pygidium similar in size to that of the complete meraspis specimen 4, with five annulations, was produced.

Specimen 22. The pygidium Plate 11, fig. 3, CPC 18864 is 1.9 mm long and approximately 4 mm wide; four axial annulations are observed.

Specimen 23. The pygidium Plate 11, fig. 4, CPC 18865 is 2.25 mm long and its width is about twice that length; assuming that the cephalon was about twice that length, it should be close to the cranidium specimen 16, which is 5.0 mm long. The pygidial axial lobe has five annulations and the festoons are discernible.

Specimen 24. The pygidium Plate 11, fig. 5, CPC 18866 is 2.6 mm long and about 6.0 mm wide, and fits exactly the cranidium specimen 16, better even than specimen 23. Five axial annulations are present.

Specimen 25. The pygidium Plate 11, fig. 6 (same in Pl. 10, fig. 4), CPC 18867 is 4.3 mm long; the festoons are well developed; it has four axial annulations—a constant number in all subsequent larger pygidia. In the interval between this pygidium and specimen 24 the pygidia of specimen 3 (3.3 mm long) and specimen 2 (close to 4.0 mm), which still have five annulations, can be placed. The relative decrease in length of this pygidium after it lost a segment to the thorax, cannot be evaluated in the absence of corresponding complete exoskeletons; the cranidium specimen 11 correlates probably with specimen 25.

Specimen 26. The pygidium Plate 11, fig. 7, CPC 18868 is 5.0 mm long. It is a holaspid shield, combining with a cephalon about 10 mm long or somewhat shorter; the festoons are prominent and the pleural furrows and ribs are angulate (as in all pygidia of that species).

Specimen 27. The pygidium Plate 11, fig. 8, CPC 18869 is 5.5 mm long, and is emarginate in the rear.

Specimen 28. The pygidium Plate 11, fig. 9, CPC 18870, locality M377, is about 6.0 mm long; its posterior axial annulation is incompletely defined against the terminus; the rear is emarginate.

Specimen 29. The pygidium Plate 11, fig. 10, CPC 18871 is 7.6 mm long and is the largest available; it should correlate with a cephalon 14-15 mm long. The interpleural partitions are prominent; irregular scleritisation is apparent in the terminus, and the posterior annulation is ill defined as in specimen 28.

The pygidia specimens 27-29, characterised by having four annulations in the pygidial axis, differ from *Fuchouia atopa* (q.v.) whose equally large pygidium has five annulations.

Occurrence and age: Fuchouia fecunda sp. nov. has been found in great abundance in a calcareous sequence attributed to the Currant Bush Limestone, in a narrow latitudinal belt of outcrops close to the Northern Territory/Queensland border, about latitude 18°38′. Its age is the Middle Cambrian Zone of *Euagnostus opimus.*

Morphogenesis of **Fuchouia fecunda** nov.

Plate 12; Text-figures 11-17

The matrix is grey silty limestone with some fine sand grains. The fossils are all preserved as tests with a shiny surface. Silicification is completely absent and the matrix adheres to the objects irregularly: parts of a fossil were visible already on the surface of limestone fragments, and the rest of the matrix was removed by a thin steel needle at magnifications ranging from 30× to 100×; soaking in hot water was also of some use during the process of dematrication. Experiments with chemicals (KOH, oxalic acid) were unscuscessful: the matrix disintegrated, but so did the fossils also. The loss in specimens, especially of protaspides and small merispid cranidia, was also considerable under the needle, mainly from the damage inflicted on spines, palpebral lobes etc.; nevertheless, the number of dematricated specimens is still sufficient for a study of the morphology of the growth series, but not complete enough for a statistical study of instars.

The specimens in Plate 12 were photographed by Mr C. G. Gatehouse, and the protaspis of Plate 6, fig. 2 by Dr P. J. Jones, of this Bureau. Specimens were selected for illustration according to length, and it became apparent that the supply of each of the length classes is uneven; even some gaps in the series are evident.

Morphology of protaspides

No anaprotaspides of *Fuchouia fecunda* have been identified as yet. The studied material contains early metaprotaspides showing no division separating the protopygidium from the cephalon, and late metaprotaspides which have acquired a separating divisional line. All protaspides are exuviae but preserving their original convexity and shape with the free cheeks lost; this loss is an advantage—indicating the presence of functional cephalic sutures as evident from the free edges of the frontal limb and the palpebral lobes; the posterior sutures cannot be conveniently illustrated because they surround the steep (hanging) posterolateral limbs; the sutures cut the posterior cephalic edge down from and close to the intergenal spines, in a manner seen in the meraspis Plate 12, fig. 6b and Text-figure 12. The free cheek is unknown; it possessed, presumably, the genal spine.

Structures hitherto unknown in any kind of protaspides are (1) the bacculae and the slanting baccular ridges, (2) the median node on the second glabellar lobe, and (3) the rather delicate slanting caecal veins (Text-fig. 11).

The bacculae are retained in subsequent meraspid instars, but disappear about the degrees 5 to 6 (Text-fig. 17).

The baccular ridge, not discernible in the meraspides, disappears apparently during the moulting from the late metaprotaspis to the meraspid degree 0. The median node on the second glabellar lobe remains discernible in better preserved cranidia in early instars of about degree 5 (Text-fig. 15).

The system of slanting caecal veins, however, seems a particular structure of the protaspis: it becomes dismantled (when, is unknown) and replaced by veins fanning out from the corners of the glabellar rear—the position of the obsolete bacculae (see *F. atopa* nov., comment on Pl. 10, fig. 2a, page 42).

The caecal veins arise at the axial furrows (probably at the glabellar flanks); five pairs are evident, corresponding to the five glabellar lobes (metameres); the sixth pair (the baccular ridges) belongs by its position to the posterior glabellar lobe and not to the occipital segment of the cephalon; it is, however, not connected with the axial lobe but may be a separate and transient duct of the pleural cephalic region. Distally, the caecal veins are moderately branching and cross the marginal furrow. The caecal systems of mature trilobites have been discussed by Öpik (1961a); supplementary information regarding the Dolichometopidae is given in this paper (*Fuchouia atopa* sp. nov., *Horonastes eminens* sp. nov., *Sunia cornunda* sp. nov. and some other forms). The knobs on the anterolateral corners of the cranidium seen only in protaspides of *F. fecunda* are pleural structures and homologues of the procranidial spines of *Leptoplastus* (Raw, 1927; see Whittington, 1957a, fig. 8), and of olenellids (ibid., fig. 2). Such spines are generally subject to morphogenetic reduction, but in some exceptional forms (*Diceratocephalus* Lu, 1957; *Holanshania* Lu, in Lu, op. cit.) they are retained throughout the life history. In passing, the intergenal spines are also pleural by their position and generally retarded or obliterated in the course of morphogenesis, but are, nevertheless, developed to a spectacular size in *Nepea narinosa* Whitehouse (Öpik, 1963).

The habit of the protaspides of *Fuchouia fecunda* is close to the general picture given by Whittington (1957a).

The length ranges from about 0.35 to 0.45 mm and even 0.5 mm (in metaprotaspides with gradationally retroflected protopygidium). The shape (without the free cheeks) is subcircular to transverse elliptical, with an oblate to almost semiglobose convexity. The border is discontinuous in front of the glabella, but otherwise flat and equipped with strong retral intergenal spines; the cheeks are rather tumid, with steeply down-sloping flanks. The palpebral lobes are narrow, approximately 0.5 of glabellar length (oblique in plan, as in all subsequent instars) and well down from the top level of the cheeks. The ocular ridges, continuous with the palpebral lobes, intervene direct between the rim and the steep front of the cheeks; consequently, a brim is absent. The axial furrows are deep valleys; the axial lobe (glabella and the occipital lobe) is sunk below the level of the cheeks. The fossulae are roughly circular deep pits, flanking the glabellar front and sunk partly in the rim and partly in the adaxial ends of the ocular ridges.

The cephalic axis is divided by transcurrent furrows into five swollen segments; the posterior segment is the occipital lobe, and four constitute the glabella. The frontal glabellar lobe is about twice the width of the lobes behind it, and transverse elliptical to subpentagonal in shape. It is well defined all around, without any trace of a lateral expansion that is common in protaspides of ptychopariids (Text-fig. 10). The frontal lobe has a pair of short, distinct lateral furrows and is composed, consequently, of two fused meta-

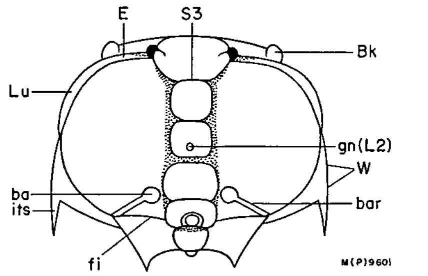


Fig. 9. Diagram of late protaspis of *Fuchouia fecunda* sp. nov. (Pl. 6, fig. 2). ba—baccula; bar—baccular ridge; Bk—anterolateral knob on border; E—ocular ridge; fi—intersegmental pleural partition separating the protopygidium from the cehpalon; gn (L2)—median node on second lobe; its—intergenal spine; Lu—palpebral lobe; S3—third glabellar furrow; W—posterolateral limb, position indicated, but invisible from above.

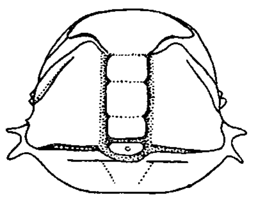


Fig. 10. Metaprotaspis of a ptychopariid; presumably *Lyriaspis sigillum* Whitehouse, 1939; from a specimen flattened in siltstone, illustrated for comparison with Text-figures 9 and 11.

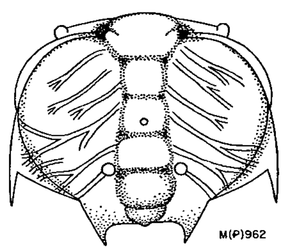


Fig. 11. Metaprotaspis of *Fuchouia fecunda* sp. nov. (Pl. 12, figs. 1 and 2); note the caecal veins on the pleural lobes and the absence of the intratagmatic partition of protopygidium and cephalon.

meres. The same composite structure (vide Whittington, op. cit., figs. 5 and 7) is also present in early meraspides of *Paradoxides* and in metaprotaspides and early meraspides of *Welleraspis* (described by Rasetti, 1954). It can be speculated that the glabellar front of only two fused segments, the ocular ridge (eyes), and the laterally developed frontal border recapitulate in a condensed manner the structure of the cephalon of the ancestral pre-trilobite. In any case, it is the foremost and therefore morphogenetically the earliest known post-embryonic part of the trilobite.

The three posterior glabellar lobes are unequal in length and width, and the posterior is the widest.

The occipital lobe is bulbous and, apparently, semiglobose in its rear; an occipital spine, or node, is absent.

The protopygidium is relatively flat, visibly narrower than the cranidium, and short, about 0.25 of glabellar length; it has a pair of retral marginal spines, and one annulation and a tiny terminus in its axis. As usual in early metaprotaspides it slopes down and forward, and in late metaprotaspides it is deflected rearward and becomes visible from above.

The protaspides of *F. fecunda,* around 0.35-0.47 mm long, are smaller than the protaspides of *Corynexochides? expansus* Rasetti (1967) which have an average length of 0.65 mm; apart from the different lengths, the two are quite similar: in the *C.? expansus* protaspides, (1) the glabellar frontal lobe is also transverse elliptical, well circumscribed and flanked by fossular pits; (2) anterolateral knobs on the rim are present (lateral view, op. cit., pl. 12, figs. 12 and 15); (3) baccular ridges are visible (ibid., figs. 13 and 14), and (4) the protopygidium is visibly narrower than the cephalon.

The metaprotaspides of *Bathyuriscus* (*Orria*) *fimbriatus* Robison (1967), some 0.48-0.52 mm in length, are close in size to *F. fecunda*; bacculae and the right baccular ridge are probably indicated in one specimen (op. cit., pl. 24, fig. 5), but the presence of the lateral knobs on the rim is inconclusive owing to the secondary granulosity of silicification. In the same specimens the left free cheek is probably retained, but the intergenal spines and parts of the posterolateral border are lost; there seems to be a small remnant of these structures preserved in the form of a retral 'spine'. Sutures are invisible (undetectable) in these specimens, but their course in the metaprotaspides should be the same as in *F. fecunda.*

For further comparison with the metaprotaspides of *F. fecunda* (Dolichometopidae) a line drawing of a metaprotaspis of *Lyriaspis sigillum* Whitehouse (Ptychopariidae) is given in Text-figure 10. The main differences are: (1) the battle-axe shape of the frontal glabellar lobe, with rearward swept tips (in *fecunda* the frontal glabellar lobe is transverse-elliptical); and (2) the protopygidium is as wide as the cephalon (in *fecunda* it is about 0.6, and in Rasetti's *Corynexochides? expansus* about 0.7 of the cephalon). Of a lesser importance is the absence of a frontal border in the protaspis of the ptychopariid; its appearance is delayed till the next instar; but it may be present under the cover of the flattened frontal lobe. The two posterior lateral spines are, apparently, disappearing rudimentary marginal pleural spines; there is no explanation for the two small spines because of the absence of the free cheeks which are probably concealed under the flattened test.

Description of the growth series

In the description that follows, the material is arranged according to successive increase in length; the length (L) is given in millimetres.

The first L-measurement, at the start of the description of each item, is the length of the cephalon (or the cranidium); the length of the occipital spine (mostly its stump) is also included; consequently, the lengths of smallest cranidia are not quite comparable; this uncertainty is, however, negligible because it has no effect in placing the objects in the succession correctly.

Protaspides

A. L = 0.39 mm; metaprotaspis, Plate 12, fig. 2, CPC 18873.

The width/length ratio is about 1.1; it is narrower and hence smaller than the next specimen. The protopygidium dips down and is deflected forward—as is usual in early metaprotaspides. The median node on the middle glabellar lobe is visible, and so are the anterolateral nodes of the rim; the left intergenal spine is intact; the intergenal spines are retained, with decreasing emphasis, during the whole life history; no occipital spine or node.

B. L = 0.39 mm; metaprotaspis, Plate 12, figs. 1a-1d, CPC 18872.

The width/length ratio of about 1.4 indicates a size larger than before; the protopygidium starts to become visible from above. The strong convexity is apparent in fig. 1d. The bacculae and baccular ridges are visible. The occipital lobe is bulbous and lacks any median projection.

C. L = 0.42 mm (cephalon); metaprotaspis, Plate 6, fig. 2, CPC 18846.

The lateral edges are worn, but the width/length (cephalic) ratio is close to 1.7. The protopygidium is retroflected, and the total length in plan is about 0.45 mm; the protopygidium itself is 0.11 mm long. The shields are firmly fused, but the pygidial front is defined by a transverse line (see Text-fig. 9). The node on the second glabellar lobe is prominent and a node on the occipital lobe announces the occiptal median spine; the bacculae are relatively large (poorly defined in the photograph). The three protaspides A, B, and C represent apparently three instars in a relatively rapid succession of moulting; a predominant growth in width is apparent; a concurrent retroflexion of the pygidium and the appearance of the transverse line of the intertagmatic joint, but no other structural changes, have passed by in this set of protaspides.

Meraspis degree 0

D. L = 0.42 mm; cranidium, Plate 12, fig. 3, CPC 18874.

The width/length ratio is about 1.9, but the length is very close to the cephalon of protaspis C (L = 0.42); the increase in length is very small as compared with the increase in width, which is expressed in the lateral spreading of the posterolateral limbs whose tips, however, remain in a vertical position. The general structure and the structure of the cephalic axial lobe are exactly the same as in the protaspides; bacculae are there but the baccular ridges have disappeared; an innovation to stay, however, is the occipital spine. The event of liberation of the protopygidium and the cephalon from each other resulting in the development of free tagmata and articulation occurred interstadially after the last protaspid ecdysis and before the incrustation of the meraspid degree 0.

Meraspides, degrees 1-5

A meraspis of degree 5 (i.e. having five free segments in the thorax), Plate 7, fig. 3 and Plate 12, fig. 8, marks the interval occupied by four degrees represented by the isolated cranidia specimens E-H.

E. L = 0.47 mm, Plate 12, fig. 4, Text-figure 12, CPC 18875.

This meraspid cranidium has the same length as specimen D (meraspis degree 0); it is therefore possible that it is just another instar of the same degree 0. Reminiscent of

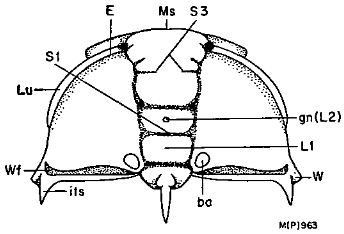


Fig. 12. Meraspid cranidium of *Fuchouia fecunda* sp. nov., diagram of specimen E, L = 0.47 mm, Plate 12, fig. 4. L1—posterior glabellar lobe; Lu—palpebral lobe; Ms—frontal glabellar recess; S1—posterior glabellar furrow; Wf—blind end of posterolateral marginal furrow; other symbols as in Text-figure 9.

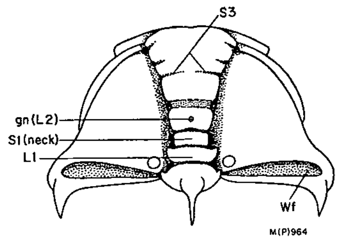


Fig. 13. Meraspid cranidium of *Fuchouia fecunda* sp. nov., diagram of specimen F, L = 0.53 mm, Plate 12, figs. 5a and 5b. Symbols as in Text-figures 9 and 12.

the protaspides and of specimen D (meraspid degree 0) are the direct contact of the ocular ridges with the lateral rim, and the presence of bacculae; the transient protaspid glabella ('a tri-annulated handle with an elliptical head', and transcurrent transverse furrows) is out of the picture: (1) only the two posterior furrows are transcurrent; these will also disappear, the posterior will be the last; (2) the third (S3) transcurrent furrow is interrupted in the middle, and in front of it the transverse elliptical protaspid-meraspid degree 0 lobe is modified into a layer structure with two pairs of lateral glabellar furrows of which the posterior is new (Text-fig. 12); it may be an independent structure or the anterior branches of the bifurcate S3 furrows. The L3 lobe is now visibly long; the glabellar flanks are not parallel but divergent, and the glabella itself is clavate. The posterolateral marginal furrows are now horizontal and their distal ends are blind and remain so throughout the life history. Seeing that the specimen D (meraspid degree 0) and the cranidium under discussion (specimen E) are about equal in size, the following interpretations are probable: (1) the stadium between the two moults was of rather short duration; this accepted, (2) the transformation of the glabella cannot be ascribed only to the anabolic differential growth (a differential assimilation of new supply of matter), but (3) also to a 'dismantling' of existing structures and placing the material in different positions (metathesis).

F. L = 0.53 mm; early meraspis cranidium, Plate 12, figs. 5a, 5b; Text-figure 13. CPC 18876.

This cranidium may represent an instar succeeding that of specimen E (L = 0.47); the degree it belongs to (one or two segments) cannot be established. As before, some of the protaspid structures (close contact of the ocular ridges with the border, bacculae, and the median node on the L2 lobe) are retained; the glabella in general terms, especially in its anterior half, and shape, is the same as the one introduced with specimen E; but the design in the rear is visibly modified: (1) the S2 furrow is transformed into a short, and the posterior S1 furrow into a long neck, the L1 lobe is abbreviated and (2) the shape of the L1 lobe is that of an occipital lobe with drawn-out extremities. These structures persist beyond the meraspid degree 5 and disappear gradationally (see specimen L = 1.31). The incidence of these structures can be ascribed to the anabolic metathesis and not simply to anabolic growth. The following speculative interpretations are possible: (1) The anterior half of the glabella has been assembled according to a plan of a cephalon whose occipital lobe with a median node is the L2 lobe; (2) the 'quasi occipital' L1 lobe, semi-elliptical, is only the posterior half of the elliptical L1 lobe which became reduced by the incidence of the neck; and (3) the formation of the neck and the development of the apodemes are concurrent events, as discussed in the next examples.

G. L = 0.78 mm; meraspid cranidium, Plate 12, figs. 6a-6c; Text-figure 14, CPC 18877.

This cranidium, L = 0.78, is considerably larger than specimen F (L = 0.53) and within the interval in between, more than one instar should exist. The cranidium G, however, differs from F, in having developed a border in front of the glabella (see Text-fig. 14); the neck between the L1 and L2 lobes is visibly in contact with its flanking deep apodemal pits. The specimen is illustrated in three

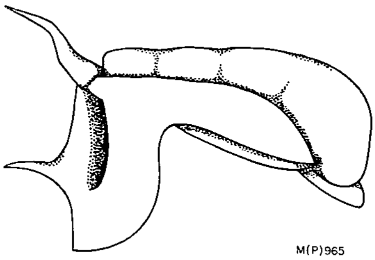


Fig. 14. Meraspid cranidium of *Fuchouia fecunda* sp. nov., diagram of lateral view, specimen G, L = 0.78 mm, Plate 12, fig. 6. Note the large posterolateral limb and the blind end of the posterolateral marginal furrow.

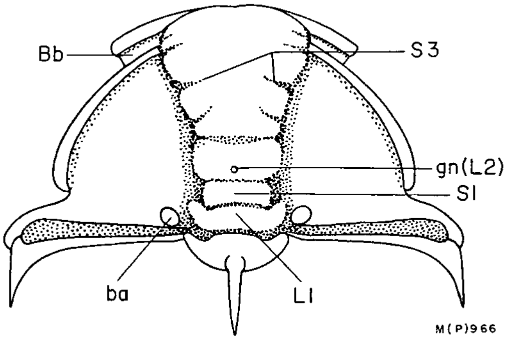


Fig. 15. Meraspid cranidium of *Fuchouia fecunda* sp. nov., diagram of specimen H, L = 0.78 mm, Plate 12, fig. 7. Bb—brim, intervening between the ocular ridge and the rim (only lateral). Other symbols as before.

views showing the tumidosity of the cheeks, the steepness of the frontal lobe, and the verticality of the distal part of the posterolateral limb. The frontal border is narrow and invisible in plan. Other detail in specimen H, and Text-figure 15.

H. L = 0.78 mm; meraspid cranidium, Plate 12, fig. 7, Text-figure 16, CPC 18878.

This cranidium supplements the specimen G, of the same size (L = 0.78). Generally, the description of the much smaller cranidium F (L = 0.53) can be applied here, but with the following additions: (1) the ocular ridges are now separated from the border by the incipient lateral brim; (2) the palpebral lobes are longer; and (3) a pair of shallow oblique furrows are visible in the L3 lobe; these furrows appear emerging from the apodemal pits corresponding to the transverse transcurrent S2 furrow and are, apparently, branches of that furrow; hence, no odd glabellar metamere is present.

Meraspis degree 5

I. L = 0.94 (of cephalon); complete meraspis, Plate 12, fig. 8, and Plate 7, fig. 3, CPC 18849.

A description of this specimen was given above in the description of *Fuchouia fecunda* specimen 5. The total length of the exoskeleton is about 1.7 mm; the pygidium is slightly less than 0.2 mm. The thorax consists of five free segments, and two transitory segments can be distinguished in the pygidium. The cranidium is probably granulose. It is damaged, but is supplemented by the next cranidium, specimen J.

J. L = 0.94 mm; meraspid crandium, Plate 12, fig. 9, CPC 18879.

The length of the tip of the occipital spine is about 1.0 mm. The characters are essentially the same as in specimen H (L = 0.78), but of a lesser emphasis owing to somewhat different preservation.

Meraspid cranidia, degrees 5-7

The degree-controlling complete specimens are the exoskeletons specimen I (degree 5) and specimen No. 4, Plate 7, fig. 2 (degree 7). The number of instars in a degree is, however, unknown and the by-passing of a degree by simultaneous release of two segments to the thorax is also a possibility.

K. L = 1.09 mm; meraspid cranidium, Plate 12, fig. 10, Text-figure 16, CPC 18880.

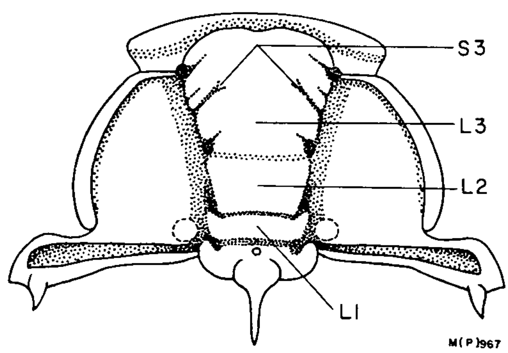


Fig. 16. Meraspid cranidium of *Fuchouia fecunda* sp. nov., diagram of specimen K, L = 1.09 mm, Plate 12, fig. 10. Note the now transcurrent frontal rim, the horizontal ocular ridges, and the additional occipital median node; no node on L2.

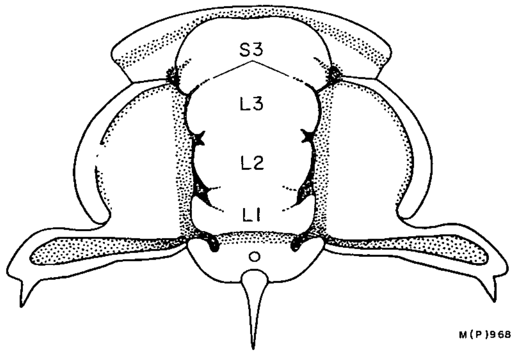


Fig. 17. Meraspid cranidium of *Fuchouia fecunda* sp. nov., diagram of specimen L, L = 1.31 mm, Plate 12, fig. 11.

In this specimen the bacculae (passed on from the protaspis) and the two posterior transverse glabellar furrows (persisting from specimen E, L = 0.47) are present, but subdued in relief; in subsequent instars these structures disappear completely. The clavate, forward-expanding, early meraspid glabella, however, remains unchanged. The ocular ridges, well separated from the rim, are horizontal and remain so thereafter. The glabellar furrows are contracting to the apodemes, the neck is relatively short and inconspicuous, but the posterior glabellar lobe still preserves its quasi-occipital shape (see specimen F).

L. L = 1.31 mm; meraspid cranidium, Plate 12, fig. 11, Text-figure 17, CPC 18881.

In this instar the rim is well established in front of the glabella, but no brim and plectrum are evident yet; the clavate shape of the glabella seen in specimen K (L = 1.09) is moderate, apparently because the width of the glabella has increased behind the ocular ridges; of the transcurrent glabellar furrows and the necks only vestiges are discernible; the apodemal pits flanking the glabella remain prominent, but they will disappear in subsequent instars. It appears that the last morphogenetic step—the reduction of the so well impressed and expressed relief—is well in progress. The palpebral lobes are very long, and the interocular cheeks wide, longer and wider than in maturity.

M. L = 2.34 mm; cranidium, Plate 13, fig. 2 (specimen No. 18, see details in the taxonomic description of *F. fecunda*).

In this specimen, about 2.6-2.7 mm long, the brim with the plectrum is visible, and the apodemes (see specimen L) are almost obsolete; the glabella is only little clavate.

N. L = 3.47 mm (of cephalon); a late meraspis exoskeleton of degree 7; Plate 7, fig. 2 (specimen No. 4, see details in the taxonomic description of *F. fecunda*).

The brim and its plectrum are fully developed; the glabella remains slightly clavate; and the apodemes are obsolete.

The morphogenesis of the early meraspid pygidium is known insufficiently. The smallest is described from specimen I (above), and it is 0.2 mm long; another pygidium (not illustrated) of the same length shows a pair of incurved marginal spines; it is closely associated with several protaspides and early meraspid cranidia. Well documented however is the pygidial history of the late-meraspid to advanced holaspid periods (see description of *F. fecunda* and Pl. 11).

Succession of characters in morphogenesis

The diagnosis of the species *Fuchouia fecunda* refers to its morphogenetic holaspid period; it is evident also that this diagnosis applies to the meraspid degree 7 regarding the structure of the cephalon. The holaspid characters, however, in *F. fecunda* and in any other species of trilobite, are established not at once, but as a succession of events. Furthermore, transient structures appear and subsequently disappear at times different from each other.

The protaspid image of the cephalon stays till the meraspid degree 0; later on, in later stadia the incidence of the modifications is rapid.

The meraspid images are transient, but some of their characters reach the holaspis.

The morphogenetic history of some of the holaspid characters is as follows: (1) the opisthoparian sutures, (2) the intergenal spines, and (3) the frontal glabellar notch are inherited from the protaspid period (see Pl. 13, fig. 3); (4) the occipital spine initiated as a node in the late metaprotaspis stays from the meraspid degree 0 onward; (5) the pustulose ornament persists from the earliest meraspid period onward, from about L = 0.53 mm; (6) the ocular ridges become separated from the lateral border, and the border in front of the glabellar is introduced at L = 0.78 mm; (7) the ocular ridges are horizontal from L = 1.09 mm onward; (8) the frontal border is differentiated into a rim and a plectrate brim at

L = 2.34 (advanced meraspid period); (9) the shape of the holaspid glabella develops within the interval of L = 2.34 to L = 2.47 mm; (10) the glabellar relief (obsolete to vestigial glabellar furrows) becomes stabilised from about L = 3.28 mm onward (cranidium No. 17, see taxonomic description of *F. fecunda*, Pl. 13, fig. 3). To note, obliteration of glabellar furrows and of apodemes (see below) cannot be taken as an indication of reduction of the size, number, or efficiency of appendages.

The record of the transient characters not reaching the holaspid period is as follows: The baccular ridges are present in protaspides only; the protaspid glabellar shape ('tri-annulated handle with an elliptical head') reached the meraspid degree 0; the anterolateral knobs of the protaspis disappear after degree 0; the median node in the middle lobe of the glabella of the protaspis disappears after the meraspid L = 0.78 mm; the bacculae of the protaspis are passed on till the meraspid L = 1.09 mm; two transcurrent glabellar furrows are passed onward from L = 0.47 to L = 1.09 mm; the necks in the glabella prevail in the interval of L = 0.53 to L = 1.09 mm, and are lost at L = 1.31 mm; the apodemes are well established in the interval of L = 0.53 to L = 1.31 mm, and are obsolete in L = 2.34 mm.

All transcurrent furrows have disappeared in L = 0.78 mm.

The process of growing was governed by anabolic assimilation; the assimilation was differential topologically as well as in time: the amount of matter assimilated by a structure was different at different times. Furthermore (see description of the meraspid cranidium E, L = 0.47 mm) incidental metathesis (redistribution of already assimilated material) may have occurred concurrently with anabolic assimilation.

The morphogenetic growth was a process directed according to the holaspid 'blue print'; it seems, however, that another, transient and possibly rudimentary, 'blue print' was handy and operational (see specimen F, L = 0.53 mm) before the plan of the holaspis started to prevail.

Fuchouia sp. aff. **fecunda**

Plate 3, fig. 6

The illustrated pygidium, CPC 18829, is 2.5 mm long. Its axial lobe shows four annulations; pygidia of *F. fecunda* of a similar size have five annulations—indicating that the specimen in hand belongs to a different species. The material is, however, insufficient for a proper diagnosis.

This pygidium is a rarity because in the Inca Formation remnants of polymerid trilobites are exceptional, especially when compared with the abundance and diversity of its agnostids.

Occurrence and age: Fuchouia sp. aff. *fecunda* is found in the silty shale of the Inca Formation, locality M199, Mount Isa area. Its age is the Zone of *Euagnostus opimus.*

Fuchouia labda sp. nov.

Plate 2, figs 5, 6; Plate 3, fig. 1;

Plate 31, fig. 1; Text-figure 18

Material: Two cranidia, one free cheek, and one pygidium are illustrated, all from a single site and bed of sandy, hard and brittle bituminous (smelly) limestone. The material is fragmentary with the exception of the free cheek which shows the course of the posterior suture and the outline of the posterolateral limb and allows reconstruction of the cephalon, Text-figure 18. The fossils are tectonically sheared.

Holotype. The larger cranidium, Plate 31, fig. 1, has preserved its convexity and the occipital lobe and is selected as the holotype.

Diagnosis: Fuchouia labda sp. nov. has a forward-expanding glabella slightly contracted in front of the eyes, long palpebral lobes, and a tapering pygidial axis with four annulations and a small terminus; it is distinguished by the absence of a brim and plectrum, by the absence of a fully developed occipital

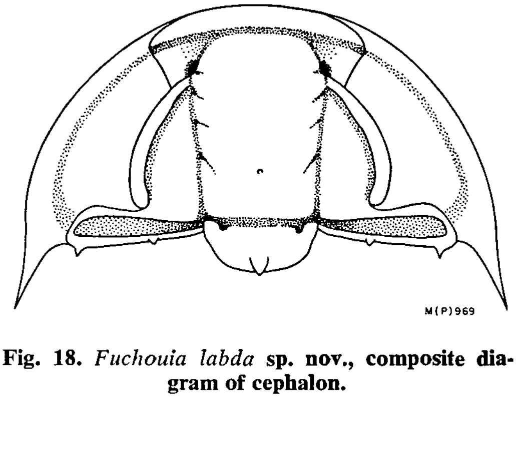


Fig. 18. *Fuchouia labda* **sp. nov., composite diagram of cephalon.**

spine, by the large size of the occipital lobe, relatively narrow free cheeks, and short genal spines.

Differential diagnosis: F. labda differs by its long palpebral lobes from *F. manchuriensis* and other Asian species, and from the Australian *F. atopa* and *F.? bensoni,* which all have short palpebral lobes; *F.? bensoni* is, however, also brimless. From *Fuchouia fecunda* nov., *F. labda* differs by the absence of the brim and of the occipital spine, and the narrowness of the free cheeks. The structure of the occipital lobe and the free cheeks is reminiscent of *Horonastes* gen. nov. (q.v.), and the constriction of the glabellar front combined with the occipital lobe is reminiscent of *Deiradonyx* gen. nov.; these similarities may have some phylogenetic meaning.

Description: The free cheek appears narrow because its margin in its anterior half is very slightly convex, and some convexity is attained close to the base of the spine; the spine itself is somewhat deflected and drawn into an almost needle-like point. The border is wide and rather flat in the rear, and narrow and slightly convex in its anterior part; the subocular area is tumid. The posterior sutures are diametrical, sinuate, and the posterolateral limbs spatulate and triangular at the tips.

The anterior sutures are almost straight, and reach the margin in short curves; the rim is convex (flattened in Pl. 2, fig. 5) and relatively short, as long as 0.16 of glabellar length; it is separated from the glabella by a distinct but narrow furrow.

The palpebral lobes are long (0.7 of the glabella), moderately oblique, with the anterior tips placed about 0.22× and the posterior tips 0.5-0.55× the glabellar width from the axial furrows; the lobes are narrow, defined by deep palpebral furrows, and the short ocular ridges are distinct. The interocular cheek is 0.5, and together with the palpebral lobe 0.7 of the glabellar width; an emargination is evident in the edge of the cheek at the palpebral furrow opposite the third glabellar lobe—a structure observable also in some cranidia of *F. fecunda* sp. nov.

The occipital lobe is subpentagonal and long (0.27 of glabellar length); its front has a pair of short dents, and a marginal knob represents the undeveloped median spine; the occipital furrow is narrow and deep.

The axial furrows are also narrow and deep. The glabella is long, in the rear as wide as 0.55× its length; it expands moderately forwards to the level of the ocular ridges, and attains about 1.2× its width in the rear; in front of the ocular ridges the glabella is contracted abruptly to give space for the posterior fossulae; the frontal part of the glabella is evenly rounded. Four pairs of short and shallow glabellar furrows can be seen in whitened specimens. In the holotype, Plate 31, fig. 1, a shallow transcurrent furrow connects the posterior glabellar furrows; it is reminiscent of immature *F. fecunda,* but also of *Poliellina.* Only one pygidium is available; its axial lobe has four annulations and resembles pygidia of *F. fecunda* of a similar (5.0 mm) length, as for example Plate 11, fig. 7, In *F. labda,* however, the axial lobe tapers relatively rapidly, its shape is almost conical, and no axial nodes are apparent; the festoons on the tips of the ribs are vestigial or even absent, and only three pairs of pleural furrows are evident. A border is missing and the furrows extend close to the margin.

Comment on illustrated specimens

All specimens come from locality H4, Huckitta Sheet area, Northern Territory. The holotype crandium, Plate 31, fig. 1, CPC 18986, is 7.0 mm long. Posterolateral limbs are lost, the rim is damaged, but the occipital lobe is preserved; the test is almost intact.

The cranidium Plate 2, fig. 5, CPC 18822 is 4.0 mm long and smaller than the holotype. The rim is preserved but slightly flattened.

The free cheek Plate 3, fig. 1, CPC 18824 is 8.8 mm long to the tip of the genal spine; the border and even the genal spine are punctate.

The pygidium Plate 2, fig. 6, CPC 18823 is 5.0 mm long without the half-ring. It is distorted.

Occurrence and age: Fuchouia labda sp. nov. has been collected at site H4, Huckitta Sheet area, Northern Territory in a black bituminous limestone attributed to the Arthur Creek beds; the age is presumably the Zone of *Ptychagnostus atavus,* and rather early in that zone.

Fuchouia atopa sp. nov.

Plate 3, figs. 7-9; Plate 9, figs. 3a-3c;
Plate 10, figs. 1-2b; Text-figure 19

Material: The illustrated material consists of five cranidia and one pygidium; altogether eight cranidia and three pygidia have been identified in the collections; only holaspides are available.

Holotype: The cranidium Plate 3, fig. 8, CPC 18831, loc. M186, is selected as the holotype.

Diagnosis: Fuchouia atopa sp. nov. is distinguished by almost parallel glabellar flanks, visibly impressed glabellar furrows, moderately long palpebral lobes (0.55-0.6 of glabellar length), five axial annulations in the holaspid pygidium, evenly curved (not angulate) pygidial pleural furrows and ribs, and a slightly concave pygidial periphery without festoons.

Differential diagnosis: Specimens of *Fuchouia* are relatively rare as compared with the associated rather abundant *Fuchouia fecunda*; but adequately preserved *atopa* and *fecunda* can be separated from each other even by their general appearance.

In *Fuchouia fecunda* the palpebral lobes are longer, the glabellar flanks are concave, the glabellar furrows are obsolete in late meraspides and in holaspides, and its holaspid pygidium has four annulations in the axis, its ribs and pleural furrows are angulate, and the periphery is flat but festooned. In *Fuchouia quadrata* Resser & Endo (1937, pl. 39) the pygidial axis has also five annulations and the glabellar furrows are well impressed; but the pygidial axis and the glabella are broader, a brim and a plectrum are absent, and the rim is narrow and upturned; the other Asian forms are discussed in the description of the genus *Fuchouia* (q.v.). The parallel-sided glabella slightly expanded in front recalls *F.? bensoni* and *Dolicholeptus ansatus* sp. nov. which are, however, different in other characters.

I presume that in meraspides of *Fuchouia atopa* the glabella should be clavate and differ little from *F. fecunda.*

Description: The posterior sutures are sinuate, the posterolateral limbs are spatulate and expand abaxially, before curving rearward to cut the posterior margin; the intergenal spines are placed close to the tips of the posterolaterals. The length of the frontal area is variable between 1.5 and 2.0× the glabellar length; the rim is flat or almost so; the plectrum is defined in its rear by a faint crest spanning between the anterior fossulae, as seen in Plate 9, fig. 3a and Plate 10, fig. 1.

The palpebral lobes, variable in length (0.55-0.6 of the glabella, and therefore of a moderate size) are oblique having the posterior tips at the distance of 0.5× glabellar width from the axial furrows. They are evenly arcuate except for a small deviation at the anterior end which corresponds to a slight emargination in the edge of the interocular

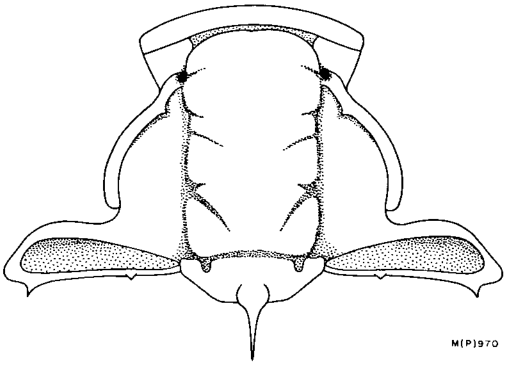


Fig. 19. *Fuchouia atopa* **sp. nov., cranidium.**

cheek, seen also *F. fecunda*; the ocular ridges are horizontal. The interocular cheeks are moderately tumid (Pl. 9, fig. 3c), horizontal, and slightly wider than half the glabella; their posterior swelling overshadows the adaxial section of the pleuro-occipital furrows (as common in most of the Horonastinae).

The occipital lobe is crescentic, has two dents in its front, is transversely rugose (Pl. 10, fig. 1), and carries a slender marginal median spine.

The axial furrows are narrow and well incised, and surround the glabella; the anterior fossulae seem stronger than the posterior ones.

The rear width of the glabella is 0.6× the length; its flanks are straight except for an almost imperceptible concavity about the second pair of glabellar furrows; the frontal part is slightly and visibly expanded, especially in the holotype. Four pairs of glabellar furrows are present; but they are shallow and therefore, not very photogenic. The test is punctate and densely and minutely granulose.

To supplement the description of the pygidium in the diagnosis, its axial annulations are equipped with low median nodes; in the second and third annulation the non-functional articulating half-rings are visible, and are indicated even in the posterior annulations. The axial lobe is slender, about 0.25× the shield's width. Three pairs of fused interpleural grooves can be seen as narrow lines with elevated borders. The shield's rear is slightly emarginate. This single pygidium is assigned to *F. atopa* as the only choice, because it cannot belong to *F. fecunda*: the larger, holaspid pygidia of the latter have four axial annulations, and the fourth is losing in definition (specimens 24-29), whereas the *atopa* pygidium, as large as specimen 28, has five (and not four) annulations.

Comment on illustrated specimens

All material comes from the limestone attributed to the Currant Bush Limestone, in the Lawn Hill Sheet area, Queensland, and the adjacent easternmost part of the Mount Drummond area, Northern Territory.

The holotype cranidium, Plate 3, fig. 8, locality M186 (Northern Territory) is 11.0 mm long. The right posterolateral limb is slightly deformed, but the test and convexity of the whole are preserved. In the illustration the glabellar furrows seem weaker than in the actual specimen. Venulosity is apparent in the rear of the right interocular cheek and a part of the posterolateral limb.

The fragmentary cranidium Plate 3, fig. 9, locality M377 (Queensland), CPC 18832 is 7.6 mm long. The rock is a dark aphanitic bituminous limestone. This cranidium is assigned to *atopa* on account of the short brim and the short palpebral lobe, slightly less than 0.6 of glabellar length.

The pygidium Plate 3, fig. 7, CPC 18830, locality M180 (Northern Territory) is 6.3 mm long without the half-ring. From the same locality M180 a cranidium and another pygidium 6.5 mm long are included in the paradigm, but not illustrated.

The cranidium Plate 10, fig. 1, CPC 18858 is 9.0 mm long. Its chevron of rugae on the occipital lobe is quite strong. The original papillosity of the test is preserved on the left interocular cheek.

The cranidium Plate 9, figs. 3-3c, CPC 18857, locality M186, is 8.9 mm long; it is complete, with both the posterolateral limbs preserving their intergenal spines. In frontal view (fig. 3c) the anterior fossulae are well visible, the front is arched upward and the interocular cheeks are tumid; the rim is slightly convex.

The cranidium Plate 10, figs. 2a & 2b, CPC 18859 is about 9.3 mm long. The posterior, rugose part of the occipital lobe has collapsed over the void lined by the articulating doublure, and the glabellar front is pressed down from the level of the brim. The occipital dents appear as a pair of pits; weak and widely spaced caecal veins are evident on the brim, and delicate veins can be distinguished on the interocular cheeks as fanning out from about the posterolateral corners of the glabella.

Occurrence and age: Fuchouia atopa sp. nov. is scattered in strata assigned to the Currant Bush Limestone in the Lawn Hill area (Queensland) and the adjacent part of the Mount Drummond area (Northern Territory). Its age is the Zone of *Euagnostus opimus.*

Fuchouia sp. nov. aff. **atopa**

Plate 9, fig. 2

The illustrated cranidium, CPC 18856, is 7.4 mm long. The palpebral lobes are 0.6 of glabellar length and somewhat shorter than in *F. fecunda*, and the glabellar flanks are straight (not concave)—characters reminiscent of *F. atopa* sp. nov.; but the glabellar furrows are absent, as in *F. fecunda.* The occipital spine is very short—only a tubercle, and almost as small as in *F. labda* (q.v.). The occipital lobe is transversely rugose, the test is apparently impunctate and ornamented by a minute and dense granulosity. The posterior fossulae are distinct, the anterior ones are shallow. On the brim, widely spaced caecal veins are indicated whose junctions with the rim are developed into prominent knobs with intercaecal pits; it is a structure not seen hitherto in dolichometopids.

Occurrence and age: The specimen was collected by Mr M. A. Randal in the vicinity of localities M180-M186, in the sequence attributed to the Currant Bush Limestone. The age is the Zone of *Euagnostus opimus.*

Fuchouia morstonensis sp. nov.

Plate 3, figs. 2, 4-5, 3?

Material: The illustrated material consists of one cranidium and free cheek, one pygidium, and one hypostoma, all collected from a single bedding plane of a chert layer. The hypostoma fig. 3 cannot be definitely attributed to *F. morstonensis* as explained in the comment below.

Holotype: The cranidium, Plate 3, fig. 5, CPC 18828, is selected as the holotype.

Diagnosis: Fuchouia morstonensis sp. nov. is distinguished by its slightly forward-tapering glabella, well impressed glabellar furrows, a relatively long frontal area, and relatively well elevated median nodes of the pygidial axis; no festoons are evident in the pygidium.

Differential diagnosis: F. morstonensis has long palpebral lobes, a brim and a rim, and in general terms is close to *F. fecunda*, whose glabella, however, expands forward and has concave flanks, and the frontal area is also shorter; furthermore, median nodes in the pygidium of *F. fecunda* are vestigial. Further differences are found in the description that follows.

Description: The free cheek has an almost evenly curved margin and a relatively short deflected spine; the shield is also somewhat narrow in its posterior part—narrower than in *F. fecunda.* The posterior sutures are sinuous, the posterolateral limbs spatulate, and intergenal spines are present. The frontal area is 0.27 of glabellar length and longer than in *F. fecunda* (variable, 0.16-0.2). The palpebral lobes are not preserved, but the position of their tips is discernible, indicating a length of the lobes about 0.7 of the glabella. The glabellar flanks are almost straight, but a slight expansion is evident in front of the eyes; the rear width of the glabella is about 0.7× its length—and therefore wider than in *fecunda.* Four pairs of glabellar furrows are visible, the two posterior pairs are relatively strong, and the posterior furrows are swept rearward and almost reach the occipital furrow.

The pygidium (which is 5.8 mm long) has four annulations in its axis as have pygidia of *F. fecunda* of a similar size. The axial lobe is 0.8 of the shield's length, apparently shorter than in other species. The pygidial pleural lobes are not flat but slightly tumid.

Comment on illustrated specimens

The holotype cranidium, Plate 3, fig. 5, is 10.0 mm long; some of its silicified test is preserved.

The free cheek Plate 3, fig. 2, CPC 18825 is 10.3 mm long from tip to tip. The test is silicified.

The pygidium Plate 3, fig. 4, CPC 18827 is 5.8 mm long. Visible is a part of its very narrow doublure; the axial nodes are prominent and the pleural lobe is slightly convex.

The hypostoma Plate 3, fig. 3 is 5.0 mm long; it has a marginal frame with two pairs of spines and prominent maculae and resembles *F. fecunda*; but hypostomata of a similar structure belong also to *Eurodeois, Sunia,* and *Undillia.* Furthermore, *F. morstonensis* is associated with cranidia of *Itydeois* (q.v.) whose hypostoma is unknown. The specimen is quite large (5.0 mm long) and should correspond to a cranidium as long as, or slightly longer than, the holotype; but by its size it may fit also the *Itydeois* cranidium, Plate 32.

Occurrence and age: Fuchouia morstonensis has been collected at locality M160, a chert layer in fine-grained and impure platy dolomite of the Age Creek Formation, Camooweal Sheet area, Queensland; its age is the Zone of *Euagnostus opimus.*

Fuchouia? bensoni (Öpik, 1961)

The dolichometopid species *bensoni* was originally attributed to *Amphoton*, but with the provision (Öpik, 1961, p. 140) of being intermediate between *Amphoton, Fuchouia,* and *Sunia* and possibly representing a separate subgenus of *Amphoton.* The name *Amphoton* at that occasion was applied in acceptance of *Dolichometopus deois* as its type species. It is apparent, however, that neither *Amphoton* and *Sunia* nor *Eurodeois* as understood in the present Bulletin can accommodate the species *bensoni*, which is structurally close to *Fuchouia*: (1) as stated earlier (op. cit.), in its pygidium the pleural furrows almost reach the margin and its border is very narrow, and (2) the palpebral lobes, about 0.45 of glabellar length, are as short as in *Fuchouia manchuriensis* (Walcott). The glabella is furrowless, slender and expanded in front (clavate) reminiscent of *Fuchouia atopa* nov., but also of *Dolicholeptus ansatus* nov., whose frontal area and pygidium are, however, different. In *F.? bensoni*, incidentally, the rim close to the sutures is as convex as the border of the free cheeks. It is, however, correct that the free cheek of *F.? bensoni* with its advanced and deflected short spine reminds one of *Undillia rustica* nov. and not of cheeks of known species of *Fuchouia.* This aberrant structure of the free cheek of *bensoni*, together with the acute posterolateral tips and pygidial corners, is the reason why the generic classification (*Fuchouia?*) is queried.

The age of *Fuchouia? bensoni* is the lower part of the Zone of *Proampyx agra*—the middle of the three zones with *Leiopyge laevigata* (vide Öpik, 1961b, p. 141).

Genus **Dolicholeptus** nov.

The type species of *Dolicholeptus* is *D. ansatus* sp. nov.

Diagnosis: The species of the dolichometopid genus *Dolicholeptus* are distinguished by a combination of cranidium with a convex rim and narrow interocular cheeks, a glabella with vestigial glabellar furrows, very long axial spines and a short pygidium with deep pleural furrows, a relatively long axial lobe and an obsolete or indistinct narrow border; the pleural ribs terminate in slightly swollen festoons—which are rather weak in holaspid but prominent in meraspid shields. Intergenal spines are absent.

Differential diagnosis: The pygidia of *Dolicholeptus* are structurally close to *Fuchouia*, but differ from the latter by the smaller number of axial annulations and the broadness of the axial lobe; the particular similarities are the rearward-swept pleural ribs, the extension of the pleural furrows to the margin, and the festoons which in *Fuchouia* (for example Pl. 10, fig. 4) are retained in maturity, and in *Dolicholeptus* are best expressed in meraspides. Quite similar is also the pygidium of *Corynexochus spinulosus* Angelin (Westergaard, 1948, pl. 3, fig. 9). Reminiscent of *Fuchouia* is also the incidence of a plectrum and the convexity of the rim. Narrow interocular cheeks (narrower than in *Dolicholeptus*) occur also in *Undillia rustica*, which, however, is different regarding other characters. Long axial spines are present also in *Sunia* and in some species of *Eurodeois*, and weak glabellar furrows in other forms; these structures are significant in combination with others but alone are inconclusive regarding matters of affiliation. The free cheek is reminiscent of *Fuchouia*, but not of the exorbitant shields of *Eurodeois* and *Undillia*, nor of *Sunia* with its widened base of the genal spine. The absence of intergenal spines is of some significance because these are present in *Fuchouia* and in the bulk of the dolichometopids described in this Bulletin.

The following five species taxa are included in *Dolicholeptus*: (1) *D. ansatus* nov., the type of the genus; (2) *D. licticallis* nov., (3) *D. baiatus* nov., (4) *D.* cf. *ansatus* (?sp. nov.), and (5) *D. kallalicus* nov.

Dolicholeptus ansatus sp. nov.

Plate 15, figs. 6, 7; Plate 16, figs. 1-4;
Plate 26, fig. 3, Text-figure 20

Material: The illustrated material consists of three cranidia and three pygidia. Some 25 cranidia and seven pygidia have been examined. The separation of the pygidia and free cheeks of *D. ansatus* from the shields of the concomitant *Undillia rustica* is discussed under the latter.

Holotype: The cranidium Plate 15, fig. 7, CPC 18896 is selected as the holotype; its posterolateral limbs are lost, but those of the specimen in Plate 15, fig. 6 are preserved.

Diagnosis: Dolicholeptus ansatus sp. nov. has a short frontal area comprising a convex rim and a brim with plectrum, very long occipital spine, and weak glabellar furrows; and is distinguished by long palpebral lobes placed close to the glabella, narrow, band-like posterolateral limbs, straight glabellar flanks slightly converging behind the ocular ridges, and an expanded glabellar front; its pygidium is relatively short—about half the shield's width, is thickened along the margin, and lacks a border.

Differential diagnosis: In *Dolicholeptus licticallis* sp. nov. the glabella is widened in the middle, the palpebral lobes are short, the posterolateral limbs are triangular; the length of the pygidium is less than half its width, and it has an indistinct depressed border. Further differences are discussed under *Dolicholeptus baiatus* nov., and *D.* cf. *ansatus* (?sp. nov.).

Description: The cephalon of *Dolicholeptus ansatus* is roughly semicircular in plan, but the slope of the free cheeks and posterolateral limbs is unknown; unknown also is the number of segments in the thorax; eight are preserved in a small headless and tailless fragment which itself is incomplete; ten to eleven segments, however, are possible. The pygidium is relatively small, apparently smaller than in

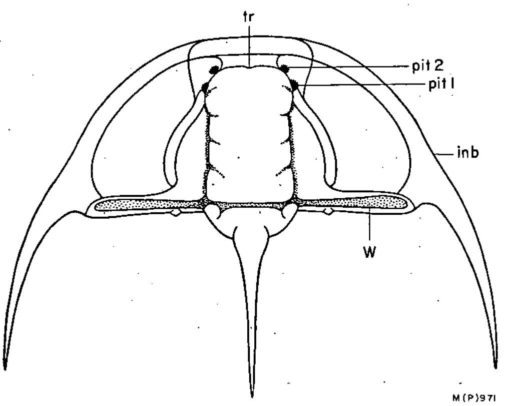


Fig. 20. *Dolicholeptus ansatus* **sp. nov., cephalon restored. inb—inbent margin of free cheek; pit 1—posterior fossula; pit 2—anterior fossula; tr—plectrum; W—posterolateral limb (no intergenal spines in** *Dolicholeptus*).

Fuchouia fecunda nov. and estimated 0.35-0.4× the cephalic length.

The free cheek shown restored from fragmentary specimens in Text-figure 20 is broad, with a deflected and long genal spine whose base is somewhat expanded (but less than in *Sunia*); the margin of the free cheek is also slightly inbent.

The posterior sutures are diametrical; the posterolateral limbs are narrow transverse bands, and the posterolateral marginal furrow, distally wide, is abaxially narrow owing to the swollen and rearward-expanded interocular cheek; the fulcra are prominent.

The anterior sutures diverge only slightly and the frontal area is narrow transversely, 'in style' with the narrow, slender axial part of the cephalon. The frontal area, about 0.22 of the glabellar length, is equally divided between the rim and the brim.

The palpebral lobes, 0.7 of the glabellar length, are long, with the posterior tips at a distance of 0.3 of the glabellar width from the axial furrows. The interocular cheeks, 0.5 and 0.35 of the glabellar width with and without the palpebral lobes, respectively, are narrow and long.

The axial furrows are narrow, and somewhat shallow around the glabellar front; bacculae or alae are absent, but the fossulae (two pairs) are discernible. The occipital furrow is distinct in the middle, but shallow abaxially; the occipital lobe is only slightly wider than the rear of the glabella and has only one pair of weakly impressed dents.

The glabella is somewhat slender, as wide as 0.68× (less than 0.7×) its length; its flanks are straight but slightly converging till the third glabellar furrows, and the frontal part is visibly expanded, creating a weakly clavate shape of the whole; the front is almost straight and shows sometimes an almost imperceptible median notch. In longitudinal profile the glabella is evenly arched, without the steep frontal slope seen in some other dolichmetopids. Five pairs of very weak glabellar furrows are discernible in whitened specimens.

The pygidium is subtriangular to semicircular, as long as 0.5× its width; it is thickened along the margin by the low pleural festoons. Two pairs of weak interpleural grooves are evident. Three pairs of recurving pleural furrows are developed; the posterior ones are short and narrow, the anterior furrows are deep, broad and sinuate, and with pointed tips from which their very narrow distal ends extend to the margin. The pleural ribs are prominent, adaxially pointed and distally swollen into festoons. The cushions in the pleural furrows at the axial lobe are short and low. The axial lobe is broad (about 0.35 of shield's width), elevated, slightly tapering to the prominent rounded terminus which almost reaches the margin. Three annulations are present, the second and third exposing the non-functional half-rings. The fulcra are widely separated from each other by 0.75 of the shield's width and are prominent, but the facets are relatively small. An interpretation of the structure of the thorax deduced from the fulcral distance and given below under *D. licticallis* sp. nov. is also applicable to *D. ansatus*.

The test is punctate.

Comment on illustrated specimens

The four following specimens come from locality M54, V-Creek Limestone.

The cranidium Plate 15, fig. 6, CPC 18895, a rubber cast of the exterior, is 7.8 mm long; it is flattened, showing the posterolateral limbs in plan. It has no intergenal spines.

The holotype cranidium, Plate 15, fig. 7, CPC 18896, is 5.7 mm without, and 11.0 mm with, the occipital spine. Vestigial glabellar furrows are discernible.

The pygidium Plate 16, fig. 1, CPC 18897 is 4.2 mm long (without the half-ring). The distal ends of the pleural ribs are weakly festooned and the margin is thickened. The test of the terminus is abnormal, with a window of test over a patch of the earlier test accidentally retained after moulting.

The pygidium Plate 16, fig. 2, CPC 18898 is 3.5 mm long (without the half-ring); the test of the terminus is normal (windowless); the pleural furrows are broad but change abruptly into distal narrow incisions; festoons on the pleural ends are weak; the posterior transverse furrows are incomplete.

The cranidium Plate 16, fig. 3, CPC 18899, locality M52, from a chert lamina in V-Creek Limestone, is 6.8 mm long (with the stump of the occipital spine). It is associated with a cranidium of *Asthenopsis*.

The pygidium Plate 16, fig. 4, CPC 18900 is 3.0 mm long; its locality, M41, is close to M52 (see above) and the matrix (chert laminae) is the same in both places.

The hypostoma Plate 26, fig. 3, CPC 18958 is 7.0 mm long; the matrix is chert, a lamina in V-Creek Limestone, locality M41. This chert occurs as litter on the limestone surface and contains an abundance of trilobites; cranidia of *Dolicholeptus ansatus* are also present in the chert. Only lateral spines are present and a small median node is present between the maculae.

Occurrence and age: Dolicholeptus ansatus sp. nov. occurs in the middle and upper parts of the V-Creek Limestone, Camooweal Sheet area, Queensland; its age is the Zone of *Doryagnostus notalibrae.*

Dolicholeptus cf. **ansatus** (?sp. nov.)

Plate 16, figs. 5, 6; Plate 17, fig. 7

Material: Three cranidia are illustrated, selected from two different localities.

Description: The glabella, as wide as 0.6× its length, is narrower than in *D. ansatus,* and the palpebral lobes, 0.6× the glabellar length, are shorter than in *ansatus* but longer than in *D. licticallis* sp. nov.; furthermore, the posterolateral limbs widen (longitudinally) in an adaxial direction, but less than those of *licticallis.* The shape of the slender glabella, however (straight flanks and slightly expanded frontal part), is visibly similar to *D. ansatus,* and not to *D. licticallis.* The species nomenclature is nevertheless open for the following reasons: (1) the material consists only of cranidia and needs supporting evidence from pygidia and free cheeks which are still unknown; (2) the form as described above is still different from *D. ansatus* and can be taken as a separate taxon (a species; or a subspecies of *ansatus*); and (3) it is of a uniform morphology with a relatively wide areal distribution, and of some duration; the specimen Plate 16, fig. 6 is older than the other illustrated cranidia.

The cranidium Plate 16, fig. 6, CPC 18902 comes from site M64, high in the Currant Bush Limestone, Camooweal area; the matrix is dark and bituminous; it is associated with several similar cranidia; the age is late *Ptychagnostus punctuosus* Zone.

The cranidium Plate 16, fig. 5, CPC 18901 is 5.4 mm long; the cranidium Plate 17, fig. 7, CPC 18909 is 7.5 mm long. These two cranidia (and three more) come from the V-Creek Limestone at locality M247 in the Mount Isa Sheet area, Queensland. The matrix is pale bluish grey laminated limestone with a fauna consisting of *Papyriaspis lanceola* Whitehouse, *Mapania angusta* (Whitehouse), *Eurodeois marginicrassa* sp. nov., *Asthenopsis, Goniagnostus nathorsti, Doryagnostus magister,* and other agnostids. The age is the Zone of *Doryagnostus notalibrae.*

Dolicholeptus licticallis sp. nov.

Plate 16, fig. 7; Plate 17, figs. 1-6;
Text-figure 21

Material: Illustrated are three cranidia, one free cheek, one segment of the thorax, and one pygidium. Fourteen cranidia, one free cheek, five pygidia, and several parts of the thorax have been examined.

Holotype: The cranidium Plate 17, fig. 2 is selected as the holotype.

Diagnosis: Dolicholeptus licticallis sp. nov. has a very short frontal area with a convex rim almost confluent with the weak plectrum and an undeveloped brim, long occipital spine, and no glabellar furrows; it is distinguished by short palpebral lobes, triangular posterolateral limbs, and outward convex glabellar flanks slightly behind its middle, and a pydigium whose length is less than its width.

Differential diagnosis: D. licticallis differs from the type of the genus (*D. ansatus*) by all its diagnostic characters; the discrimination of pygidia alone, however, is somewhat uncertain because their structure in both lacks stability. The difference from *D. baiatus* is discussed under that species.

Description: Dolicholeptus licticallis regarding its structure and general appearance is close to *D. ansatus.* In the free cheek the genal spine is slightly deflected and, owing to the relatively small eyes, the posterior sutures are oblique (diametrical in *D. ansatus*); for the same reason the posterolateral limbs are triangular. The anterior sutures diverge slightly and the frontal area is transversely narrow; it consists of a convex rim and a very short brim which may be even suppressed almost completely; the plectrum is, therefore, also weakly developed. The frontal area is somewhat less than 0.2 of the glabellar length.

The palpebral lobes are relatively short, variable between 0.5-0.55 of glabellar length, with posterior tips very close to the glabella—at a distance of about 0.26 of glabellar width from the axial furrows. The interocular cheek is about 0.3 of the glabella and, therefore, narrow, even narrower than in *D. ansatus.*

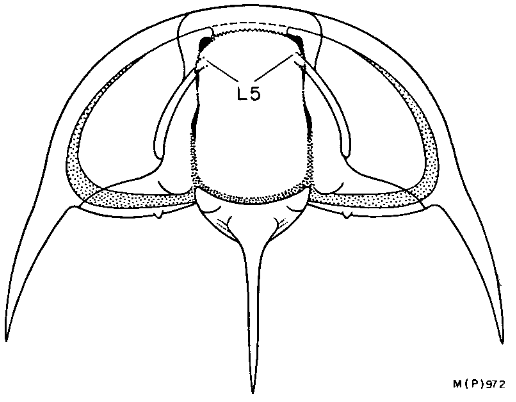


Fig. 21. ***Dolicholeptus licticallis*** **sp. nov., reconstruction of cephalon. L5—fifth glabellar lobe.**

The occipital furrow is shallow and narrow; dents on the front of the occipital lobe are effaced and the long medial spine rises in a retral curve from a broad base.

The axial furrows are very narrow, distinct, and deepened in the middle. The glabella, as wide as 0.65-0.7× its length and widest in the middle, seems plump, with its flanks bulging laterally slightly behind its middle. It is also expanded, as in *D. ansatus,* about the level of the anterior palpebral tips, and is well rounded in front. Glabellar furrows are absent, but in Plate 17, fig. 6a muscle spots and oblique lines (as in *Dolicholeptus baiatus* sp. nov.) are weakly indicated.

The thoracic segment Plate 17, fig. 4 is described in the comment below.

The pygidium is relatively wide, its length being 0.4× its width. The pleural furrows, three pairs, are deep but less wide than in *D. ansatus.* The border, which is narrow and weak in the illustrated specimen, is even less developed in some of the other pygidia. The festoons of the pleural ribs are weak and masked by the border. The fulcra are far apart, at a distance of 0.75 of the shield's width from each other. This relative distance is also large in the segment of the thorax (Pl. 17, fig. 4), but narrower in the rear margin of the cranidia; it appears, therefore, that the fulcral lines of the thorax may have been subparallel. The same interpretation of the structure of the thorax is also applicable to *D. ansatus.*

The test is punctate.

The cranidium Plate 17, figs. 6a and 6b comes from collecting site M118; all other specimens were collected at site M41 from a single bed of greenish grey sandy limestone, interbedded in marly limestone.

The piece of limestone shown in Plate 16, fig. 7 contains the two cranidia Plate 17, figs. 1 and 2, the thoracic segment Plate 17, fig. 4, and the pygidium Plate 17, fig. 5.

The cranidium Plate 17, figs. 1a and 1b, CPC 18903 is 14.3 mm long to the tip of the occipital spine and 9.2 mm without the spine. The posterolateral limbs are flattened in plan, but otherwise intact; the glabellar flanks seem less convex outward than in the holotype; the plectrum has collapsed and the rim is therefore accentuated.

The holotype cranidium, Plate 17, fig. 2, CPC 18904, is 9.8 mm long without, and 13.8 mm with, the occipital spine. The separation of the plectrum from the rim is diffuse; the anterior fossulae are well impressed and the glabella is slightly carinate.

The free check Plate 17, fig. 3, CPC 18905 is 9.0 mm long from tip to tip.

The thoracic segment Plate 17, fig. 4, CPC 18906 was originally about 12.8 mm wide; note the strong convexity of the axial lobe, the triangular cushion in the pleural furrow, the distal position of the fulcra, and the straight lateral margin of the pleura. The tip of the pleural furrow reaches the rear margin of the pleura.

The pygidium Plate 17, fig. 5, CPC 18907 is 4.2 mm long (without the half-ring). The axial lobe is twisted owing to the abnormal asymmetry of its second annulation. The border is accentuated through flattening and collapse over the doublure; the test of the terminus has a window over a patch of the test retained from the preceding exuvia.

The cranidium Plate 17, figs. 6a and 7b, collection M118, CPC 18908 is 8.5 mm long as preserved. The palpebral lobes, 0.5 of glabellar length, are shorter than in other specimens; the rim and the glabellar front are close to each other and the brim and its vestigial plectrum are suppressed. The glabella is weakly baiate and reminiscent therefore of *D. baiatus* sp. nov.

Occurrence and age: Dolicholeptus licticallis occurs in the early half of the V-Creek Limestone and possibly in late beds of the Currant Bush Limestone; its age is early in the Zone of *Doryagnostus notalibrae* (the overlap of *Pt. punctuosus* and *Goniagnostus nathorsti*) and late in the Zone of *Pt. punctuosus;* it is older than *Dolicholeptus ansatus.*

Dolicholeptus baiatus sp. nov.

Plate 20, fig. 4; Text-figure 22

Material: The available material consists of the illustrated cranidium, CPC 18925, salvaged from a collection destroyed in a fire.

Diagnosis: Dolicholeptus baiatus sp. nov. is distinguished by its forward-arched cranidial front, convex rim, absence of a brim, almost parallel-sided glabella, relatively short and narrow palpebral lobes, indistinct palpebral furrows, and the well developed peculiar 'baiate' (palm leaf) pattern on the surface of its test which itself is quite thick.

Differential diagnosis: Dolicholeptus baiatus sp. nov. can be compared only with *D. licticallis* sp. nov., which also has relatively short palpebral lobes and undeveloped brim and plectrum; *D. baiatus* differs, however, by its parallel and straight glabellar flanks (expanded in *licticallis*), total absence of a brim, and vestigial palpebral furrows. A very weak baiate pattern of the glabella may occur also in some specimens of *licticallis* (Pl. 17, fig. 6a); in *baiatus,* however, it is well developed and relatively strong.

Description: The holotype cranidium is 12.0 mm long. The anterior sutures are relatively short owing to the forward-arched margin with rearward-swept wings of the frontal area; the rim (damaged) is convex and separated from the glabella by the deep and narrow frontal furrow. The posterolateral limbs are leaf-shaped to subtriangular, as shown in Text-figure 22. In the photograph they appear advanced owing to their geniculation and slope and the attitude of the specimen. Intergenal spines are absent. The palpebral lobes are narrow, almost without relief, and about as long as 0.55 the glabellar length, and with the distance of the posterior tips about 0.35 of glabellar width from the axial furrows. The interocular cheeks are moderately convex and together with the palpebral lobes as wide as 0.5 of the glabella. The glabella is parallel sided, and has a well rounded front and vestigial lateral furrows. A median flat carina is apparent with some three pairs of forward-diverging laterals and with muscle spots which cannot be readily related to glabellar furrows. The occipital spine is lost but is represented by its quite large base. The test is punctate.

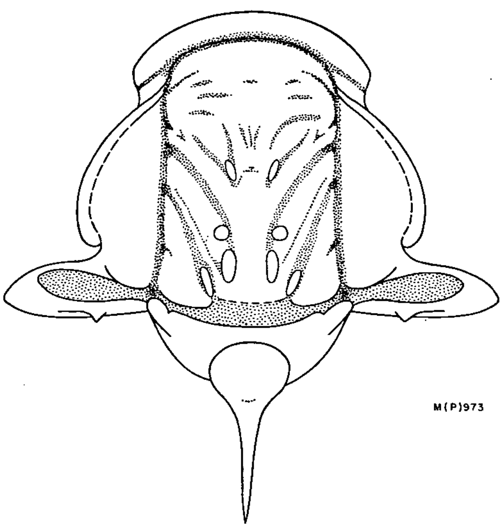


Fig. 22. *Dolicholeptus baiatus* **sp. nov., holotype cranidium restored.**

Occurrence and age: The specimen of *Dolicholeptus baiatus* sp. nov. was collected in the V-Creek Limestone, locality M409, Camooweal Sheet area, Queensland, close to the east bank of the creek; its age is the Zone of *Doryagnostus notalibrae.*

Dolicholeptus kallalicus sp. nov.

Plate 30, figs. 6a, 6b; Text-figure 23

Only one cranidium, the holotype, CPC 18985 is suitable for description. The matrix is friable sandstone, in places slightly hardened as in the case of the holotype, which yielded an external mould for a latex cast.

Diagnosis: Dolicholeptus kallalicus sp. nov. has a well impressed frontal furrow and a rim, and a slight expansion of the pre-ocular glabella; it is distinguished by the flatness of the elevated rim, visibly forward-tapering glabella, wide interocular cheeks, and oblique and arcuate palpebral lobes.

Differential diagnosis: The generic classification with *Dolicholeptus* is speculative because the pygidium of *kallalicus* is unknown and because the structure of its frontal cranidial part (well impressed marginal furrow, well differentiated rim, and expanded glabellar front) are also evident in *Fuchouia* and in *F.? bensoni*—also affiliates of *Dolicholeptus. Amphotonella* of Kobayashi, 1942 (type species: *Dolichometopus alceste* Walcott) has also a tapering glabella, but is otherwise quite disparate as well an insufficiently known for further comparisons.

Description: The holotype cranidium is 14.2 mm long without the occipital spine. The

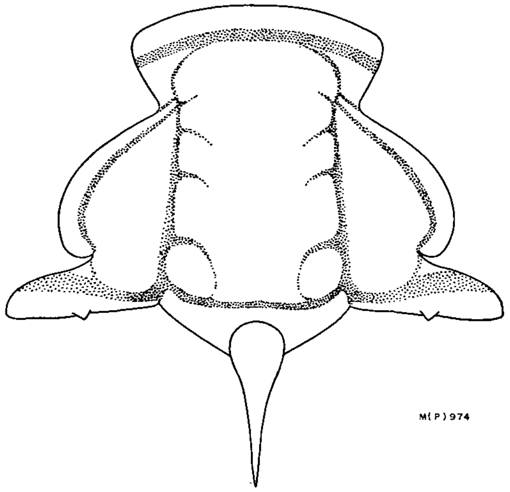


Fig. 23. *Dolicholeptus kallalicus* **sp. nov., holotype cranidium restored.**

posterolateral limbs defined by the oblique posterior sutures are triangular. The anterior sutures are apparently almost straight and divergent and reminiscent of *Fuchouia bensoni,* and the frontal limb is therefore relatively wide; the rim is elevated but flat and the marginal furrow deep and wide; a brim is absent.

The palpebral lobes, about 0.65-0.7 of the glabeller length, are arcuate and continuous with the short ocular ridges; the interocular cheeks together with the palpebral lobes are 0.7 of the glabellar width—wider than in any other Australian dolichometopid.

The crescentic occipital lobe is blunted abaxially and lacks the drawn-out ends common in other forms; the occipital median spine rises from a broad base. The glabella, as wide as 0.7× in the rear, tapers forward to about 0.6× the glabellar length at a level just behind the ocular ridges; its expanded front is still narrower than the rear. Four pairs of glabellar furrows can be distinguished and the posterior furrows intersect the axial furrows a short distance from the occipital furrow and tend to isolate swollen pre-occipital lobes.

Occurrence and age: Dolicholeptus kallalicus sp. nov. occurs in the Steamboat Sandstone, locality D54, Kallala station, Urandangi Sheet area, Queensland; its age is the Zone of *Leiopyge laevigata.*

Genus **Itydeois** nov.

The type species of *Itydeois* is *I. elegans* sp. nov.

Diagnosis: Itydeois nov. refers to dolichometopids with exorbitant margin of the free cheeks and parallel to concave glabellar flanks distinguished by having a well developed frontal limb consisting of a rim and a brim, and a convex to almost flat or even concave pygidial border separated from the pleural lobes by a marginal furrow.

Differential diagnosis: Exorbitant free cheeks are also present in *Undillia* and in *Eurodeois; Undilla,* however, is brimless and has a tapering glabella; *Eurodeois* is also brimless and has a concave pygidial border. In the cranidium of *Sestrostega* (q.v.) the frontal limb is also differentiated into a brim and a rim, but the brim is convex and the rim concave; the glabella is clavate and its occipital structure is peculiar. Its clavate glabella is reminiscent of *Eurodeois deois* (which is brimless) rather than of *Itydeois.* It is possible that *Sestrostega,* being two or three zones older than *Itydeois,* is ancestral to *Itydeois* or *Eurodeois,* or both.

Furthermore, the known species of *Itydeois* are about one or two zones older than *Eurodeois marginicrassa* sp. nov., *Eu. serotina,* and *Eu.* sp. nov. aff. *serotina* (Pl. 21, figs. 1, 2) whose relatively wide border furrow in front of the glabella can be interpreted as a vestigial, reduced brim. Consequently, it is even possible (if required) to regard *Itydeois* and *Eurodeois* as two subgenera of a common genus.

The following four species, all new, are described here: (1) *Itydeois elegans,* the type of its genus; (2) *I. vultuosa;* (3) *I. balli;* and (4) *I.* sp. nov. aff. *vultuosa.*

These species are the oldest known dolichometopids with exorbitant free cheeks, older than *Undillia* and the Australian and Asian species of *Eurodeois* and *Sunia.*

Ecologically, the species of *Itydeois* are rare itinerants in the Undilla Basin as can be concluded from the following: (1) the number of finds is very small, and only holaspides have been collected; (2) their age is a single zone—the Zone of *Euagnostus opimus*—and younger or older material has not been discovered so far; and (3) all sites of *Itydeois* (*I. balli* excepted) are within the Age Creek Formation and its margins interfingering with the Currant Bush Limestone.

Itydeois elegans sp. nov.

Plate 14, figs. 1-5; Text-figure 24

Material: Illustrated are two cranidia, one free cheek and two pygidia; two more cranidia and one more free cheek have been examined.

Holotype: The cranidium Plate 14, fig. 1, CPC 18885 is the best preserved and is selected as the holotype.

Diagnosis: Itydeois elegans sp. nov. has a convex rim, subparallel glabellar flanks, moderately wide interocular cheeks, triangular posterolateral limbs of a moderate length, and is distinguished by a lateral expansion of the second glabellar furrows, and a longitudinal step of the interocular cheeks facing the palpebral lobes.

Differential diagnosis: Itydeois vultuosa sp. nov. is rather different having a flat rim, concave glabellar flanks, well developed glabellar furrows, relatively wide interocular cheeks (which are stepless) and exceptionally long and spatulate posterolateral limbs. *Itydeois balli* sp. nov. seems closer to *elegans* in having a convex rim and subparallel glabellar flanks, but its glabellar furrows are well impressed, and its interocular cheeks are stepless and narrow.

Description: The cephalon of *Itydeois elegans* is somewhat parabolic and owing to the exorbitant flanks even reniform in outline; the thorax is unknown; the pygidium is relatively large, about 0.65× the cephalic length assuming the holotype cranidium and the pygidium Plate 14, figs. 3a and 3b are parts of a single exuvia; if this is correct *I. elegans* has a pygidium larger than *Eurodeois deois* (Walcott) whose pygidium is only 0.5× the length of the cephalon (vide Kobayashi, 1942, pl. 1, fig. 10).

In the free cheek the marginal furrow is broad and the border convex at the rim; the genal spine is slightly deflected and curved; it is a relatively large, broad shield.

The posterior sutures are curved and cut the margin quite close to the base of the genal spines; the posterolateral limbs are triangular blades, of a shape seen also in *Sunia cornunda* sp. nov. and in several Australian species of *Eurodeois;* the intergenal spines are close to the tips and the fulcra are well developed; at the swollen rear of the interocular cheeks the posterolateral furrow is very narrow, but it widens abaxially.

The anterior sutures diverge only little; the frontal limb, 0.2-0.25 of the glabellar length, is differentiated into a forward-sloping brim and a slightly convex rim of about the same length; the margin is well arched forward and marginal terraced lines are visible. The palpebral lobes are rather narrow and flat, as long as 0.65-0.7 of the glabellar length, and the

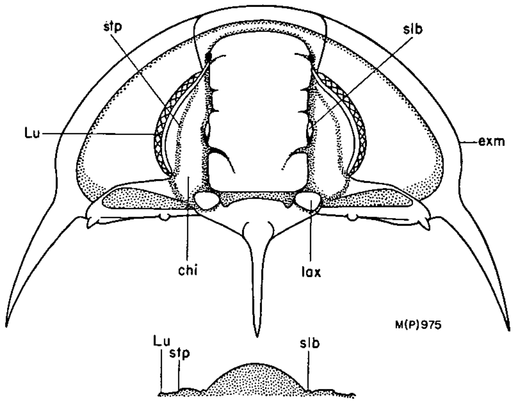


Fig. 24. ***Itydeois elegans*** **sp. nov., composite diagram of cephalon. chi—swelling of interocular cheek; exm — exorbitant margin; lax — lateral lobule of occipital lobe; Lu—palpebral lobe; slb—subsidiary lobule; stp—step in the interocular cheek.**

palpebral furrows are faint. The palpebral furrows are moderately close to the glabella with their posterior tips at a distance of 0.35 of glabellar width from the axial furrows and the very narrow anterior tips in contact with the glabella. The interocular cheeks together with are 0.4, and without the palpebral lobes 0.35, of the glabellar width; they are narrower than in *I. vultuosa* nov. and wider than in *I. balli.* The interocular cheek is long and its posterior prominent swelling impinges on the posterolateral furrow; it is also complicated by a longitudinal step (see Text-figure 24) facing the palpebral lobe. This step of the interocular cheek is a unique structure inherent to *elegans* and retained even by the flattened cranidium Plate 14, fig. 4.

The occipital lobe has a pair of dents in its frontal border, is as wide as 1.2-1.25× the glabellar rear, and its extremities are swollen forming prominent lobules; in its structure the lobe is close to other Australian dolichometopids, as for example *Sunia cornunda* sp. nov.

The axial furrows are narrow, unevenly deep, and well impressed around the glabella; the glabellar front is evenly rounded and its flanks are straight except for the lateral subsidiary lobules at the second glabellar lobe; similar lobules are present also in *Sunia lorenzi* sp. nov. (Text-figure 31). The glabellar furrows are very weak, even weaker than shown in Text-figure 24. The posterior fossulae are distinct but the anterior ones are indiscernible.

The test is minutely punctate and the occipital lobe is somewhat rugose; the pygidial border is ornamented by regular raised lines running parallel to the margin, and a similar ornament running to the tip of the genal spine is present on the border of the free cheek, apart from the stronger marginal terraced lines. This ornament is preserved on the external mould.

The pygidium is subcircular, without marginal spines, and with a well defined slightly convex border and a shallow marginal furrow; the relief of the pleural lobes is quite subdued, but three pairs of broad pleural furrows are discernible on internal casts. The axial lobe is long, reaching the border with its bluntly rounded terminus; the two anterior axial annulations are distinct, but the third is obscure; it seems (Pl. 14, fig. 3b) that the pygidial axial lobe is delicately carinate and there are two tiny marginal axial nodes present.

Comment on illustrated specimens

The holotype cranidium, Plate 14, figs. 1a & 1b, locality M161, CPC 18885 is 11.3 mm long; the matrix is yellow-brown sandy limestone, and the test is indurated by iron oxide. The base of the median occipital spine is evident in the rubber cast, fig. 1b; the intergenal spines are recognisable from their stumps. Note the step of the interocular cheek facing the palpebral lobe.

The free cheek Plate 14, fig. 2, CPC 18886 is 15.6 mm long from tip to tip. It is associated with the holotype, in one and the same piece of limestone. Coarse terraced lines are visible along the margin as well as on the frontal margin of the holotype; it is quite probable that the holotype cranidium and the free cheek are parts of a single exoskeleton.

The pygidium Plate 14, figs. 3a and 3b, CPC 18887 is 7.5 mm long without the half-ring. It is partly an external, and partly an internal mould associated with the holotype and the free cheek (as above). The convexity of the border is preserved on the left, but otherwise the border is flat, having collapsed over the relatively wide doublure.

The cranidium Plate 14, fig. 4, CPC 18888, locality M123 is 13.7 mm long; its matrix is a thin lamina of friable silica in a layer about 3 cm thick of banded chert in limestone; the lamina contains a diversity of trilobites, including several cranidia of *Itydeois elegans*. The test is flattened, silicified, and fractured; regarding its characters it is practically identical with the holotype.

The pygidium Plate 14, fig. 5, CPC 18889, a flattened fractured silicified test, is 4.5 mm long and relatively small; it is associated with the cranidium (above) in friable silica. Its terminus is relatively short; the border retains some of its original convexity.

Occurrence and age: Itydeois elegans sp. nov. comes from the Currant Bush Limestone fringed by, and interbedded with, the strata of the Age Creek Formation, Camooweal area, Queensland; its age is the Zone of *Euagnostus opimus*.

Itydeois vultuosa sp. nov.

Plate 15, figs. 1-3; Text-figure 25

Material: The illustrated material consists of one cranidium, one free cheek, and one pygidium; furthermore two more cranidia of inferior quality have been collected. The matrix is light grey sandy limestone, about 150-180 cm below the chert bed with *I. elegans* (Pl. 14, fig. 4).

Diagnosis: Itydeois vultuosa sp. nov. has well developed glabellar furrows and wide interocular cheeks and is distinguished by strongly concave glabellar flanks, extremely long spatulate posterolateral limbs, very wide free cheeks, and by the presence of a pair of shallow transverse furrows between the posterior palpebral tips and the glabella and crossing the rear of the interocular cheeks.

Differential diagnosis: I. vultuosa differs from *I. elegans* in all characters of the diagnosis, as well as by the absence of the longitudinal interocular step; the pygidia are also different as discussed in the description of the pygidium of *vultuosa* (below); differences from *I. balli* nov. and *I. elegans* are given under those species.

Description: The free cheek Plate 15, fig. 2, CPC 18891 is 16.2 mm long and belongs to a quite large cephalon, some 22 mm long; in the front it is narrow (about as narrow as *I. elegans*) and unusually wide in the rear to fit the long posterolateral limbs. The margin is visibly exorbitant, the border is almost flat, the subocular area moderately swollen, and the base of the eye is fringed by a broad furrow.

The holotype cranidium, Plate 15, fig. 1, CPC 18890, is 14.3 mm long; its counterpart is also available; although somewhat fragmentary the holotype is undeformed and retains its original convexity.

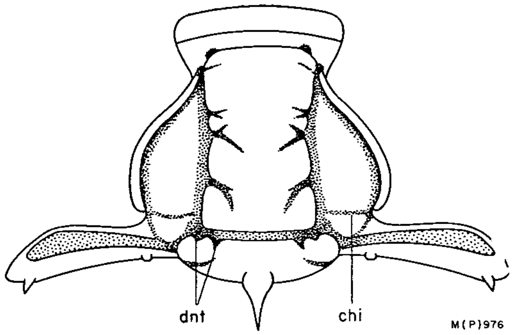


Fig. 25. *Itydeois vultuosa* **sp. nov., holotype cranidium restored. dnt—occipital dents (double); chi —swelling of the interocular cheek (separated by a transverse furrow).**

The posterior sutures are sinuate, diametrical, and delineate long and distally expanded spatulate posterolateral limbs; their slope in moderate but their geniculation at the fulcra is nevertheless abrupt; the intergenal spine is short.

The frontal limb, about 0.2-0.25 of the glabellar length, consists of a relatively flat upsloping rim and a forward-sloping brim separated from each other by the shallow marginal furrow; the brim and the rim are about equal in length.

The palpebral lobes are long (longer than in *I. elegans*), almost 0.75 of the glabellar length, narrow and well defined by the palpebral furrows (which are rather weak in *I. elegans*); the interocular cheek is wider than half the glabella—0.6 of its width (together with the palpebral furrow), quite tumid and sloping adaxially; a pair of transverse furrows cross the interocular cheeks between the posterior tips of the palpebral lobes and the glabella and separate swollen lobes from the anterior, main part of the cheeks; similar separate swollen lobes occur also in *Sunia cornunda* sp. nov., but are not separated in *I. elegans*.

The occipital lobe is as wide as 1.25-1.27× the glabellar rear, with two pairs of dents in its front and large swollen lateral lobules; the occipital spine is marginal, slender, but of unknown length. The occipital furrow is straight, narrow, and moderately deep; the axial furrows are well impressed, but the fossulae (two pairs) are rather inconspicuous.

The glabella is slender, in the rear and in front as wide as 0.63×, and in the middle 0.53×, its length; it rises only a little above the level of the tumid interocular cheeks, has an evenly arched longitudinal profile, slopes forward and becomes almost vertical at its frontal margin. The glabellar furrows (four pairs) are well impressed, the three posterior ones are bifid and the second and third furrows are rather close to each other.

The pygidium Plate 15, fig. 3, CPC 18892 is 8.5 mm long without its half-ring, and therefore relatively large. Its pleural relief is stronger than in *I. elegans*. Three broad channel-like pleural furrows with short adaxial cushions and two interpleural grooves are well impressed; the propleural veins, abaxially furcate, of the second and third segment, are relatively prominent; the border is wide, somewhat concave close to the rear margin but apparently flat or even slightly convex on the flank, and is well defined by the distinct marginal furrow from the pleural furrows, ribs, and veins. The doublure is also wide (as wide as the border) and has a lineate ventral face. In the axial lobe three annulations with small marginal median nodes are evident; the terminus almost reaches the marginal furrow and extends into a bulbous antiplectrum to the middle of the border. This bulbosity is quite an unusual structure.

Occurrence and age: Itydeois vultuosa sp. nov. comes from the Currant Bush Limestone at its interfingering with the margin of the Age Creek Formation, locality M123, Camooweal Sheet area, Queensland, somewhat below the chert bed with *I. elegans;* the age is the Zone of *Euagnostus opimus.*

Itydeois balli sp. nov.

Plate 15, figs. 4, 5

Material: The material consists of one cranidium and one pygidium, in a grey limestone with *Fuchouia fecunda* sp. nov. and an abundance of phosphatic brachiopods.

Holotype: The cranidium Plate 15, fig. 4, CPC 18893 is selected as the holotype because the holotypes of the species of *Itydeois* are also cranidia.

Diagnosis: Itydeois balli sp. nov. has a parallel-sided glabella and well impressed glabellar furrows—constituting a diagnostic combination of characters; furthermore, it is distinguished by its narrow interocular cheeks, and by the angulate edge of the pygidial border against the broad marginal furrow.

Differential diagnosis: The shape of the glabella of *I. balli* with its straight and parallel flanks recalls *I. elegans* whose glabellar furrows, however, are very weak; these are strong in *I. vultuosa,* but its glabellar flanks are emphatically concave; furthermore, the interocular cheeks in *I. elegans* and in *I. vultuosa* are wider than in *I. balli.* Regarding the pygidia the marginal furrow in *I. vultuosa* is a narrow incision (broad in *I. balli*) and the angulate edge of the border seen in *I. balli* is not evident in *elegans.*

Description: The holotype cranidium of *Itydeois balli,* locality M180, Northern Territory is 12.8 mm long and therefore fairly large. It is fragmentary, having lost its posterolateral limbs. The frontal area, 0.2 of the glabellar length, consists of a forward-sloping brim and moderately convex upturned rim which is slightly shorter than the brim.

The palpebral lobes are long—0.7 of the glabellar length, and only slightly oblique; the interocular cheeks are about 0.5 of the glabellar width with, and 0.3 without, the palpebral lobes, and are strongly convex.

The occipital lobe is as usual wider than the glabella and has two pairs of dents on its frontal border; its rear is transversely rugose. The occipital furrow is straight and relatively deep. The axial furrows are rather deep, the posterior fossulae are distinct, but the anterior ones are obsolete. The glabella, equally wide at the rear and front, is slender having a width of about 0.62× its length, and a well rounded front. Four pairs of glabellar furrows are present; the two posterior ones are deeply impressed and the posterior furrows extend adaxially only a little short of the occipital furrow. The second glabellar lobes are swollen and even slightly expanded laterally.

The pygidium Plate 15, fig. 5, CPC 18894, locality M186, Mount Drummond Sheet area, Northern Territory is 8.8 mm long without the half-ring. Its border is flat, outward sloping and somewhat narrow; its inner limit against the marginal furrow is angular, and the marginal furrow is broad and crossed by the distal ends of the pleural furrows. There are three pairs of very wide pleural furrows, and interpleural grooves are indicated in the two anterior segments. The pygidial axial lobe is long and its low and pointed antiplectrum intrudes even the border; by contrast, in *I. elegans* no antiplectrum is evident, and in *I. vultuosa* it is prominent and bulbous. Three axial annulations and a short terminus with its rear rounded are evident. The two anterior annulations are the widest, merging laterally with the triangular cushions in the pleural furrows.

Occurrence and age: Itydeois balli sp. nov. is a rare fossil in strata attributed to the Currant Bush Limestone of the Lawn Hill Sheet area (Queensland) and the adjacent part of the Mount Drummond Sheet area (Northern Territory); its age is the Zone of *Euagnostus opimus.*

Itydeois sp. nov. aff. **vultuosa**

Plate 32, figs. 3, 4

Material: The material consists of the two illustrated cranidia from a thin chert layer, locality M160; the matrix is silica and the fossils are silicified.

The species nomenclature is reserved in absence of the posterolateral limbs and free cheeks.

The cranidia are assigned to the genus *Itydeois* because the frontal area is differentiated into a brim and a rim; the comparison with *I. vultuosa* refers to the structure of the glabella having visibly concave flanks and well impressed glabellar furrows; regarding several other characters, however, these cranidia differ from *I. vultuosa* as is evident from the description that follows:

The cranidium Plate 32, fig. 4, CPC 18892 has retained its test and is 11.3 mm long. Its palpebral lobes, 0.65 of the glabellar length, are shorter than in *I. vultuosa,* the interocular cheeks are narrower (0.75 of glabellar width) and are not divided by the transverse furrows seen in *vultuosa.* The glabella is also wider, plumper than in other species of the genus.

The cranidium Plate 32, fig. 3, CPC 18991 is 7.9 mm long; it is decorticated and somewhat fragmentary. The brim is convex with a transverse crest which is also apparent in the first specimen but absent in *vultuosa;* the glabellar front is straight, and rounded only at the corners. The glabellar width in the rear, 0.66-0.67× its length, is the same in both specimens.

The cranidia of *Itydeois* sp. nov. aff. *vultuosa* that are described here occur in close association with *Fuchouia morstonensis* sp. nov. (q.v.) and the hypostoma Plate 3, fig. 3 which is assigned to the latter; it is possible, however, that the hypostoma belongs to *Itydeois.*

Occurrence and age: Itydeois sp. nov. aff. *vultuosa* comes from a thin chert layer of the

Age Creek Formation; the age is the Zone of *Euagnostus opimus*.

Genus **Undillia** nov.

The type species of *Undillia* is *U. rustica* nov.

Diagnosis: Undillia has strongly exorbitant free cheeks and a flat cranidial border, and is distinguished by its slightly forward-tapering to roughly parallel-sided slender glabella, very narrow interocular cheeks, and a subtriangular pygidium with a narrow border and a long and narrow axial lobe with three annulations.

Differential diagnosis: A flat border may occur in species of diverse dolichometopid genera; the exorbitant free cheeks, however, suggest affiliation with *Eurodeois* nov. and *Itydeois* nov., from which *Undillia* differs by the structure of the glabella and the narrowness of its interocular cheeks. These cheeks are also narrow in *Dolicholeptus* nov., which differs, however, in the structure of its pygidium, free cheeks, shape of glabella, and frontal area.

Three species are described here: (1) *Undillia rustica* nov., (2) *Undillia* sp. nov. A, and (3) *Undillia lara* nov.

Undillia rustica sp. nov.

Plate 18, figs. 1-5; Plate 19, figs. 1-3; Text-figure 26

Material: Illustrated are three cranidia, three free cheeks, two hypostomata, and two pygidia. Some 15 cranidia and six pygidia have been examined. *U. rustica* is found in association with numerous shields of *Dolicholeptus ansatus* nov.; in absence of complete specimens the correct assignment of free cheeks and pygidia from collecting site M54 was therefore inconclusive; the problem, however, was resolved by the collection from M41 which contains only *Dolicholeptus licticallis,* whose morphology of the pygidium and free cheek is rather close to *D. ansatus* but very different from the shields attributed to *U. rustica.*

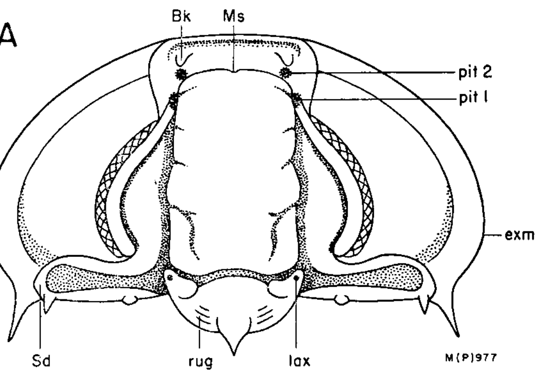
Holotype: The largest cranidium, Plate 18, figs. 2a, 2b, is selected as the holotype.

Previous record in the literature: I think that two cranidia Whitehouse (1939, p. 24, fig. 23) attributed to *Amphoton serotinum* may belong to *Undillia rustica* sp. nov. and that the occipital spine, and the free cheeks with 'short genal spines' quoted in the diagnosis of *serotinum* (op. cit., p. 238) may refer to material of *U. rustica;* the holotype of *serotinum,* however (ibid. figs. 21a, 21b) has 'a glabella that expands slightly in the anterior quarter' and its flanks are visibly concave, and it is therefore substantially different from *U. rustica.* Further comment is given under *Sunia lorenzi* sp. nov. and *Eurodeois serotina* (Whitehouse).

Diagnosis: Characters of the species *U. rustica* nov. are the obscure development of the third pygidial annulation, the weak expression of the glabellar furrows and lobes, the length of the palpebral lobes (0.75 of the glabellar length) and possibly the relative shortness of median and genal spines.

The following particular structures may be of specific or even generic significance: (1) the forward advanced position of the anterior fossulae, (2) the lateral glabellar bulges, and the pits on the wings of the occipital lobe. The frontal glabellar notch, however, occurs in species of several dolichometopid genera.

A



B

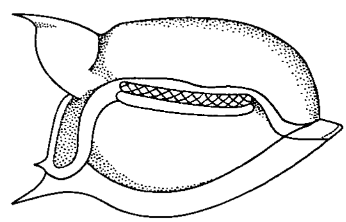


Fig. 26. ***Undillia rustica*** **sp. nov., composite diagram of cephalon. Bk—lateral knob on border (see Text-fig. 9 for presumed homology with the anterolateral knob of protaspis); exm—exorbitant margin of free cheek; lax—lateral lobule of occipital lobe with pit; Ms—median frontal recess; pit 1—posterior fossula; pit 2—anterior fossula; rug—rugosity of occipital lobe; Sd—posterior suture, cedariform distal end.**

Differential diagnosis: See the differential diagnosis of the genus, and the comments on *Undillia* sp. nov. A and *Undillia lara* sp. nov.

Description: The cephalon of *Undillia rustica* is broadly reniform when flattened in plan (Text-fig. 26); unflattened its flanks are geniculate and sloping abaxially and its anterior margin is arched upward; this shape is apparent in the cranidial frontal view (Pl. 18, fig. 1c), in the slope of the posterolateral limb (Pl. 18, figs. 1b and 2b) and the lateral view of the free cheek, Plate 18, fig. 5; the reconstruction in Text-figure 26, however, is only approximate because the deformation of the specimens cannot be accurately evaluated. In the thorax the axial lobe is slender and bears median spines similar to the occipital lobe; the fulcra are close to the axis, at about 0.25 of the width of the axial lobe from the axial furrows; the free pleurae are relatively long and have well developed facets. The number of segments in the thorax is unknown, and the pygidium is an estimated 0.4× the cephalic length.

The strongly exorbitant free cheek has a flat border, a short deflected spine, and some terraced lines along the margin. The posterior sutures are sinuate and distally slightly cedariform. The posterolateral limbs are spatulate, and strongly swollen in front of the broad posterolateral furrow; the intergenal spines are close to the tips of the limbs; the fulcra are prominent and close to the occipital lobe, at a distance of 0.25-0.3 of the occipital width from the axial furrows.

The anterior sutures diverge slightly, and at the front of the glabella enclose a transversely narrow frontal limb; a brim is absent and the frontal area, 0.17-0.2 of the glabellar length, is flat, slopes slightly forward and is arched somewhat upward; along its margin a narrow thickening (?rim) is apparent; a pair of swellings (nodes) is seen on the wings of the limb placed opposite from, and in line with the axial furrows, and just in front of the advanced anterior fossulae; the posterior fossulae (= anterior pits) are also distinct in their usual position at the ocular ridges.

The occipital lobe, subtriangular to semicircular or even crescentic, and about 0.3 of the glabellar length, is relatively large. The retral median spine is short to medium in length (in the small cranidium Pl. 19, fig. 1); the rear of the lobe is slightly rugose, the front has the usual pair of dents. and the lateral tips are curved forward. The tips are each provided with a distinct circular pit—a unique feature hitherto unobserved in the dolichometopids. The occipital furrow is narrow, shallow but distinct.

The palpebral lobes are long—0.75 of the glabellar length—and quite close to the axial furrows: the distance of the anterior tips equals the width of the ocular ridge, and the rear tips only 0.23-0.25 of glabellar width; the interocular cheeks, about 0.47 and 0.28 (with, and without the palpebral lobes, respectively) are moderately swollen, narrow, and long and merge in the rear into the swelling in front of the posterolateral furrow. The axial furrows are distinct and narrow along the glabellar flanks; their closure at the glabellar front is merged with the frontal cranidial furrow. In small, immature cranidia (Pl. 19, fig. 1) the glabellar flanks are straight and parallel; in maturity lateral bulges (as for example in *Rhyssometopus* Öpik, 1967) break the straight lines, and the glabella tapers forward to about 0.85 of its rear width, across the posterior, and 0.8 across the anterior fossulae. The glabella is slender, about 0.63-0.65 of glabellar length in its rear; the glabellar furrows are weak but four pairs are discernible; the posterior furrows are cutting back, almost reaching the occipital furrow. The glabellar lobes are low, even flush, and the front has a median notch.

The cephalic test is punctate.

The hypostoma is described in the comment below. Its marginal frame, posterior and lateral spines, and the bulbosity of the maculae are structures seen also in *Sunia* and *Eurodeois*.

The pygidium is also described below in the comment on illustrated specimens; characteristics are the relatively narrow and slightly convex border arched up in its rear, and the long and slender axial lobe with two well developed and one less distinct annulation; the second and third annulations show their non-functional articulating half-rings.

Comment on illustrated specimens

All available material comes from locality M54, in the bed of Douglas Creek, south from and close to Undilla homestead, Queensland. The matrix is irregularly nodular grey marly limestone.

The cranidium Plate 18, figs. 1a-1c, CPC 18910 is 7.5 mm long. The test is well preserved.

The holotype cranidium, Plate 18, figs. 2a, 2b, CPC 18911, is 7.8 mm long. The test is slightly crushed and the tip of the occipital spine is lost. The frontal glabellar notch and the fossulae are well impressed.

The cranidium Plate 19, fig. 1, CPC 18915 is 4.1 mm long without the occipital spine. It belongs, apparently, to a late meraspis. The glabella is parallel sided and the occipital spine prominent. The associated free cheek is about 8.0 mm long to the base of the genal spine. The anterior part of the border is flat.

The isolated free cheek Plate 18, fig. 3, CPC 18912 is 9.5 mm long from tip to tip and belongs to a relatively large cephalon. The marginal furrow seems evenly deep.

The free cheek Plate 18, fig. 5 associated with a hypostoma is about 7.0 mm long; note the base of the eye and the convexity of the shield.

The hypostoma Plate 18, fig. 5, CPC 18914 is 5.4 mm long. It is a little deformed; the lateral spines are lost, but the stumps of the posterior spines are preserved. The maculae are prominent and bulbous.

The hypostoma Plate 18, fig. 4, CPC 18913 is 2.8 mm long and belongs to a late meraspis. The immaturity may explain its granulose ornament and the pair of emarginations of its frontal edge.

The pygidium Plate 19, fig. 2, CPC 18916 is 3.6 mm long (without the articulating half-ring). The axial lobe, about 0.7 of the shield's length, is relatively short, and so is its terminus.

The pygidium Plate 19, fig. 3, CPC 18917 is 5.8 mm long (without the half-ring); the terminus is quite long and its anterior part is the third annulation; reticulate veins are apparent around the terminus and three pairs of propleural veins on the pleural lobes.

Occurrence and age: Undilla rustica has been found only at site M54, at Undilla, Queensland; the formation is V-Creek Limestone; the age is the Zone of *Doryagnostus notalibrae.*

Undillia lara sp. nov.

Plate 20, figs. 3a, 3b; Text-figure 27

Material: The available material consists of a single cranidium—the holotype, CPC 18924, salvaged from a collection destroyed in a fire.

Diagnosis: Undillia lara is distinguished by broad and flat palpebral lobes, forward-arched anterior cranidial margin, relatively broad and parallel sided (not tapering) glabella, posterior glabellar furrows extending to the occipital furrow; and the oblique (not cedariform) distal sections of the posterior sutures.

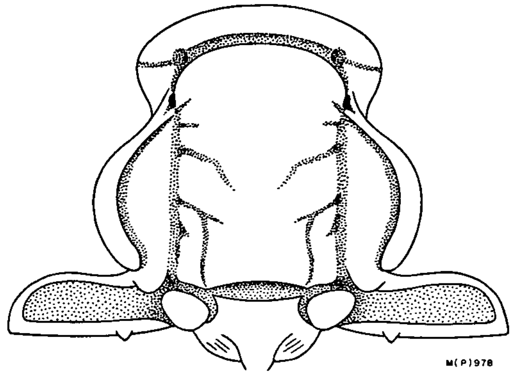


Fig. 27. *Undillia lara* **sp. nov., holotype cranidium restored.**

Differential diagnosis: In *Undillia rustica* the glabella is slender and tapers forward, the posterior sutures are distally cedariform, the palpebral lobes are convex and relatively narrow, and the frontal margin is arched forward less than in *U. lara.*

Both *rustica* and *lara* have long palpebral lobes placed close to the glabella and a similar structure of the cranidial rim.

Description: The holotype cranidium is 12.6 mm long; it is extensively decorticated and shows the considerable thickness of its test. The posterior sutures, diametrical and slightly sinuous, are oblique and almost straight within the posterior border. The posterolateral limbs are blades with roughly parallel edges. The posterolateral furrows are broad and deep channels.

The rim is curved in plan, slightly convex, as long as 0.17 of the glabellar length, and separated from the glabellar front by a deep furrow; this furrow is shallow in *U. rustica.* The posterolateral knobs on the wings of the rim are quite prominent. The palpebral lobe is long (0.7 of glabellar length), flat and unusually wide in the middle; the palpebral furrow is obscure, but the lobe is depressed below the level of the interocular cheek, which is defined by an abrupt step against the lobe. The palpebral lobes are almost parallel to each other with the posterior tips distant only 0.25 of the glabellar width from the axial furrows. The interocular cheek is almost flat and very narrow—0.3× the glabellar width without, and 0.5× with, the palpebral lobe.

The glabella is relatively wide (wider than in *U. rustica*), as wide as 0.7× its length, slightly expanded in the middle (as in *U. rustica*) and has a well rounded front. Four pairs of glabellar furrows are discernible; the posterior furrows are swept retrally and reach the occipital furrow; a similar structure can be expected also in peeled specimens of *U. rustica* in which externally (Text-fig. 26) these furrows are slightly shorter.

It is possible that the pygidium described as *Undillia* sp. nov. A, Plate 22, fig. 8, belongs to *U. lara*. This pygidium and the holotype of *U. lara* are not associated, however, and their relationship remains therefore uncertain.

Occurrence and age: The holotype of *Undillia lara* sp. nov. was collected at site M409, Camooweal Sheet area, Queensland, in the V-Creek Limestone; its age is the Zone of *Doryagnostus notalibrae*.

Undillia sp. nov. A.

Plate 22, fig. 8

Open nomenclature is applied here because a cephalon (or a cranidium) is absent and I hesitate to select a pygidium as the holotype. The illustrated pygidium, CPC 18938, without its articulating half-ring is 5.0 mm long, and in size is close to the pygidium of *Undillia rustica*, Plate 19, fig. 3. Both are subtriangular, have similar narrow borders, narrow and long axial lobes, about the same distance of fulcra from the axial furrows, and bare non-functional articulating half-rings of the second and third annulations; in *Undillia* sp. nov. A, however, the third annulation is well developed, the rear of the border is slightly emarginate, and the relief of the pleural ribs is more strongly developed than in *U. rustica*.

Occurrence and age: Undillia sp. nov. A comes from a calcite pod of V-Creek Limestone at locality M89, Camooweal Sheet area, Queensland. Its age is the Zone of *Doryagnostus notalibrae*.

Genus **Amphoton** Lorenz, 1906

The legal status of the name (word) 'Amphoton' is discussed in the glossary.

The type species of *Amphoton* by original designation and monotypy (Lorenz, 1906, p. 89) is *A. steinmanni* Lorenz. In the subsequent literature, however, *Dolichometopus*(?) *deois* Walcott (1905; 1913; 1916) is commonly quoted as the type species of *Amphoton* on grounds of its nomenclatorial seniority over *A. steinmanni* and subjective synonymy of both species. This synonymy, however, cannot be substantiated: *Amphoton steinmanni* (Lorenz, op. cit., pl. 4, figs. 16 and 17) has well expressed glabellar furrows and even somewhat tumid glabellar lobes; but in *A. deois* (Walcott, 1913, pl. 22, figs. 1, 1b, and 1f; also 1916, pl. 54, figs. 1e, 1f, and 1j) the glabella is smooth and 'marked by three pairs of rather short, very faintly impressed furrows' (Walcott, 1916, p. 365).

Lorenz published three cranidia, all syntypes of *Amphoton steinmanni,* without designating a holotype; of these the specimen of his plate 4, fig. 17 is about 7 mm long and belongs to a small holaspis; it is fragmentary, but even more so are the other specimens. Furthermore, the free cheek, the hypostoma, and the pygidium of *Amphoton steinmanni* are unknown; the structure of these sclerites, however, is essential in identification of *Sunia* Kobayashi, 1942 and *Eurodeois* gen. nov. (*Dolichometopus deois* Walcott, 1905) whose comparison with *Amphoton,* 1906 remains therefore incomplete and inconclusive. Before 1942 (the date of *Sunia*) the name *Amphoton* (with its illegitimate type species *deois*) could be used as a comprehensive generic designation, but this procedure is inappropriate in consideration of the subsequent refined generic classification; the name *Amphoton* is applicable now only to its type species *A. steinmanni* Lorenz, 1906.

A satisfactory diagnosis as well as a differential diagnosis of *Amphoton* remains unattainable, except for the following incomplete concept: Dolichometopidae without a brim but with a flat(?) or concave(?) and short frontal border, with a prominent occipital spine, a slightly forward-expanding glabella having convex flanks and at least three pairs of visibly developed lateral furrows; convex glabellar flanks are evident in the cranidium (Lorenz, op. cit, pl. 4, fig. 16 and repeated in the text-figure, p. 80); the border is evident in figure 17 (ibid.); the concept (above) is based on these two syntypes, and Lorenz seemingly preferred the specimen figure 16.

Genus **Amphotonella** Kobayashi, 1942

The type species of *Amphotonella*—*Dolichometopus alceste* Walcott (1913, pl. 22, figs. 3-3b)—is quite distinct from *deois* but its glabellar furrows recall *Amphoton steinmanni* Lorenz; the cranidium of *alceste* is, however, only a distorted fragment. The genus *Amphotonella* Kobayashi, 1942 is based on *alceste;* but its diagnosis and reconstruction (Kobayashi, op. cit., pl. 3. fig. 4; Harrington & others 1959, p. 0223) are problematical being part *alceste* and, apparently, part *Dolichometopus hyrie* Walcott (1913, pl. 22, fig. 6). According to Walcott (1916, p. 359), however, *hyrie* is a species of *Anomocare* and, consequently, not a corynexochid at all. The pygidium attributed to *alceste* (Walcott, op. cit., pl. 22, fig. 3b) may belong to a species of *Sunia* and was found 'a little lower down in the section' (ibid., p. 272)—below the described cranidium. Nevertheless, '*Amphotonella*' *alceste* is a valid species distinguished by its narrow interocular cheeks, narrower than in *Sunia typica* (Kobayashi, 1942, pl. 1, figs. 1 and 2). According to Kobayashi (op. cit., p. 164) *Amphotonella* is distinguished by a 'forward tapering glabella'. Walcott (op. cit., p. 215), however, described the glabella of *alceste* as having nearly parallel sides; it appears also that the glabella in the fragment is lopsided by deformation; hence, its shape is inconclusive. Furthermore, the three anterior glabellar furrows are 'faintly impressed' but are retouched in Walcott's illustrations and appear strong.

Genus **Eurodeois** nov.

The type species of *Eurodeois* is *Dolichometopus deois* Walcott (1905; 1913; 1916).

Diagnosis: Eurodeois is distinguished by its slightly concave to straight glabellar flanks, slightly forward-expanding glabella, a short frontal border, exorbitant lateral margin of the cephalon (of the free cheeks) and a concave and laterally widening border of the pygidium. The hypostoma (Walcott, 1913) has slightly rearward converging flanks.

Differential diagnosis: The comparison with *Amphoton* Lorenz, 1906 (q.v.) is inconclusive; *Sunia* Kobayashi, 1942 has a different pygidium (with a narrow border), different free cheeks (with sideways deflected genal spines) and a visibly subtriangular pygidium; *Itydeois* gen. nov. also has exorbitant cephalic flanks but its frontal border is differentiated into a brim and a rim; in *Undillia* which has exorbitant free cheeks, the glabella tapers forward and palpebral lobes are especially close to the axial furrows.

Two groups of species of *Eurodeois* can be distinguished: (1) species lacking the genal spines; these are *Eu. deois* (Walcott) and *Eu. adelpha* nov.; and (2) species with well developed genal spines, short in *Eu. marginicrassa* nov. and long in *Eu. anepsia* nov.; these characters, however, are for the time being of a lesser taxonomic value because the free cheeks are unknown in several species. In the generic identification of isolated cranidia some guidance is provided for by the glabellar furrows: in known species of *Eurodeois* these furrows are more or less vestigial, the posterior furrows excepted; but in *Sunia* (*S. typica* excepted) the glabellar furrows are clearly impressed, and other structures (as discussed for example under *Eurodeois serotina*) are also of help in discriminating these two genera. Nevertheless, the second group of *Eurodeois* is quite close to *Sunia* and a conclusive generic classification depends on the knowledge of the structures of the free cheeks and the pygidia in the first place.

Eurodeois deois (Walcott)

Plate 20, fig. 5; Text-figure 28

Text-figure 28 is a combination from Walcott's (1913; 1916) original illustrations: the cranidium (1913, pl. 22, fig. 1b; 1916, pl. 54, fig. 1e) and the free cheek (1913, pl. 2, fig. 13b; pl. 22, fig. 1a; 1916, pl. 54, figs. 1a and 1g); the outline of the free cheek corresponds to the fig. 1g; the intergenal spines shown in our Text-figure 28 have not been mentioned in the literature, but are evident in some illustrations, as for example in Walcott (1913, pl. 22, fig. 2b, on the left posterolateral limb).

The synonymy of *Dolichometopus deois* (senior) and *Bathyuriscus asiaticus* Lorenz (junior) as suggested by Walcott should be accepted; but *Amphoton steinmanni* is not a synonym of *D. deois* (see under *Amphoton*); furthermore, Endo (1944) included in the synonymy of *deois* all species of '*Amphoton*' previously described by Resser & Endo (1937); of these only *Amphoton alia* was considered by Kobayashi (1944) as a synonym of *deois*. Inconclusive is the status of *Amphoton blackwelderi* Resser (1942), based on a pygidium attributed to *deois* by Walcott (1913, pl. 22, fig. 1h); the cranidium and especially its associated pygidium included by Resser & Endo (1937, pl. 58, fig. 23) in *A. deois* represent apparently a species (indet.) of *Sunia*.

The complete specimen of *A. deois* published by Kobayashi (1942, pl. 1, fig. 10) has its cephalon fractured, but the spineless exorbitant free cheek is preserved; in the thorax some stumps of the axial spines (not considered, however, in reconstructions) are indicated; the pygidium is well preserved and is emarginate in the rear; its border is mildly concave and wide on the flanks. The reconstruction of the same specimen (ibid., pl. 3, fig. 6) shows the exposed occipital articulating doublure—seen also in *Sunia rutilata* sp. nov. (Pl. 28, fig. 2); in Harrington & others (1959, fig. 163(5), p. 0223) this doublure is interpreted erroneously as a very narrow occipital lobe.

The three meraspid cranidia (Walcott, 1913, pl. 22, figs. 1d, 1e, and 1f) are informative regarding the morphogenesis of *Eu. deois.* Two smaller specimens (1d and 1e) are about 1.0 mm long and have retained the transcurrent glabellar furrows and the expanded frontal lobe of the metaprotaspis; they are consequently more conservative and less modified than the meraspides of *Fuchouia fecunda* of a similar size. The cranidium fig. 1f, about 1.8 mm long (without the occipital spine) is a late meraspis; its border is developed, the glabella has lost its furrows and its clavate outline, but the palpebral lobes are relatively large—visibly larger than in the holaspid period. Significant taxonomically is the relatively rapid external reduction of the glabellar furrows.

The illustrated free cheek Plate 20, fig. 5, CPC 18926 is 12.0 mm long from tip to tip, and therefore, quite large, of a cephalon about 15 mm long. The pale spots (not granulosity!) on the border indicate an incipient silicification; a part of the border in its rear was lost during dematrication undertaken to establish the absence of the genal spine. The margin is exorbitant, the border is slightly convex, and the marginal furrow is quite distinct anteriorly; the posterior suture is sinuate and the caecal veins are radiate to reticulate; the test is punctate. The free cheek of *deois* illustrated by Walcott (1913, pl. 21, fig. 13b) is identical with our specimen in outline, posterior suture, caecal veins, and punctation.

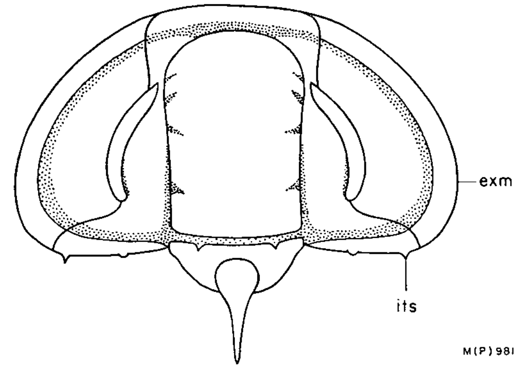


Fig. 28. *Eurodeois deois* **(Walcott), cephalon restored (from** *Dolichmetopus deois* **Walcott, 1913; 1916). exm—exorbitant margin of the free cheek; its—intergenal spine.**

Occurrence and age in Australia: The described specimen of *Eurodeois deois* (Walcott) comes from the Currant Bush Limestone, locality M30, Camooweal Sheet area, Queensland; its age is late in the Zone of *Ptychagnostus punctuosus;* at the same site *Dolicholeptus licticallis* occurs above *Eu. deois.*

Eurodeois adelpha sp. nov.

Plate 22, figs. 3 and 10

Material: Illustrated are one cranidium and one free cheek; rare fragments of cranidia and another free cheek have been noted in the collection. The matrix is phanerocrystalline limestone (calcite).

Holotype: The cranidium Plate 22, fig. 3, CPC 18933 is selected as the holotype; the free cheek is also characteristic but less suitable in comparisons.

Diagnosis and differential diagnosis: Eurodeois adelpha has a parallel sided glabella, a strongly developed occipital spine, visibly developed glabellar furrows (vestigial in *Eu. deois*), a relatively long and gently concave cranidial border (shorter, and flat to slightly convex in *Eu. deois*), exorbitant margin of the free cheek and no genal spine (as in *Eu. deois*), but is distinguished by its broad marginal furrow (narrow in *Eu. deois*) and suppression of the border in the anterior part of the free cheek (not suppressed in *Eu. deois*).

Description: The holotype cranidium is 7.2 mm long; the palpebral lobes are an estimated 0.7 of glabellar length, and the glabellar width is 0.7× the length; its front is bluntly rounded and the flanks are about straight; four pairs of glabellar furrows are evident, and even the fifth seems indicated. The fossulae are shallow and the anterior fossulae are placed at the anterolateral corners of the glabella.

The free cheek, Plate 22, fig. 10, CPC 18940, is 5.0 mm long from tip to tip; its rather broad marginal furrow is the continuation of the concavity of the cranidial border—the evidence of specific unity of these sclerites. The long sinuous posterior suture indicates long and spatulate posterolateral limbs not preserved in the holotype. In *Eu. deois* the posterolateral limbs are triangular. Radiating very weak caecal veins are apparent on the tumid subocular area of the free cheek.

Occurrence and age: Eurodeois adelpha was obtained at locality M89 from a calcite pod in the V-Creek Limestone; its age is the Zone of *Doryagnostus notalibrae.*

Eurodeois aff. **Dolichometopus dirce** Walcott

Plate 22, figs. 4, 5

Material: Illustrated are two cranidia: (1) Plate 22, fig. 5, CPC 18935 is a meraspis, 1.3 mm long, and (2) Plate 22, fig. 4, CPC 18934, is taken as a small holaspis, 2.5 mm long. These cranidia are regarded as conspecific because of the absence of glabellar furrows, the similarity of the narrow frontal border and of the occipital lobe, and their association in a single calcite pod.

The meraspid cranidium has a corynoid glabella and large palpebral lobes and recalls the larger meraspis of *Eurodeois deois* described by Walcott (1913, pl. 22, fig. 1f); in this specimen, however, glabellar furrows are discernible.

In the larger cranidium (Pl. 22, fig. 4) the test is silicified but quite friable; the frontal border is narrow, elevated and slightly convex, and separated from the glabella by a deep and narrow furrow.

An exorbitant spineless free cheek about 7.0 mm long is in the collection provisionally assigned to this form; it differs from *Eu. adelpha* (q.v.) in having a continuous narrow border and a narrower outline. The posterolateral limb (preserved on the right side) slopes steeply down; the palpebral lobe is long (0.7 of the glabellar length) and the interocular cheek with the palpebral lobe is 0.5, and without that lobe 0.4, of the glabellar width. The glabella has straight and parallel flanks and a subtruncate front; glabellar furrows are absent. The absence of glabellar furrows and the rectangular shape of the glabella are found also in *Dolichometopus dirce* Walcott (1913, pl. 22, fig. 5), whose occipital lobe, however, is spineless and unusually short for *Eurodeois* and for a dolichometopid is general. The pygidium attributed to *dirce* by Walcott is reminiscent of a *Lisania* Walcott, and the free cheek belongs, apparently, to a different trilobite as well.

Less similar is *Dolichometopus derceto* Walcott (op. cit., p. 217, pl. 22, fig. 4): it has a slightly forward-expanding glabella, and two pairs of rather strong, short furrows; but its short occipital spine and narrow frontal border are still reminiscent of our form.

If the pygidium has been correctly identified as belonging to *derceto* this species cannot be placed in *Eurodeois* or in *Sunia;* but it may not be the pygidium of a dolichometopid.

Occurrence and age: Eurodeois aff. *dirce* was recovered from a calcite pod of the V-Creek Limestone, at locality M89 in the Camooweal Sheet area, Queensland; it age is the Zone of *Doryagnostus notalibrae.*

Eurodeois marginicrassa sp. nov.

Plate 21, figs. 3a-3d, 4; Plate 26, figs. 1, 2

Material: The description is based on one cranidium, two free cheeks, and four pygidia.

Holotype: The cranidium Plate 21, figs. 3a-d, CPC 18929 is selected as the holotype.

Diagnosis: Eurodeois marginicrassa nov. refers to forms with an evenly wide glabella with obscure glabellar furrows, relatively short palpebral lobes and narrow interocular cheeks, broad and moderately exorbitant free cheeks, occipital and genal spines, and particularly distinguished by its convex cephalic border (the rim and the border of the free cheeks) and strong deflection of the genal spines, which are short. The pygidium resembles *Eu. deois* (Walcott) but differs by lesser fusion of its pleurae.

Differential diagnosis: the weak glabellar furrows and the pygidial structure resemble *Eu. deois,* but in *deois* the glabellar flanks are concave, genal spines are absent, and the cranidial border is almost flat; in *Eu. adelpha* nov. the glabella is evenly wide, but its border is concave and genal spines are absent; in *Eu. anepsia* nov. all spines are long, the glabellar flanks are concave, and the border in the cranidium is flat.

The short genal spine recalls *Undillia rustica* (q.v.); *rustica,* however, has a narrower free cheek than *Eu. marginicrassa,* its border is flat, and the posterior sutures run a different course.

Description: In the free cheek the border is convex to fit the convexity of the cranidial rim, and widens rearwards; the marginal furrow is distinct over its total length, and quite deep; the genal spine is short, moderately curved, advanced and deflected, accentuating the moderate exorbitant course of the margin; the subocular area is tumid, and covered with even externally visible, radiating to reticulate caecal veins obliquely crossed by the somewhat irregular principal vein. The posterior sutures are slightly sinuous, are oblique, and define the long triangular posterolateral limbs which are equipped near their tips with the usual intergenal spines.

The anterior sutures diverge slightly and define a relatively narrow frontal limb; this consists of a convex rim separated from the glabella by the somewhat wide and deep frontal furrow.

The palpebral lobes are relatively short (0.55-0.56 of the glabellar length), moderately oblique, and close to the glabella: the posterior tips are separated from the axial furrows by a distance of 0.3 (or even slightly less) of the glabellar width, and the width of the interocular cheeks together with the palpebral lobes is about 0.4 (less than half) of the glabellar width. The interocular cheeks are gently tumid and slope abaxially (Pl. 21, fig. 3c).

The occipital furrow is broad and shallow. The occipital lobe is transversely well arched; dents are absent in its front, and absent also are the drawn-out lateral extemities which are so prominent in other Australian dolichometopids; for this reason the occipital lobe of *Eu. marginicrassa* is transversely as wide as the glabella—a character shared only by *Eurodeois deois* (Text-fig. 28). The occipital spine is moderately long and curved, almost arcuate.

The axial furrows are narrow and deep; the anterior fossulae (Pl. 21, fig. 3c) are placed well forward, but the posterior ones are obscure.

The glabellar flanks are parallel but somewhat wavy, and the width is about 0.65× (less than 0.7×) the length; the front of the glabella is well rounded; it is also prominently arched (Pl. 21, fig. 3d). Distinct (incised) glabellar furrows are absent but their positions are indicated as depressions between the rather weakly swollen lateral lobes.

The pygidium is roughtly semicircular, and moderately convex; the margin may be weakly emarginate in the rear; the border is concave (shallow), and widened laterally.

The pleural lobes are moderately tumid, with three pairs of broad furrows. The interpleural partitions (ridges, not grooves!) are distinct; the combination of these ridges with the propleural veins and abaxially bilobed ribs complicates the picture of the pygidium. The fulcral points are well apart, the distance in between being about half the shield's width, and the articulating facets are relatively well developed. The axial lobe is long (0.8 of the shield's length) and consists of three annulations and a terminus of medium size; the anterior annulation is wider than the rest and carries a low marginal median node above the non-functional but exposed articulating half-ring of the second annulation. The test is thin, shiny, and punctate.

Comment on illustrated and other specimens

The holotype cranidium, Plate 21, figs. 3a-d, CPC 18929, locality M65, is about 7.0 mm long without the occipital spine; it is the largest of the available cranidia. A transverse, accidental fracture between the frontal fossulae (fig. 3c) deforms the glabellar extreme front into a 'quasi plectrum'; it is a unique deformation as evident from undeformed cranidia about 6.8 mm long in the same collection (not illustrated); the right (triangular) posterolateral limb is preserved with its intergenal spine. The matrix of the M65 collection is light grey limestone, sandy and quite hard.

The free cheek Plate 21, fig. 4, CPC 18930, also from locality M65, is 10.0 mm long from tip to tip; the principal caecal vein is prominent; the anterior suture owing to flattening seems unusually long, but in the cranidium (lateral view, fig. 3d) the distance from the palpebral lobe to the frontal margin is equally long. Another free cheek from the same locality is 5.0 mm long from tip to tip; it has preserved the convexity as compared with the free cheek above.

A pygidium (not illustrated) associated with other specimens from locality M65 is 12.2 mm long; it is incomplete but its structure is the same as in the next specimen, from another locality, which is well preserved.

The pygidium Plate 26, fig. 1, CPC 18956, locality M247 is 8.8 mm long without the articulating half-ring. The emargination in its rear is minimal, but is accentuated by a fracture. The bifurcate ridges result from the combination of elevated interpleural partitions and the propleural veins of the pleurae immediately behind. The matrix is grey laminated limestone.

The pygidium Plate 26, fig. 2, CPC 18957, locality M41 (close to the top of V-Creek Limestone) is 15.8 mm long, indicating an exoskeleton about 45 mm long. It is flattened and silicified in a thin chert layer. Its structure is the same as in the other pygidium (fig. 1).

Occurrence and age: Eurodeois marginicrassa nov. occurs in V-Creek Limestone at several sites in the Undilla Basin (Camooweal and Mount Isa Sheet areas). Its age is the Zone of *Doryagnostus notalibrae*.

Eurodeois serotina (Whitehouse, 1939)

Plate 20, fig. 1

Material: Available are three fragmentary cranidia in a piece of pink sandy limestone; illustrated is the better preserved specimen, 9.8 mm long. It is assigned to the species *serotina* because of its similarity to the illustration of the holotype of *Amphoton serotinum* Whitehouse (1939, pl. 24, figs. 21a, 21b). Whitehouse originally assigned to this species also one pygidium (ibid., fig. 22) which is included here in *Sunia lorenzi* nov. (q.v.), and two cranidia (ibid., fig. 23) in a piece of limestone which are placed here in *Undillia rustica* nov. (q.v.). Kobayashi (1942, p. 165) attributed *serotinum* to *Sunia* on general considerations.

The generic name *Eurodeois* is substituted here for *Amphoton* Lorenz for the following reasons: (1) as discussed separately, only its type species is known (*A. steinmanni*) and the fragmentary material is insufficient for a comparison with the other dolichometopids; (2) the concave flanks of the glabella and its somewhat expanded front recall *Eurodeois deois* in the first place; *Sunia, Itydeois* nov. and some other genera are considered in the description that follows next.

The palpebral lobes, about 0.55 of the glabellar length, are medium in size and relatively close to the glabella, with the posterior tips at about 0.38 of glabellar width from the axial furrows; the interocular cheek with the palpebral lobes is as wide as 0.6×, and without, 0.4× the glabellar width. The frontal area is short, only 0.12 of the glabellar length; the rim is flat and has a pair of posterolateral nodes comparable with *Undillia* and *Sunia; Undillia,* however, has a tapering glabella and is out of the question; the structure of the rim would indicate a species of *Sunia* (but compare *S. cornunda* nov.) but it is a generality shared by several dolichometopids, including *Horonastes* nov. The shape of the glabella at the same time is not compatible with the known species of *Sunia.* The rear of the rim between the posterolateral nodes is depressed as a very narrow band or step and suggests either a reduced or an incipient brim; it is at any rate a vestigial structure not comparable with the well developed brim of *Itydeois.*

The occipital lobe is relatively short, about 0.12-0.13 of the glabellar length, and bears a reclined median spine.

The glabella is delicately carinate and exceptionally slender (long) having the rear as wide as 0.54-0.55× the glabellar length. Two or probably three pairs of weak glabellar furrows are discernible and the posterior ones reach close to the occipital furrow. The test is preserved and displays oval muscle spots with dark peripheries, especially on the anterior part of the glabella; the same pattern is evident in the holotype of *'Amphoton' serotinum* (Whitehouse, 1939, pl. 24, fig. 21a) whose glabella is also long, with concave flanks and expanded front; I presume that these characters are essential in identifying the species.

The test is punctate.

Occurrence and age: The holotype of, and our specimens attributed to, *Eurodeois serotina* (Whitehouse) come from the V-Creek Limestone; the specimen described here has been found at site M52, Camooweal Sheet area, Queensland; its age is the Zone of *Doryagnostus notalibrae.*

Eurodeois sp. nov. aff. **serotina**

Plate 21, figs. 1a-c, 2

Material: The material consists of one cranidium and one pygidium from a single locality.

Open species nomenclature is applied for the following reasons: (1) the cranidium and the pygidium are not strictly associated in a single bed, but were collected from two beds in closest superposition as a fossiliferous layer; and (2) no other dolichometopid specimens are present in the collection.

The pygidium Plate 21, fig. 2, CPC 18928 is 9.8 mm long without its articulating halfring; it is flattened, but its wide border has retained some of its concave structure—it belongs to a *Eurodeois;* its axial lobe, however, about 0.7 of the shield's length, is rather short, shorter than in other species. It should correspond to a cephalon 18 to 20 mm long.

The cranidium Plate 21, figs. 1a-c, CPC 18927 is 18.0 mm long; the posterolateral limbs and a large part of the occipital lobe with its spine are lost. The structure of the flat rim having a pair of knobs close to its abaxial ends is the same as in *Eurodeois serotina* (Whitehouse); a delicate ridge connects the knobs, running close to the rim. The palpebral lobes, however, are almost effaced and are longer, and the glabella is stouter and its flanks are less concave than in *Eu. serotina;* furthermore glabellar furrows are also evident which in *Eu. serotina* are replaced by muscle spots. Weak transverse depressions between the glabella and the posterior palpebral tips separate the swollen rear of the interocular cheeks from the posterior border, and combined with some effacement of the palpebral furrows, suggest a comparison with *Itydeois elegans* (q.v.); similar structures, however, are also present in some species of *Sunia* as well as of *Eurodeois.*

Occurrence and age: Eurodeois sp. nov. aff. *serotina* comes from locality M157, from a limestone layer (Currant Bush Limestone) about 15 m thick, an interbed sandwiched between sheets of detrital dolomite of the Age Creek Formation; associated trilobites indicate the Zone of *Ptychagnostus punctuosus.*

Eurodeois anepsia sp. nov.

Plate 27, fig. 5; Plate 28, figs. 7a,b; Plate 29, figs. 1-6; Plate 30, figs. 1-5; Text-figure 29

Material: Illustrated are five cranidia, four pygidia, one hypostoma, eleven free cheeks, and one segment of the thorax—altogether 22 specimens selected from an abundant collection; the ten free cheeks Plate 27, fig. 5 and the cranidium Plate 30, figs. 4a, b have friable red sandstone as the matrix; all other specimens are more or less compressed in the friable silty fine-grained sandstone of the Split Rock Sandstone at locality M417—the origin of Whitehouse's material of *Amphoton spinigerum* (q.v.). The tests are leached out and the space left behind was closed by compaction as well as filled in some specimens by silt. The preservation is therefore below the 'limestone quality', not quite compensatable by the large number of 'best preserved' objects. Specimens assigned with some doubt to *Eu. anepsia* are so indicated in the comment.

Holotype: The cranidium Plate 29, fig. 1, CPC 18947 is selected as the holotype; the explanatory diagram, Text-figure 29, was drawn with the support of the cranidia Plate 29, figs. 2 and 3.

Diagnosis: Eurodeois anepsia sp. nov. is distinguished by moderately exorbitant free cheeks, a flat or almost flat cephalic border, long genal and axial spines, visibly developed posterior glabellar furrows, and the absence of emargination in the pygidial rear; in the pygidium, the pleural lobes are fused and interpleural partitions are not evident.

Differential diagnosis: In *Eurodeois deois* (Walcott) genal spines are absent and glabellar furrows are vestigial; its pygidium is emarginate and its border is wider than in *anepsia. Eurodeois marginicrassa* has a convex cephalic border, broad free cheeks and short genal spines, and retains interpleural partitions in the pygidium. *Eurodeois serotina* (Whitehouse) has a narrower glabella, a different structure of the cranidial border, shorter palpebral lobes, and a peculiar relief of the glabella.

Description: Eurodeois anepsia may have reached the length of about 80 mm (see comment on pygidium Pl. 28, fig. 7)—and is the largest known among the Australian Dolichometopidae. Its exoskeleton is prominently convex, with a prominent axial lobe and arched, forward-sloping glabella (Pl. 30, fig. 4), and abruptly geniculate flanks; the genal, occipital, and axial spines are long and the test is smooth. It is found in silty sandstone and quartzose sandstone indicating a well aerated and euphotic marine habitat.

The free cheek is broad; its border, flat in front, attains some convexity rearward, and its margin is only moderately exorbitant, less than in *Eu. deois,* in *Itydeois elegans,* or especially in *Undillia rustica.* The genal spine is advanced and deflected. The posterior sutures are slightly sinuous, almost straight, and cut the rear margin at a fair distance from the genal spines. The posterolateral limbs are moderately long and triangular and the intergenal spines are relatively short. The anterior sutures are convex, and, owing to the closeness of the anterior tips of the palpebral lobes to the glabella, they define a frontal limb that is relatively narrow transversely. The border is relatively short (0.17 of glabellar length) and flat, separated from the glabella by a broad and shallow, almost imperceptible transverse depression.

The palpebral lobes are oblique, moderately curved in the posterior and moderately long (variable, 0.65-0.68 of glabellar length) with posterior tips at the distance of 0.4 of glabellar width from the axial furrows. The interocular cheeks are well below the glabellar crest, horizontal, a little tumid (Pl. 30, fig. 4a); with the palpebral lobes they are 0.6×, and without, about 0.5× the glabellar width. In the rear the swelling of the interocular cheeks approaches the occipital lobe.

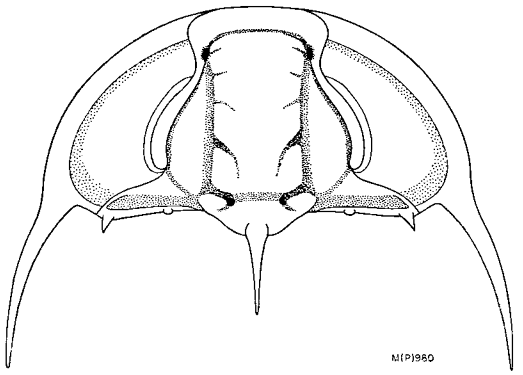


Fig. 29. ***Eurodeois anepsia*** **sp. nov., composite diagram of cephalon. Note the moderately exorbitant margin of the free cheek.**

The occipital furrow is shallow; the front of the occipital lobe has a single pair of dents, and its forward-deflected extremities are slightly swollen.

The axial furrows are narrow and distinct, and only the posterior, shallow fossulae are discernible. The glabellar flanks are gently concave, and the width of the glabella in front and rear is 0.63× and in the middle about 0.57× its length; it is a relatively slender glabella. It is well arched transversely, and in profile it is evenly curved; the front is bluntly rounded. The preocular part of the glabella is somewhat short and lacks the structural detail seen in *Sunia cornunda.* Four pairs of glabellar furrows are discernible; clearly visible are the posterior and recurved long furrows; the remaining furrows are weak and may escape observation in some specimens; their position, however, could be established as shown in Text-figure 29.

The hypostoma is described in the comment below.

The number of segments in the thorax is unknown, but by analogy with *Eurodeois deois* (Walcott) (see Kobayashi, 1944, pl. 1, fig. 10) seven, and in large specimens possibly eight, can be assumed. In the segments (Pl. 29, fig. 6) the articulating half-ring is quite large, the axial lobe is transversely broad, the cushions in the oblique pleural furrows are long, the fulcra are prominent, the facets are well developed, and the pleurae have short sideways-deflected tips.

The pygidium is almost semicircular, and lacks in its rear the emargination present in *Eu. deois.* The facets are well developed, the border is gently concave and relatively wide laterally. The pleural lobes are slightly tumid and slope moderately outward; three pairs of pleural furrows and ribs are present and well developed in less flattened specimens. The axial lobe consists of three annulations lacking median nodes, and an uplifted rounded terminus. The anterior annulation is visibly wider than the rest. Interpleural partitions (grooves, ridges) are absent.

Comment on illustrated specimens

In the piece of sandstone Plate 27, fig. 5, CPC 18966, locality M141 the free cheeks appear aligned and rest convex side up; the margin is exorbitant in all specimens, indicating a *Eurodeois,* apparently *anepsia.* The cheeks rest flat, exposing the largest surface, and appear therefore broader than the cheek in Plate 29, fig. 4, which dips slightly outwards.

The cranidium Plate 30, figs. 4a, b, CPC 18983, in sandstone, locality M415 (or M296) is about 19.0 mm long; it is the only specimen preserving its original convexity; the flanks of the glabella are subparallel, and not concave as in other cranidia; hence the specific identification can be challenged.

The next specimens are all from locality M417, at Split Rock on Wooroona Creek, from a single layer about 30 cm thick.

The holotype cranidium, Plate 29, fig. 1 CPC 18974, is 19.4 mm long (without the occipital spine); the spine itself appears thin—it is only the imprint of its median convex part, the rest being lost. The structure of the occipital spine is evident in Plate 29, fig. 3. The left intergenal spine is indicated.

The cranidium Plate 29, fig. 2, CPC 18975 is 22.5 mm long. It is flattened to some extent, but otherwise undeformed. The glabellar width in the middle is about 0.57×, and in the rear and front 0.63× the length; the palpebral lobe is close to 0.68×; the interocular cheek together with the palpebral lobe is 0.6× the glabellar width. A pygidium like Plate 30, fig. 2 should belong here.

The cranidium Plate 29, fig. 3, a rubber cast of CPC 18976, is 17.0 mm long (without spine); its counterpart is also in the collection. The posterior glabellar furrows are accentuated through collapse of the test; about 5 mm of the occipital spine is preserved.

The cranidium Plate 30, fig. 5, CPC 18984 is 20.0 mm long; its front is deformed (telescoped, shortened), the border therefore convex; but the anterior glabellar (S4) furrows accentuated.

The free cheek Plate 29, fig. 4, CPC 18977 is 37.5 mm long to the tip of the spine, and about 21.5 mm without spine. The genal spine is advanced at the base; some of the exorbitant part of the margin is worn off.

The hypostoma Plate 29, fig. 5, CPC 18978 is 11.5 mm long; a pair of posterior spines and a pair of lateral spines are evident; the maculae are elongate, relatively large and swollen, but worn. The flanks are subparallel and different from the subtriangular hypostoma of *Sunia.*

The thoracic segment Plate 29, fig. 6, CPC 18979 has a span of 32 mm between the pleural tips.

The pygidium Plate 30, fig. 2, CPC 18981 is 11.6 mm long without its half-ring. The border is flattened over the doublure; the relief of the pleural lobes is subdued.

The pygidium Plate 30, figs. 1a, b, CPC 18980 is 13.5 mm long without, and 15.2 with, the half-ring. The border is visibly concave in fig. 1b.

The pygidium Plate 28, figs 7a, b, CPC 18973 is 17.0 mm without, and 18.5 mm with, the half-ring; the axial lobe has partly collapsed; the pleural ribs and furrows are well expressed; in fig. 7b the wide concave border is clearly visible. A corresponding cephalon should be 35 mm, and a complete exoskeleton about 80 mm long.

The pygidium Plate 30, fig. 3, CPC 18982 is also 17.0 mm long without the half-ring; the third (posterior) annulation of the axis is ill defined.

Ecology of Eurodeois anepsia

Tolerance of, but no preference for, a habitat with lutitic and arenitic sedimentation characterises *Eurodeois anepsia*; furthermore, alternatives were not available because limestone was not deposited in the Undilla Basin in the Zone of *Goniagnostus nathorsti*—the time of *Eurodeois anepsia.* Among its coeval trilobites the agnostids (*Goniagnostus nathorsti, Peronopsis,* and *Grandagnostus*) are rare; of the polymerid trilobites, *Sunia, Dorypyge, Lisania, Menocephalites* (*acanthus* Walcott) and *Anomocarella* indicate seaways communicating with China. The large collection of *Eurodeois anepsia* from Split Rock contains remains of holaspides only: moulting is evident, but not breeding, and the same condition is shared by the almost equally abundant *Nepea narinosa;* adults prevail also in the trilobite populations of earlier zones, *Fuchouia fecunda* (q.v.) excepted. It appears that the mode of life of *Eurodeois anepsia* in the Undilla Basin was that of temporary settlers, en route from their breeding biotopes.

Occurrence and age: Eurodeois anepsia nov. is common in the Split Rock Sandstone in the Camooweal and Mount Isa Sheet areas, and very abundant at Split Rock on Wooroona Creek. Its age is the Zone of *Goniagnostus nathorsti.*

Eurodeois? (or **Sunia?**) **spinigera** (Whitehouse)

'Amphoton' spinigerum Whitehouse (1939)

Whitehouse (1939, p. 236, pl. 24, figs. 13-20) established the species *spinigerum* and described it on the basis of eight fragments and specimens not illustrated, presuming a specific homogeneity of the material. Kobayashi (1944, p. 165) expressed the opinion that *Amphoton spinigerum* Whitehouse, 1939 is close to *Sunia.* I suggest the use of that name *(spinigerum)* should be restricted to its holotype (op. cit., figs. 14a, 14b) cranidium in the first place, for the following reasons:

(1) the whole material lacks uniformity, consisting of fragments of a *Sunia* and of a *Eurodeois;*

(2) the genus of the holotype owing to its unsatisfactory state of preservation remains indeterminable;

(3) in my collections no cranidium exists with a glabellar length 'about three times the width' as attributed to *spinigerum* (op. cit., p. 236) in its diagnosis; and

(4) the rest of the characters are inconclusive. The species *spinigerum* is nevertheless valid and legitimate.

I interpret the illustrations (Whitehouse, 1939, pl. 24) as follows:

Fig. 15—cranidium, sp. indet. (probably *Sunia rutilata* sp. nov.);

Fig. 16—pygidium of a *Sunia* (apparently very close to Plate 28, figs. 5a, 5b);

Figs. 17, 18—free cheeks of a *Sunia*;

Fig. 13—cranidium, sp. indet., probably of a *Eurodeois* (*Eu. anepsia* nov.);

Fig. 14a, b—the holotype: reminiscent of *Eurodeois* as well as of *Sunia*;

Fig. 19—free cheek, possibly of *Eurodeois anepsia* nov.;

Fig. 20—a thoracic segment, indet.

Occurrence and age: According to Whitehouse (1939, p. 237) "from the *Amphoton* stage at 'Split Rock' on Waroona Creek, at the crossing of the main road from Camooweal to Mount Isa"; this is locality M417, and the formation is the Split Rock Sandstone; it is the youngest (Öpik, 1956, 1957; 1960) Middle Cambrian formation in the Camooweal Sheet area, Queensland; the age is the Zone of *Goniagnostus nathorsti.* Whitehouse (op. cit., p. 264) originally placed the 'Amphoton Stage' at the base of the Middle Cambrian, and its name refers to *'Amphoton' spinigerum.*

Eurodeois? sp. indet.
Plate 22, fig. 6

The illustrated cranidium, CPC 18936, is 17.0 mm long without its occipital spine. It is immersed in chert and cannot be readily dematricated. Its frontal border is flat, and the glabella tapers visibly forward. It is a slender glabella with a rear width of slightly less than 0.6× its length. Four pairs of glabellar furrows are apparent from the adhesive remnants of the silicified test; the third pair of furrows seems accompanied by a pair of muscle spots off the axial furrows. An inconspicuous tiny median node is apparently present on the extreme glabellar front. The occipital spine (together with the occipital lobe) is as long as the glabella. The interocular cheek together with the palpebral lobe is slightly less than half the glabellar width. Associated are also six less well preserved cranidia, a fragmentary free cheek, and a pygidium whose structure recalls *Eurodeois* (and not *Sunia*). Nevertheless the generic classification *Eurodeois?* remains queried because the cranidium alone is insufficient for a definite determination and the associated fragments may belong to a different species; consequently *Sunia* is another possibility. The described specimen fits the concept of *Amphotonella* Kobayashi, 1942 regarding the forward-tapering glabella; but *Amphotonella* is based on a rather deficient fragment of *Dolichometopus alceste* Walcott (1913) unsuitable for an accurate generic concept.

Occurrence and age: The described cranidium comes from locality M227, V-Creek Limestone, Mount Isa Sheet area; its age is the Zone of *Doryagnostus notalibrae.*

Eurodeois sp., cf. **marginicrassa** sp. nov.
Plate 22, fig. 1; Plate 25, fig. 5

The hypostoma Plate 22, fig. 1, CPC 18931 is 6.0 mm long; it is assigned to *Eurodeois* because of its elongate shape different from the subtriangular hypostomata of *Sunia,* for example, *S. cornunda,* Plate 24, fig. 4. It is decorticated but undeformed, preserving its convexity and the vertical attitude of the wings, one of which is preserved. The marginal ridge is prominent and has the usual two pairs of spines; the maculae have retained the test.

The pygidium Plate 25, fig. 5, CPC 18955 is 9.0 mm long; its border is concave and widens laterally; it seems close to *Eurodeois marginicrassa* nov. which has, however, a longer axial terminus. A second specimen of this kind of pygidium is also available, also about 9 mm long. The propleural veins in these pygidia are rather prominent.

These specimens are presented here for the following reasons: (1) they are large specimens suitable for illustration of structures that are less visible in smaller specimens; cranidia and free cheeks assignable to these shields (which presumably are conspecific) cannot be identified in the collection; (2) the described specimens are closely associated with *Sunia elissa* sp. nov. (q.v.) whose shields were identified by eliminating material belonging to different taxa.

Occurrence and age: The described hypostoma and pygidium come from the calcite pod, locality M89, V-Creek Limestone, containing remains of about six different forms of dolichometopids (Camooweal Sheet area, Queensland). The age is the Zone of *Doryagnostus notalibrae.*

Genus **Sunia** Kobayashi, 1942

The type species of *Sunia* is *Amphoton (Sunia) typica* Kobayashi—by original designation. The subgeneric status of *Sunia* is impracticable, however, for the following reasons: (1) the name *Amphoton* Lorenz, 1906 (q.v.) is applicable only to its type species, *A. steinmanni,* the material of which is inadequate for a conclusive specific, as well as generic, diagnosis. It is even possible, but by no means demonstrable, that *Sunia* itself is a synonym of *Amphoton* in its original sense; (2) the concept of *'Amphoton'* in terms of Kobayashi and of the current literature is based not on *Amphoton* Lorenz but on *Dolichometopus deois* Walcott (q.v.)—the type species of *Eurodeois* gen. nov.; and (3) the three taxa: *Amphoton, Sunia,* and *Eurodeois* can be regarded subjectively as subgenera of a single genus stressing the publication priority of the first named and suppressing at the same time the inconclusiveness of the concept it stands for.

Diagnosis of Sunia Kobayashi: In *Sunia* the pygidium is subtriangular with a narrow and almost evenly wide, relatively flat border, the genal spine arises from a broad base at the inbent part of the margin of the free cheek, the margin in front of the inbent part is evenly curved (not exorbitant), and the hypostoma is subtriangular; the characters are evident in the type species, *S. typica* Kobayashi, 1942, pl. 1, figs. 1-9, but not included in the original diagnosis (op. cit., p. 165). Furthermore, as stated in the original diagnosis, in *Sunia typica* only the posterior glabellar furrows are distinct and the cephalic spines are long; but in Australian forms all furrows are clearly impressed; the long genal and median spines are important in comparison with *Dolichometopus deois* (the quasi-type of *Amphoton*) but not with *Amphoton steinmanni,* whose genal spines are unknown and whose occipital spine is apparently strong and rises from a large base. In Australian forms of *Sunia* these spines are long indeed, but long spines are also possible in *Eurodeois* nov., *Itydeois* nov., and *Dolicholeptus* nov. The absence of genal spines in *Eurodeois deois* (Walcott) and *Eu. adelpha* nov. is, of course, a rare character particularly of these species.

Sunia idica sp. nov.

Plate 25, figs. 1, 2

Material: The available material consists of two cranidia.

Holotype: The cranidium Plate 25, fig. 1, CPC 18951, locality M416 is selected as the holotype.

Diagnosis: Sunia idica sp. nov. has a parallel sided glabella, a short and moderately convex rim, long palpebral lobes, and is distinguished by its densely pustulose test.

Differential diagnosis: No other known species is as pustulose as *idica.* To note, the palpebral lobes in the holotype appear relatively coarsely punctate, but the punctae are decapitated pustules. Owing to the sandstone matrix the ornament of *Sunia rutilata* nov. is unknown, but its frontal border is concave (convex in *idica*) and its palpebral lobes are longer than in *S. idica.*

The generic classification (*Sunia*) is indicated by the parallelism of the glabellar flanks; supporting evidence from the free cheeks and pygidium is not available because they are unknown.

Description: The holotype cranidium is 6.0 mm long (without the occipital spine) and has retained its test; the matrix is limestone. The posterior sutures are directed diametrically, the posterolateral limbs are parallel-edged bands with obliquely cut extremities and small intergenal spines (preserved as stumps) close to the tips; the posterior marginal furrows are deep and moderately wide, and the fulcral geniculation points are strong.

The anterior sutures are very close to the glabella, and subparallel, and the frontal limb is therefore transversely very narrow. No brim is present and the rim is short, about 0.12-0.13 of the glabellar length.

The palpebral lobes, defined by rather deep furrows, are prominent and long (0.7 of glabellar length); their anterior tips are separated from the glabella only by the axial furrows, and a distance of about 0.43× the glabellar width separates the posterior tips from these furrows. The occipital lobe is relatively short, with slightly forward-swept swollen extremities, and a pair of dents in its front. The occipital furrow is well defined by the exceptionally abrupt glabellar rear.

The axial furrows are narrow and deep. The glabella is moderately slender, as wide as 0.58× (not quite 0.6×) its length, with a bluntly rounded front; there is also a weak frontal notch set with a little round node. The two posterior glabellar furrows are sharply incised in a frame of smooth test; the posterior furrows are oblique, long and almost reaching the glabellar rear; the second furrows are much shorter. The anterior furrows (two pairs) are replaced by smooth muscle spots.

The cranidium Plate 25, fig. 2, CPC 18952, locality M226 is 6.6 mm long and lacks the test; it is distorted in its siliceous hard matrix. Evident are the convex rim and the pustulosity.

Occurrence and age: The holotype of *Sunia idica* sp. nov. comes from locality M416, Camooweal Sheet area, Queensland; V-Creek Limestone (upper levels); its age is the Zone of *Goniagnostus nathorsti;* the second cranidium was found in a silicified siltstone of the Split Rock Sandstone; its age is somewhat younger than the holotype.

Sunia cornunda sp. nov.

Plate 19, fig. 4; Plate 23, figs. 1-5; Plate 24, figs. 1-5; Text-figure 30

Material: Three cranidia, two free cheeks, one hypostoma, two pygidia, and two segments of the thorax from the different sites are illustrated; 20 specimens altogether have been examined; the largest cranidium is 21 mm long; the matrix is limestone.

Holotype: The cranidium Plate 24, fig. 1 and Plate 23, fig. 2, locality M57, CPC 18943 is selected as the holotype; it shows the undistorted external surface with all structures well preserved, and its counterpart shows the palpebral lobes and the posterolateral limbs.

Diagnosis: Sunia cornunda sp. nov. is distinguished by two well impressed pairs of fossulae, five clearly developed pairs of glabellar furrows, strong intergenal spines, strongly rugose axial lobes of the thorax, and a triannulated pygidial axial lobe.

Differential diagnosis: The cranidial structure, the free cheeks, and the hypostoma of *Sunia cornunda* are very close to *Sunia typica* Kobayashi (1942) in which, however, the palpebral lobes are somewhat short, no intergenal spines are evident, and the pygidial axial lobe has four annulations. Further comparison remains inconclusive because the specimens of *S. typica* are flattened in shale and may have lost some of their characters. In passing, *S. cornunda* and *S. typica* are very close to each other in age.

The generic characters of *Sunia cornunda* (as well as of *typica*) are: (1) the structure of the free cheek with an inbent margin, (2) the subtriangular hypostoma, and (3) the very narrow pygidial border.

Sunia elissa sp. nov. has a quite different pygidium but resembles *S. cornunda* in having the externally developed fifth glabellar lobes and furrows; it lacks, however, the prominent fossulae, and its palpebral lobes are shorter, and closer to the glabella, than in *cornunda.* In *S. lorenzi* sp. nov. the cranidial front is strongly arched forwards and the foremost glabellar lobes and furrows are undifferentiated, and the pygidium is different also. In *Sunia rutilata* sp. nov. the free cheek is narrower, the palpebral lobes are longer, and the pygidial axial lobe is shorter than in *S. cornunda.*

Description: Sunia cornunda may have attained a length of about 50 mm. Its general habit recalls *Fuchouia fecunda* (Text-fig. 8), except for *cornunda's* very long genal, occipital, and axial spines and the different pygidium.

The free cheek is relatively broad and moderately convex, with a well impressed marginal furrow and an almost flat border; the unusually long genal spines extended to the

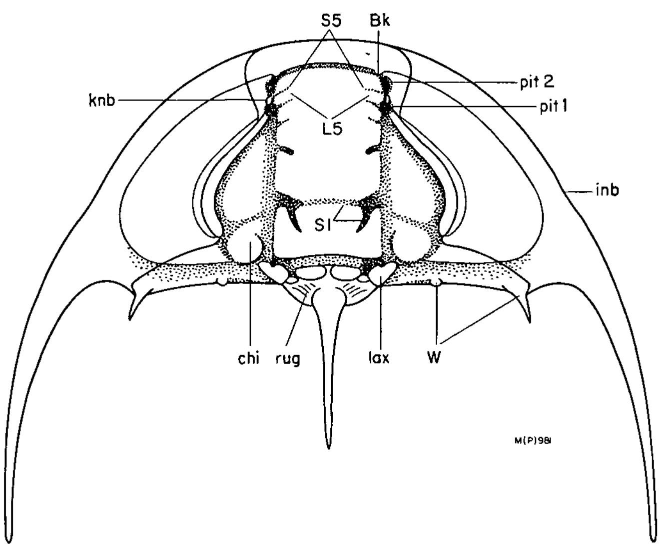


Fig. 30. ***Sunia cornunda*** **sp. nov., composite diagram of cephalon. Bk—anterolateral knob (compare Text-figs. 9 and 26); chi—swollen subdivision of interocular cheek; inb—inbent margin of free cheek; knb—anterior knob (flanking L5); L5—the fifth (foremost) glabellar lobe; lax—lateral lobule of occipital lobe; pit 1—posterior fossula; pit 2—anterior fossula; rug—rugosity on occipital lobe; S1—posterior glabellar furrows (connected by a vestigial transcurrent furrow); S5—anterior (foremost) glabellar furrows; W—posterolateral limb (defined adaxially by the fulcrum).**

rear of the thorax, diverging sidewise from the border (from the inbent part at the mid level of the eyes) as broad horns and slightly advanced at the genal angle; this structure is almost identical with *Sunia typica* Kobayashi (1942, pl. 1, fig. 4). The posterior sutures, oblique and almost straight, become subangular, cutting across the rear border as short and adaxially deflected lines. The posterolateral limbs are elongate triangular and the intergenal spines close to their tips are slender but quite prominent. The fulcra are elevated, distinct, and the marginal furrows are relatively deep and broad.

The anterior sutures diverge slightly and remain close to the glabellar flanks, and the frontal limb is therefore narrow—as usual in Dolichometopidae. The frontal brimless border is short, about 0.14 of the glabellar length, and developed as a slightly convex rim separated from the glabellar front by a well impressed furrow. In one cranidium (Pl. 24, fig. 3) a low ridge is present on the floor of that furrow. A pair of small nodes occur on the rear edge of the rim about the anterior fossulae.

The palpebral lobes are long, 0.7 of the glabellar length (0.58-0.6 in *Sunia typica*); their anterior tips are very close to the glabella leaving only a little space for the ocular ridges; the posterior tips are placed at a distance of 0.43-0.45× the glabellar width from the axial furrows, and the interocular cheek together with the palpebral lobe is about 0.6× the width of the glabella. The palpebral furrows are moderately broad and deep. The interocular cheek is subhorizontal, slightly tumid, and divided by an oblique depression into two parts; the posterior part is a separate swelling behind the level of the rear palpebral tips comparable, for example, with *Itydeois vultuosa* sp. nov.

The occipital lobe with its drawn-out and swollen extremities is visibly wider than the glabella; another pair of low and elongate swellings are superimposed on the mid front, which possesses also two pairs of dents; the rugosity of the chevrons flanking the base of the spine is weak (weaker than in the thorax Pl. 23, fig. 5) and the occipital spine is long, recurving, and rises up steeply. The occipital furrow is well impressed and its appendiferi are deep elongate pits.

The axial furrows are relatively deep; two pairs of fossulae, separated from each other by an elongate knob or node (posterior fossula/knob/anterior fossula) flank the front of the glabella as deep pits in the axial furrows; flanking the posterior glabellar lobe, narrow lunate vestigial alae seem to be present in the holotype (Pl. 24, fig. 1). The fossulae are even stronger than in *Undillia rustica* sp. nov. (Pl. 18, fig. 2a).

The glabella is almost, but not quite, parallel-sided with its slightly concave flanks about the second glabellar furrows; it is moderately slender having the rear width (in the holotype) between 0.6-0.64× its length; the pre-ocular part is slightly expanded on account of the fifth glabellar lobes (between the fossulae); the front is broadly rounded. The longitudinal profile (Pl. 23, fig. 1b; Pl. 24, fig. 3b) is an evenly moderate arc.

Sunia cornunda has five pairs of glabellar furrows and lobes; consequently the cephalon (including the occipital lobe and furrow) is composed of six metameres. A similar number is also evident in *Horonastes eminens* sp. nov. and in *Fuchouia fecunda* (morphogenesis, q.v.). The posterior (S1) furrows are well impressed, with a rather oblique (as usual in dolichometopids) posterior and weaker subhorizontal branches, which in some specimens may join into a vestigial transcurrent furrow. The second (S2) furrows are distinct but short and the S3 furrows are short and very shallow. The two anterior furrows (S4 and S5) are oblique, subparallel, and enclose each of the small but swollen foremost lateral lobes; these extend somewhat laterally interrupting the axial furrows. The cranidial ornament consists of a dense minute granulation developed close to the glabellar midline, on the occipital lobe, and on the elevated, central parts of other lobes.

The hypostoma is subtriangular (as in *Sunia typica* and other species) and its maculae are small but prominently swollen (see also the description in the 'comment' below).

The segments of the thorax are described under 'comment', below.

The moderately convex pygidium is almost semicircular, only slightly longer than half its width. The border is convex (preserved in Pl. 23, fig. 3) and very narrow, unlike the species of *Eurodeois* and *Itydeois* but very close to *Sunia typica* Kobayashi, and the doublure is also narrow. Three pairs of pleural furrows are developed and the pleurae are separated by narrow and fused interpleural joints having a rather weak groove on the crest. Propleural veins are also evident and a reticulate venulosity covers the pleural area around the terminus. The axial lobe is long and extends with its low antiplectrum to the margin. Three axial annulations are well developed, and in the specimem Plate 23, fig. 3 the vestige of one more annulation is indicated. The two anterior annulations are relatively wide, comparable with the occipital lobe and the axial lobes of the thorax—a frequent structure among the Dolichometopidae; triangular cushions are apparent in the adaxial parts of the two anterior pleural furrows. Abaxially the annulations are swollen and carry a pair of low nodes, or only a pair of dark spots.

Comment on illustrated specimens

The free cheek Plate 19, fig. 4, CPC 18918 comes from locality M54 (associated with *Undillia rustica* and *Dolicholeptus ansatus*); it is 13.5 mm long to the tip of the genal spine and belongs to a relatively small cephalon, about 7.0-7.2 mm long. The base of the genal spine is rather thick. The matrix is relatively soft silty grey limestone.

The next five specimens are selected from a collection from site M57 associated with *Goniagnostus nathorsti* and an abundance of diverse agnostids; the matrix is grey laminated silty limestone, in parts friable to crumbling.

The cranidium Plate 23, fig. 1, CPC 18942 is 15.5 mm long and the largest available. It is somewhat fractured; the width of the glabellar rear is 0.58× the length—a slender glabella. The occipital lobe is transversely rugose.

The holotype cranidium, Plate 23, fig. 2 and Plate 24, fig. 1, CPC 18943, is 11.2 mm long; the test is preserved and both the counterparts supplement each other. Five pairs of glabellar furrows, two pairs of fossulae, the minute ornament confined to the middle, the posterolateral limbs with their prominent intergenal spines and the tumid rear of the interocular cheeks are evident; the pair of small nodes flanking the glabellar front is also visible. The glabellar rear is as wide as 0.64× its length, and the palpebral lobes are about 0.65 of the glabellar length.

The pygidium Plate 23, fig. 3, CPC 18944 is 9.8 mm long (without the articulating half-ring), and indicates a cephalon about 20 mm in length. The articulating half-ring of the second axial annulation is bare and shows its free edge; in front of it the anterior annulation is rugose. Three distinct axial annulations with abaxial swellings are apparent; a fourth posterior vestigial ring also seems to be present.

The thoracic segment Plate 23, fig. 4, CPC 18945 has the axial lobe about 8.0 mm wide; its abaxial ends are swollen (as in the pygidium), the triangular cushion in the pleural furrow is long and swollen, and the geniculation is abrupt; the stump of the retral spine of the pleural tip on the left is preserved. The axial spine was originally over 10 mm long.

The thoracic segment Plate 23, fig. 5, CPC 18946 has a span of about 19 mm between the tips of the pleurae; the facets are well developed, reaching the prominent fulcral points; the rugosity of the axial lobe is prominent and the articulating half-ring is large—as long as the axial lobe. The chevron on the axial lobe is prominent.

The next four specimens are selected from collection M416; the matrix is a flaggy fine-grained, almost cryptocrystalline impure limestone; associated are agnostids of the *Doryagnostus notalibrae* assemblage and well preserved shields of *Asthenopsis levior* Whitehouse.

The free cheek Plate 24, fig. 2, CPC 18947 is 35.5 mm long to the tip of the genal spine.

The cranidium Plate 24, figs. 3a, b, CPC 18948 is 11.2 mm long. The glabella is delicately carinate, the rim has its posterior edge abrupt, a faint transverse ridge is visible in the frontal marginal furrow, and the posterolateral limbs with their intergenal spines are well preserved.

The hypostoma Plate 24, fig. 4, CPC 18949 is 7.8 mm long, indicating a large cephalon; the fringing ridge shows some terraced lines, and lateral and posterior spines (a pair of each) are indicated. The anterior border is vertical and has a clean-cut margin; and the anterior wings are also vertical and buried in the matrix.

The pygidium Plate 24, fig. 5, CPC 18950 is 10.0 mm long and belongs to a large cephalon; the axial lobe has three annulations.

Occurrence and age: Sunia cornunda sp. nov. occurs in the upper quarter of the V-Creek Limestone of the Undilla Basin; its age is the Zone of *Doryagnostus notalibrae.*

Sunia elissa sp. nov.

Plate 22, figs. 2, 7; Plate 25, figs. 3a-b, 4

Material: Illustrated are two cranidia, one free cheek, and one pygidium, selected from a total number of five sufficiently preserved cranidia, two free cheeks, and two pygidia.

Holotype: The cranidium Plate 25, figs. 3a and 3b, CPC 18953 is selected as the holotype.

Diagnosis: Sunia elissa sp. nov. has a glabellar front bluntly rounded and the cranidial margin moderately arched, a visibly developed fifth (foremost) glabellar lobe and furrows, and well impressed glabellar furrows; it is distinguished by its relatively long frontal border, relatively short palpebral lobes placed close to the glabella, and a subtriangular pygidium with a broad axial lobe of only two annulations defined by two transverse furrows.

Differential diagnosis: Sunia elissa cannot be confused with another species (*S. idica* nov. excepted) regarding the structure of the pygidium; the pygidium of *idica* is unknown, but *idica* is distinguished by its granulosity, short rim, transversely narrow posterolateral limbs, and long palpebral lobes. In *Sunia lorenzi* nov. the axial lobe also has two transverse furrows, but the lobe itself is long and the shield is semicircular. The cranidial structure is generally the same as in *Sunia cornunda* sp. nov., whose frontal border is, however, shorter and whose palpebral lobes are larger, than in *S. elissa;* furthermore the fossulae in *cornunda* are strong and in *elissa* indiscernible. In *S. lorenzi* the front and frontal margin are strongly arched and the foremost glabellar lobes and furrows are undifferentiated.

Description: The free cheek attributed to *Sunia elissa* is broad, the marginal furrow is shallow, and the border almost flat; the genal spine, of a medium length (shorter than in *S. cornunda*) arises from a base which is less strong than in *S. typica* and *cornunda.* The posterior sutures are slightly sinuous, slanting, and the posterolateral limbs are quite long and subtriangular; the intergenal spine is as prominent as in *S. cornunda.*

The anterior sutures are almost straight, slightly divergent, and cut the frontal border in broad curves. The cranidial border is almost flat, slopes gently forward, and is as long as 0.2 of the glabella: it is longer than in other species of *Sunia.*

The palpebral lobes are prominent but narrow and short, about 0.6 of the glabellar length; they are only moderately oblique, being placed close to the glabella; the interocular cheek together with the palpebral lobes is about as wide as 0.45 of the glabella, and the posterior palpebral tips are placed at the distance of 0.3-0.32 of the glabellar width from the axial furrows—very close indeed. The interocular cheeks are moderately tumid and their posterior ends are quite prominent (Pl. 22, fig. 2).

The occipital furrow is well defined by the abrupt glabellar rear; the crescentic occipital lobe is slightly wider than the glabella and rugose at the flanks; the long and arcuate median spine arises from a broad base.

The axial furrows are deep and narrow, but less deep is their closure around the glabellar front; bacculae are absent, fossulae are vestigial, and the pair of small knobs at the flanks of the foremost glabellar lobe are distinct.

The glabella is moderately wide, about 0.65× its length in the rear as well as in front; its flanks, however, are slightly concave, the width about 0.6× the length. Its front is bluntly rounded and angular laterally; in profile (Pl. 25, fig. 3b) it is evenly arched.

The glabellar furrows are well impressed; the anterior branches of the rear furrows are shallow and almost join in the middle; the third furrows close to the palpebral tips are short and shallow—as usual in dolichometopids; the fourth furrows (quite clear), and the fifth (very weak) enclose the small but still visible fifth (foremost) glabellar lobes, as seen also in *Sunia cornunda,* Text-figure 30.

The pygidium is subtriangular and well vaulted; the border is narrow and almost flat and clearly defined by the shallow marginal furrow; the facets are large and terminate at the prominent fulcral points which are far apart; two pairs of pleural furrows are well developed defining the swollen ribs, and interpleural partitions are vestigial. The axial lobe is broad, plump, and only slightly tapering. Two deep transverse furrows and two annulations are rather prominent; a third, reduced annulation is indicated by lobules at the anterolateral corners of the terminus, whose very broad antiplectrum slopes down vertically almost to the margin. The non-functional articulating half-rings of the second segment and the terminus are exposed; on the anterior segment a low elongate and apparently double node, and on the second a pair of small but prominent tubercles, are visible; and the ends of the annulations are swollen.

Comment on specimens

All specimens came from locality M89; the matrix is essentially phanerocrystalline calcite.

The holotype cranidium, Plate 25, figs. 3a and 3b, CPC 18953, is 13.0 mm long without, and 21.0 mm with, the occipital spine. The test is preserved. The posterolateral limb is fragmented and its outline in fig. 3b is inaccurate; the intergenal spine is preserved.

The cranidium Plate 22, fig. 2, CPC 18932 is 14.2 mm long; it shows the swollen rear of the interocular cheek, but the front of the glabella is distorted by a transverse fracture; most of the test is lost.

The fragmentary free cheek Plate 25, fig. 4, CPC 18954 is about 21.0 mm long as preserved; its structure is *Sunia* (margin not exorbitant, and the base of the spine broad and diverted sidewise); it is assigned to *S. elissa* because of its relatively short eye. A similar but smaller free cheek in the collection is 12.0 mm long without the genal spine, which is preserved.

The pygidium Plate 22, fig. 7, CPC 18937 is 5.0 mm long; another pygidium of the same size, but somewhat incomplete, is also included in the paradigm.

Occurrence and age: Sunia elissa sp. nov. has been found only in the calcite pod, locality M89, in the V-Creek Limestone (Camooweal Sheet area, Queensland); its age is the Zone of *Doryagnostus notalibrae*.

Sunia lorenzi sp. nov.

Plate 19, figs. 5-7; Text-figures 31, 32

Material: Two cranidia, one free cheek, and one pygidium are illustrated; the whole collection contains six cranidia, four pygidia, and two free cheeks; the specimens come from a single layer of irregular chert concretions in dolomite; all specimens and associated fossils are silicified.

Holotype: The cranidium Plate 19, figs. 5a, 5b is selected as the holotype; a part of it is immersed in silica but the exposed parts of the cranidium are sufficient for the reconstruction of the whole (Text-fig. 31); it is unusually well preserved and informative.

Diagnosis: Sunia lorenzi sp. nov. is distinguished by its very narrow flat cranidial border and strongly forward-arched anterior margin and glabellar front, and by its pygidial axial lobe having only two axial annulations defined externally by transverse furrows.

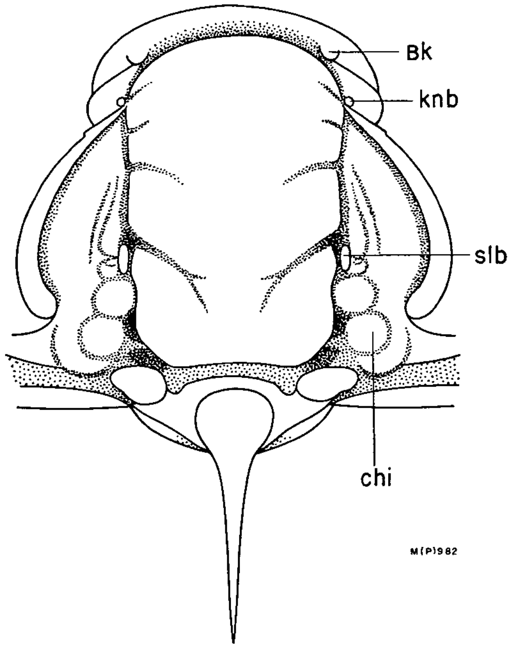


Fig. 31. *Sunia lorenzi* **sp. nov., restored. Bk—anterolateral knob on border; chi—swellings in the interocular cheek; knb—anterior knob; slb—subsidiary lobule.**

Differential diagnosis: S. lorenzi differs from other species of its genus by the characters included in the diagnosis. The forward-arched front and the presence of subsidiary lobules at the glabellar flanks suggest a comparison with *Itydeois elegans* (q.v.) which is, however, different in having a brim and the lobules at the second glabellar lobes, not the first as in *S. lorenzi*; furthermore, in *I. elegans* the lateral cephalic margin is exorbitant. The front is also arched forward in *Dolicholeptus baiatus* nov., and in *Undillia lara* nov. — a character recurrent in species of diverse genera. The species *lorenzi* nov. is attributed to the genus *Sunia* because of its pygidial structure (evenly wide flat border), and the even (not exorbitant) curvature of the margin of the free cheek; as compared with the contemporaneous *Sunia cornunda* nov. It is conspicuous regarding the absence of external manifestation of fossulae and the fifth (preocular) pair of glabellar furrows.

Description: The free cheek is tumid and relatively broad with an externally flat border. The doublure has an angular, sharp marginal edge set off from the external margin by a flange at the base of the genal spine (see Text-fig. 32).

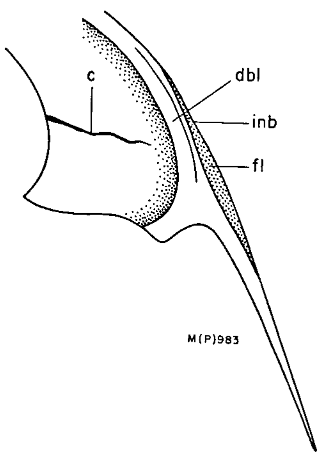


Fig. 32. *Sunia lorenzi* **sp. nov., explanatory diagram of free cheek, Plate 19, fig. 6. c—principal vein; dbl—doublure with marginal crest; fl—flange; inb—inbent margin.**

The anterior sutures, slightly convex outward, are otherwise subparallel and close to the glabellar front; their projection in plan appears short owing to the steep slope of the preocular pleural area (compare lateral view, Plate 19, fig. 5b). The frontal area is narrow and the flat border is short—about 0.1 of the glabellar length. A pair of low, almost imperceptible knobs are placed on the rear of the rim connected by a faint elevated line. The palpebral lobes, about 0.6 of the glabellar length, are quite short, narrow in front and relatively wide in the middle, and the ocular ridge is distinct, oblique and narrow. The tumid interocular cheek slopes gently abaxially, and together with the palpebral lobe is 0.5 of the glabellar width; a chain of low swellings is developed on the interocular cheek flanking the glabella; these cushions appear to imitate the swollen ends of the occipital lobe.

The occipital lobe is wider than the glabellar rear, and has a pair of frontal dents, drawn-out and swollen extremities, posterolateral flanges and a strong retrally curving median spine; similar spines are also evident on isolated segments of the thorax. Occipital posterolateral flanges occur also in other dolichometopids but are not readily dematricated. The occipital furrow is relatively wide and well defined by the abrupt glabellar rear.

The axial furrows are distinct but unevenly deep; the deepest are those at the flanks of the second glabellar lobe, and they merge without interruption with the posterior glabellar furrows; a similar deepening is also apparent in some other forms, as for example, in *Eurodeois marginicrassa* (Pl. 17, fig. 2), in *Fuchouia* (Pl. 10, figs. 1 and 2), in *Horonastes* (Pl. 4, fig. 2), and in *Itydeois elegans*. Fossulae are indiscernible; there seem to be a pair of very small nodes at the glabellar flanks in front of the ocular ridges; a pair of elongate low subsidiary lobules are visible on the floor of the axial furrows at the anterior corners of the rear glabellar lobes; similar lobules occur also in *Itydeois elegans* (Pl. 14, figs. 1a, 1b) but more forward—at the flanks of the second glabellar lobe. The anatomy of these lobules is as obscure as that of the upholstery of the adjacent interocular cheeks. A seat of some unknown organs at this position is also indicated in *Rhyssometopus* (Öpik, 1967a, p. 275) and in related forms.

The glabella, as wide as about 0.65× its length, has its flanks almost parallel but with a rather weak constriction about the second glabellar furrows, and is somewhat expanded subcircular in front of these furrows. It is evenly arched in profile (Pl. 19, fig. 5b) and steep in front. Four pairs of glabellar furrows are evident; the two anterior ones are very shallow and short, and the posterior ones are well impressed as seen in Plate 19, fig. 7.

The cranidial test is punctate and, apparently minutely papillate (preserved on the palpebral lobe).

The pygidium is subcircular, with an evenly wide and flat border gently sloping outward; the pleural lobes are arched with a quite steep peripheral slope; two pairs of broad pleural furrows are distinct, separated by interpleural crests; the propleural veins are prominent. The axial lobe is long and its steeply down-sloping antiplectrum reaches the border; two annulations are present separated by transcurrent furrows; internally, a third axial subdivision is indicated by short lateral furrows in the terminus—visible in an associated (not illustrated) pygidium.

Comment of illustrated specimens

The holotype cranidium, Plate 19, fig. 5a, b, CPC 18919, is 13.0 mm long to the edge of the occipital lobe; the left posterolateral limb is lost, and on its right it is immersed in silica; otherwise it is undeformed; its reconstruction is presented in Text-figure 31.

The free cheek Plate 19, fig. 6, CPC 18921 is 23.0 mm long to the tip of the genal spine passing beyond the echinoderm fragment (a set of marginal plates). Exposed is the venulose inside of the test (see Text-fig. 32).

In the specimen Plate 19, fig. 7, CPC 18920 the pygidium is 9.4 mm long without its half-ring; the detached part of the border is slightly concave, having collapsed over the doublure. In the associated cranidium the glabellar furrows appear quite strong owing to the back-to-front illumination.

Occurrence and age: Sunia lorenzi sp. nov. has been found only in the Camooweal Sheet area, Queensland, at locality M136 in a thin bed of dolomite with chert concretions; the dolomite belongs to the upper part of the Age Creek Formation; the age indicated by the associated fossils is the Zone of *Doryagnostus notalibrae.*

Sunia russa sp. nov.

Plate 27, figs. 1-4; Text-figure 33

Material: The described material consists of one cranidium, three pygidia, and one hypostoma. The matrix is red brown (reddened) sandstone and the tests are not preserved. The specimens are, however, relatively large and the structures therefore are not obliterated by the granular matrix.

Holotype: The cranidium Plate 27, figs. 1a and 1b, CPC 18962 is selected as the holotype.

Diagnosis: Sunia russa sp. nov. is distinguished by its relatively short palpebral lobes, forward-arched cranidial margin and concave frontal border; its pygidium is practically borderless, subtriangular and even subangular in the rear.

Differential diagnosis: Sunia russa and *S. cornunda* have a quite similar cranidial structure as can be seen from a comparison of Text-figures 33 and 30; in *S. cornunda,* however, the frontal border is not concave but even slightly convex, and shorter than in *S. russa* whose palpebral lobes at the same time are shorter; furthermore, the well differentiated preocular glabella of *cornunda* is distinct by its furrows and lobes which in *S. russa* are obliterated. The pygidium of *cornunda* is almost semicircular and has a defined border. *Sunia elissa* and *S. lorenzi* have distinctive pygidia and cannot be confused with *russa*; and *S. rutilata* has long palpebral lobes and a pygidium different by its border and shorter axial lobe. In *Sunia colainis* the pygidium is also triangular, but it has lateral spines and is longer than in *russa.*

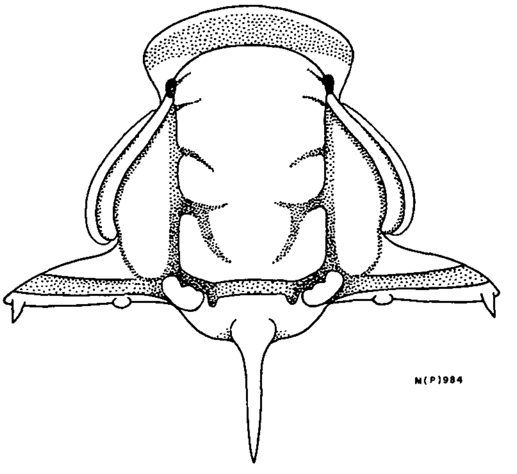


Fig. 33. ***Sunia russa*** **sp. nov., diagram of holotype cranidium. Note the concave border.**

Description and comment: The holotype cranidium, Plate 27, figs. 1a and 1b, is 15.0 mm long and its rubber cast (1b) shows a part of the occipital spine; the posterolateral limbs are triangular, the frontal border is 0.2 and the palpebral lobes 0.6 of the glabellar length. The glabella has slightly concave flanks and its width in the rear and in front is 0.65× the length. The posterior glabellar furrows are also quite distinct, and the next two pairs are shallow.

The hypostoma (Pl. 27, fig. 2) is subtriangular (a characteristic shape in *Sunia*) and well rounded at its rear margin; the marginal ridge with the two pairs of short spines is preserved and the maculae are small but prominent.

The pygidium associated with a hypostoma in Plate 27, fig. 2, CPC 18963 is 11.5 mm long; the very narrow doublure is exposed; the axial lobe tapers to 0.5 of its frontal width, and consists of three fully developed annulations, a somewhat vestigial fourth annulation, and a short terminus; the antiplectrum reaches the margin.

The pygidium Plate 27, fig. 4, CPC 18965 is 13.0 mm long and corresponds to a cephalon of 26-28 mm in length (estimated); two pairs of interpleural partitions are indicated; the terminal part of its axial lobe is, however, damaged.

The fragmentary pygidium Plate 27, fig. 3, CPC 18964 is 11.0 mm long; its pleural ribs are relatively prominent and the exposed narrow doublure can be mistaken for an external border.

Occurrence and age: Sunia russa sp. nov. comes from the Camooweal Sheet area, Queensland, locality M141, Split Rock Sandstone; its age is the Zone of *Goniagnostus nathorsti.*

Sunia rutilata sp. nov.

Plate 28, figs. 1-5b

Material: The illustrated material consists of two cranidia, one hypostoma, one free cheek, and one pygidium. The matrix is red ('reddened') friable sandstone whose grains rendered the specimens somewhat inconclusive regarding some detail structures which may or may have not been present originally. Nevertheless, the taxon is named because a differential diagnosis can be given.

Holotype: The cranidium Plate 28, fig. 1, CPC 18967 is selected as the holotype, whose structure is supplemented by the free cheek Plate 28, fig. 4, CPC 18970.

Diagnosis: Sunia rutilata sp. nov. is a regular species of *Sunia* as evident from the subtriangular hypostoma, the lateral position of the genal spine, and the narrow pygidial border; it is distinguished by its very long palpebral lobes (more than 0.7 of the glabella), narrow free cheek, and relatively short pygidial axial lobe.

Differential diagnosis: In other species of *Sunia* the palpebral lobes are shorter (0.58-0.7, depending on the species), the free cheek is visibly wider, and the pygidial axial lobe is long, touching the border or (with its antiplectrum) even the margin. The free cheek of the contemporaneous and co-formational *Sunia russa* is unknown, but its pygidial axis and palpebral lobes are longer than in *rutilata.*

In *Sunia elissa* the long cranidial border, short palpebral lobes, and peculiar pygidium prevent a confusion with *S. rutilata*; further comparison is given under *S. idica*; *S. lorenzi* differs by its forward-arched front and pygidial structure.

Description: The holotype cranidium is 12.5 mm long and therefore fairly large; the frontal border is brimless and relatively short; the rim is slightly convex (not concave as in *S. russa*); the palpebral lobes are 0.73 of the glabellar length and apparently, slightly angulate; their posterior tips stand at a distance of 0.35 of glabellar width from the axial furrows; the glabella has a rather bluntly rounded front, parallel flanks, and its width is 0.63× its length. Four pairs of glabellar furrows are present.

The cranidium Plate 28, fig. 2, CPC 18968 is 11.0 mm long as preserved. Its palpebral lobes are also long and angulate and the posterior tips are even closer to the glabella than in the holotype. The posterior glabellar furrows are furcate and the right posterolateral limb is preserved. In the decorticated occipital lobe its articulating doublure is exposed—a rare sight in dolichometopids (compare *Amphoton deois*, drawing, pl. 3, fig. 6, Kobayashi, 1942, as well as fig. 163(5) in Harrington & others, 1959).

The free cheek Plate 28, fig. 4, CPC 18970 is 15.0 mm long to the tip of the genal spine, which is visibly shorter than in *Sunia typica* Kobayashi (op. cit., pl. 1, fig. 4) and in *S. cornunda*; the eye is long and corresponds to the long palpebral lobes of the cranidium; the genal spine is advanced and arises from a broad base at the cheek's flank.

The hypostoma Plate 28, fig. 3, CPC 18969 is 5.8 mm long. It is undeformed, with its anterior wings retaining their original vertical attitude; the marginal ridge is clear, but of the spines only the stumps of the posterior pair are visible; the maculae are small and preserved as casts of about three sand grains.

The pygidium Plate 28, figs. 5a, 5b, CPC 18971 is about 12.5 mm long (without the articulating half-ring). The border is narrow and flat (fig. 5a), the pleural furrows are relatively narrow, and the ribs are prominent; the axial lobe is 0.8 of the shield's length and somewhat short for a species of *Sunia*. Of the three annulations the two anterior ones are wider than the rest. The different aspects of the two counterparts regarding the relief (subdued in fig. 5b) illustrates the 'sandstone' mode of preservation; presumably fig. 5a represents the internal cast, which usually has the relief stronger. As mentioned earlier, this pygidium is very similar to the one that Whitehouse (1938, pl. 24, fig. 16) attributed to *Amphoton spinigerum.*

Occurrence and age: Sunia rutilata sp. nov. occurs in the Split Rock Sandstone, at site M133, Camooweal Sheet area, Queensland. Its age is the Zone of *Gonianostus nathorsti.*

Sunia cf. **rutilata**

Plate 28, figs. 6a, b

This pygidium (CPC 18972) also resembles the pygidium attributed to *Amphoton spinigerum* by Whitehouse (1939, pl. 24, fig. 16); both were collected at the same place, and in the same bed; it is 13.5 mm long and slightly longer than half its width. It has a narrow depressed border and is almost subtriangular in outline; the axial lobe is longer than in *Sunia rutilata.* Both the counterparts were singed in a fire and the positive (fig. 5b) lost some of its relief.

Occurrence and age: The illustrated pygidium comes from the Camooweal Sheet area, Queensland, locality M417, Split Rock Sandstone, at Split Rock; its age is the Zone of *Goniagnostus nathorsti.*

Sunia colainis sp. nov.

Plate 26, figs. 5, 6

Material: The material consists of one pygidium and one hypostoma in a hard silicified siltstone.

Holotype: The pygidium Plate 26, figs. 5a, 5b, CPC 18960 is selected as the holotype.

Diagnosis: Sunia colainis sp. nov. is distinguished by its long pygidium (longer than half the width) with a pair of short anterior marginal spines and a borderless, evenly sloping periphery.

A differential diagnosis is superfluous because no confusion with other species is possible.

Description: The holotype pygidium is 11.0 mm long (without the half-ring) and 0.6× the shield's width; in outline it is elongate semielliptical with a slightly rearward projected posterior margin. The pleural lobes are moderately tumid; three pairs of pleural furrows are apparent, but the third are rather shallow; the anterior two pleurae are separated by vestigial interpleural lines; two pairs of propleural veins arise from the rather deep pits (apodemes) at the intersections of the axial and transverse furrows. The axial lobe is prominent and slightly less than 0.8 of the shield's length; the two anterior annulations are wide (laterally) and well defined by transverse furrows; the third annulation is almost confluent in the middle with the terminus. Exposed non-functional half-rings and median nodes are absent. The doublure (with terraced lines) is moderately narrow, apparently not reaching the rear of the terminus. The marginal spine has lost its point; it is deflected sidewise and is placed just behind the shield's maximal diameter.

The associated hypostoma, Plate 26, figs. 6a and 6b, CPC 18961, is 7.5 mm long and, preserved as an internal cast, has one of its flanks distorted. Nevertheless its subtriangular shape (of a regular *Sunia*) is recognisable. The marginal frame (ridge) is prominent and bears a pair of posterior spines and two pairs of lateral spines—one pair more than observed in other species.

Occurrence and age: Sunia colainis sp. nov. comes from a silicified siltstone bed high in the Split Rock Sandstone, locality M226, Mount Isa Sheet area, Queensland; its age is the Zone of *Goniagnostus nathorsti.*

Sunia sp. indet., pygidium with reticulate veins

Plate 26, figs. 4a, 4b

The illustrated fragmentary pygidium, CPC 18959, is about 14.3 mm long (as preserved). The matrix is aphanitic pale grey limestone. The test is preserved, and is apparently very thin. The ill-defined narrow border seen in fig. 4a may or may not be the result of collapse over the void between the outer test and the doublure. Three pleural furrows, vestigial interpleural grooves, and propleural veins are preserved; though taxonomically insignificant it is structurally informative, showing reticulate caecal veins reaching the margin around the terminus (compare Öpik, 1961a, e.g. pl. 69).

Occurrence and age: The specimen comes from the Mail Change Limestone at locality M19, Camooweal Sheet area, Queensland; its age is the Zone of *Goniagnostus nathorsti.*

Sunia sp. indet., pygidium No. 1

Plate 22, fig. 11

The illustrated pygidium, CPC 18941, is 8.2 mm long and therefore quite large. The border is narrow and almost flat; the axial lobe tapers rapidly and consists of three annulations and a subtriangular terminus. Its propleural veins are branched and the pits in the marginal furrow are impressed interspace ridges separating the distal ends of caeca.

Occurrence and age: The described pygidium No. 1 came from the Camooweal Sheet area, Queensland, locality M41, a sandy limestone (V-Creek); its age is the Zone of *Doryagnostus notalibrae.*

Dolichometopidae, pygidium No. 2

Plate 20, fig. 2

The illustrated pygidium, CPC 18923, is 5.4 mm long; it is the only pygidium of its kind in the collections. Its pleural ribs are swollen and the axial lobe has two annulations. The terminus is large and reaches the border; the fulcral points and the facets are rather strong. The marginal furrow is very deep and the border is narrow and convex, and the pygidium cannot be attributed either to *Sunia* or *Eurodeois*, or to any other of the known genera.

The border is covered by well developed terraced lines, and the non-functional articulating half-ring of the second segment is exposed. The pygidium is associated with the cranidia of *Eurodeois serotina* in limestone but it does not belong to that species.

Occurrence and age: The pygidium No. 2 comes from the Camooweal Sheet area, Queensland, locality M52, in V-Creek Limestone; its age is the Zone of *Doryagnostus notalibrae.*

Dolichometopidae gen. nov., sp. nov., pygidium No. 3

Plate 22, fig. 9

The illustrated pygidium, CPC 18939, is 2.4 mm long without its articulating half-ring, and therefore small. Its border is wide, concave, and emarginate in the rear; the pleurae within the border are swept rearward and the anterior pleurae terminate as marginal spines; these spines are short, especially in the second segment; the axial lobe is tapering and long, reaching with its antiplectrum the posterior emargination; three axial annulations are present, the anterior one with a prominent median spine, the second with a low spine, and the posterior (third) annulation with a median node; the terminus is deformed.

Occurrence and age: Pygidia attributable to the pygidium No. 3 have been found only in the calcite pod of the V-Creek Limestone, locality M89; the age is the Zone of *Doryagnostus notalibrae.*

Subfamily Acontheinae Westergaard, 1950

The Acontheinae are regarded in the extant literature as a subfamily of the Corynexochidae on account of the corynoid shape of the glabella and the absence of a clear preglabellar rim. Here, however, the Acontheinae are placed in the Dolichometopidae by virtue of the similarities in pygidial structure between *Fuchouia* (Dolichometopidae) and *Acontheus tenebrarum.* At all events the absence of eyes in *Acontheus* justifies an independent status for its subfamily.

The pygidium is known in three species— *Acontheus acutangulus* Angelin, 1851, *A. burkeanus* Öpik, 1961, and *A. tenebrarum* sp. nov. The pygidium attributed to *Corynexochus bornholmensis* by Gronwall (1902, Pl. 4, fig. 2), having a festooned border, seems to represent an unnamed species of *Acontheus* whose cephalon is unknown.

Finally *Acontheus inarmatus* Hutchinson, 1962 from Newfoundland and *A. patens* Lazarenko, 1965 from East Siberia are congeneric and distinguished by rounded (not spinose) cephalic corners; their pygidia, however, are unknown.

Acontheus tenebrarum sp. nov.

Plate 32, fig. 5

Holotype: The illustrated exoskeleton CPC 18993 is the holotype; it is the sole available material of the species.

Diagnosis: A. tenebrarum is distinguished by its long pygidial axis extended almost to the posterior margin of the shield; the axis consists of three annulations and the terminus.

Differential diagnosis: In *Acontheus acutangulus* in the pygidial axis only the two anterior annulations are clear and the terminus ends at the marginal furrow; in *A. burkeanus* the axis is even a little shorter than in *acutangulus.* The genal spine is short triangular and deflected from the cephalic margin, but in *acutangulus* and *burkeanus* it continues in the curvature of the margin.

Description of the holotype: The specimen as preserved in the matrix is about 2.0 mm long: two anterior segments, however, are overridden by the fragmentary left cheek and consequently the intact exoskeleton was a little longer than 3.0 mm. The glabella and the frontal part of the cephalon are missing, the cheek is displaced adaxially and rearward over the two anteror segments of the thorax; **a** mass of calcite represents probably the filling of the rearward displaced hypostoma. No cephalic sutures are evident in the cheek.

The thorax consists of eight segments; that number indicates a late meraspis or even a holaspid specimen. The fulcra are low and placed far apart; the extra-fulcral free pleural ends are geniculated down, swollen, and terminate as short retral spines. Opisthopleural cushions (see Öpik, 1967a, text-fig. 57a, p. 178) are relatively low and short.

The pygidium is relatively short; it consists of five pairs of pleurae rapidly decreasing in length towards the rear; the pleural furrows are clear and reach the margin, but the interpleural grooves are only just visible. The garland of festoons is well marked by the marginal furrow, and the festoons (the tips of the pleural ribs) are pointed and point retrally. The same structure of the pleural tips prevails also in the four posterior segments of the thorax. The same structure (festoons) but in a lower relief adorns the pygidia of the dolichometopid *Fuchouia fecunda* (Pl. 6; Pl. 10, fig. 4; Pl. 11).

Occurrence and age: Acontheus tenebrarum comes from the Camooweal Sheet area, Queensland, site M41—a late part of the V-Creek Limestone. Its age is the Zone of *Doryagnostus notalibrae* (= the Zone of *Pytchagnostus punctuosus* associated with *Goniagnostus nathorsti*); it is approximately contemporaneous with *Acontheus burkeanus* Öpik, 1961 and older than the Swedish *Acontheus acutangulus*.

Appendix

Fam. GIORDANELLIDAE nov.

The family Giordanellidae is monotypic based on *Giordanella meneghinii* (Bornemann, 1883); its synonymy is given by Nicosia & Rasetti (1970); an exhaustive description of the genus and its only known species has been published recently by Rasetti (1972) under 'Polymera of uncertain affinities'.

Giordanella meneghinii is regarded herein as a species of the order Corynexochida possessing a hypostomal suture and not an integrated rostral-hypostomal plate; the same structure prevails in the Australian dolichometopids described in the present Bulletin; these forms, however, remain in other morphological aspects dissimilar to *Giordanella.* The Dorypygidae and Ogygopsidae are regular Corynexochida equipped with the rostral-hypostomal plate, but at the same time provide for characters which are significant in *Giordanella*: (1) the pygidium in *Giordanella* is large and has the anterior segments provided with short spines as in *Bonnia tumifrons* Resser (1936) which is illustrated by Walcott (1916, pl. 56, fig. 3e); it is a form of the Dorypygidae; (2) the hypostomata of *Giordanella* (Rasetti, op. cit., pl. 5, fig. 1) and of *Ogygopsis* (Rasetti, *in* Moore, 1959, p. 0219) are quite similar, the rim excepted: in *Giordanella* the rim is marginal to the tips of the anterior wings and in *Ogygopsis* the rim left the margin to fade out on the wings as seen in the hypostoma of the Australian dolichometopids.

GLOSSARY

EXPLANATION OF NAMES OF FOSSILS

adelpha (Eurodeois): Greek, 'sister', alluding to the affiliation with *Eu. deois.*

Amphoton: see Öpik, 1961, p. 185. The translation given by its author (Lorenz, 1906) can be paraphrased: 'of ears' or 'about ears' because *'oton'* is genitive case as dictated by this particular meaning of *'amphi'* (Greek: 'on both sides'). The composite word 'amphoton' is genitive plural if accepted as Greek (which it is), and is therefore illegal as a genus name which shall be 'a noun in nominative singular' (Article 11f, International Code of Zoological Nomenclature). I prefer to ignore the etymology and regard 'amphoton' as an indeclinable artificial noun. Its gender can be regarded as feminine as implied by Resser & Endo 1937 (*Amphoton parallela, alia; subhorrida*) because Lorenz failed to give it a gender and Resser & Endo are the first revising authors.

anepsia (Eurodeois): Greek, 'cousin', as a relation of *Eu. deois.*

ansatus (Dolicholeptus): Latin, 'with a handle' (the long occipital spine).

atopa (Fuchouia): Greek, 'out of place, strange'.

baiatus (Dolicholeptus): Latin, 'covered with palm leaves'.

balli (Itydeois): after the late L. C. Ball, geologist, of the Geological Survey of Queensland.

barklyensis (Deiradonyx): geogr., 'of the Barkly Tableland'.

bensoni (Fuchouia): after the late W. N. Benson, the Australian and New Zealand geologist.

colainis (Sunia): Greek myth., a name of Artemis.

collabrevis (Deiradonyx): Latin, 'neck short'.

cornunda (Sunia): Latin, 'horny' in reference to the long spines.

deiradonyx: Greek, masc., 'neck low', descriptive of the occipital structure.

deois Walcott *(Eurodeois):* Greek myth., daughter of Deo (Lat. = Ceres).

dirce Walcott *(Eurodeois):* Greek myth., Dirke, a queen of Thebes who came to grief at the hands of two heroes and a bull.

Dolicholeptus: Greek, masc., 'long and thin', descriptive of structure.

elegans (Itydeios): Latin, 'tasteful, fine'.

elissa (Sunia): Greek myth., the name of queen Dido of Carthage.

eminens (Horonastes): Latin, 'eminent'.

Eurodeois: Greek, fem., 'southern Deois'.

fecunda (Fuchouia): Latin, 'fecund', descriptive of its abundance and instars of all sizes.

Horonastes: Greek, masc., 'border dweller'—found close to the Northern Territory/Queensland border.

idica (Sunia): Greek, 'peculiar, special'.

Itydeois: Greek *itys,* 'wheel rim' + *deois* (q.v.),—a Deois with a round shield.

kallalicus (Dolicholeptus?): geogr., from Kallala, Urandangi area, Queensland.

labda (Fuchouia): Greek myth., name of a woman.

lara (Undillia): Latin myth., Larabunda, a talkative nymph deprived of tongue; hence Lara.

licticallis (Dolicholeptus): Latin, 'of the abandoned track' (the abandoned Old Burketown road).

lorenzi (Sunia): after T. Lorenz, the author of *Amphoton.*

marginicrassa (Eurodeois): Latin, 'thick about the margin', descriptive of the structure.

morstonensis (Fuchouia): after Morstone station, northeast of Camooweal, Queensland.

russa (Sunia): Latin, 'brown red', after the colour of the matrix.

rustica (Undillia): Latin, 'rustic'.

rutilata (Sunia): Latin, 'painted red' (ferruginous).

satelles (Horonastes): Latin, 'companion' (of *eminens*).

Sestrostega: Greek, fem., 'sieve skin', descriptive of the punctate test.

tenebrarum (Acontheus): Latin, 'of the darkness'.

toddi (Deiradonyx): geogr., of the Todd River.

tosta (Sestrostega): Latin, 'singed' (in a fire).

Undillia: geogr., from Undilla in Queensland.

vultuosa (Itydeois): Latin, *vultuosus,* 'full of expression'.

REFERENCES

BANKS, M. R., 1956—The Middle and Upper Cambrian series (Dundas Group and its correlates) in Tasmania. *In* RODGERS, J. (Ed.), 1956, pp. 165-212. Reprinted in ÖPIK & others, 1957—The Cambrian geology of Australia. *Bureau of Mineral Resources, Australia, Bulletin* 49.

BORNEMANN, J. G., 1833—Die Versteinerungen des Cambrischen Schichtensystems der Insel Sardinien. Erste Abteilung. *Nova Acta Leopold.-Carol. Acad. Naturforsch.*, 51(1), pp. 1-149, pls. 1-33.

BRUNKER, R. L., OFFENBERG, A. C., & ROSE, G., 1967—1:3 000 000 Geological Map of New South Wales, Explanatory Notes. *Department of Mines, Geological Survey of New South Wales.*

CARTER, E. K., & ÖPIK, A. A., 1961—Lawn Hill—4 Mile Geological Series. *Bureau of Mineral Resources, Australia, Explanatory Notes* No. 21.

CASEY, J. N., & GILBERT-TOMLINSON, Joyce, 1956—Cambrian geology of the Huckitta-Marqua region, Northern Territory. *In* RODGERS, J. (Ed.), 2, 55-74. Reprinted in ÖPIK & others, 1957—The Cambrian geology of Australia. *Bureau of Mineral Resources, Australia, Bulletin* 49.

CHANG, W. T., 1957—Preliminary note on the Lower and Middle Cambrian stratigraphy of Poshan, central Shantung. *Acta palaeontologica Sinica*, 5(1), 13-31.

CHANG, W. T., 1959—New trilobites from the Middle Cambrian of north China. *Acta palaeontologica Sinica*, 7(3), 193-236.

CHAPMAN, F., 1911—On a trilobite fauna of upper Cambrian age (*Olenus* Series) in N.E. Gippsland, Victoria. *Proceedings of the Royal Society of Victoria*, 23, n.s. (2), 305-24.

CHAPMAN, F., 1929—On some trilobites and brachiopods from the Mt Isa district, N.W. Queensland. *Proceedings of the Royal Society of Victoria*, 41(2), 206-16.

DEISS, Ch., 1939—Cambrian stratigraphy and trilobites of northwestern Montana. *Geological Society of America, Special Paper* 18.

ENDO, R., 1944—Restudies of the Cambrian formations and fossils of southern Manchukuo. *Bull. Cent. nat. Mus. Manchukuo*, 7, 1-100, pls. 1-10.

GRONWALL, K. A., 1902—Bornholms Paradoxideslag og deres Fauna. *Denmarks geologiske Undersogelse*, II Raekke, 13, pp. i-xi, 1-230, pls. 1-5.

HARRINGTON, H. T., & others, 1959—TREATISE ON INVERTEBRATE PALAEONTOLOGY, 0(1): Trilobita. *University of Kansas Press.*

HUTCHINSON, R. D., 1962—Cambrian stratigraphy and trilobite faunas of southeastern Newfoundland. *Geological Survey of Canada, Bulletin* 88, pp. 1-156, pls. 1-25.

HUPÉ, P., 1952—Contribution a l'etude du Cambrian inferieur et du Precambrian III de l'Anti-Atlas marocain. *Memoires Service Géologique de Maroc*, 103.

HUPÉ, P., 1953—Classification des trilobites. *Annales de Paleontologie*, 39, 61-168.

KOBAYASHI, T., 1935—Cambrian faunas of south Chosen. *Journal of the Faculty of Science, Imperial University of Tokyo*, 4(2).

KOBAYASHI, T., 1942—On the Dolichometopinae. *Journal of the Faculty of Science, University of Tokyo*, Sec. 2, 6(10), 143-206.

KOBAYASHI, T., 1944—On the Cambrian formations in Yunnan and Haut-Tonkin and the trilobites contained. *Japanese Journal of Geology and Geography*, 19, pp. 107-37, pls. 9-10.

KOBAYASHI, T., 1962—The Cambro-Ordovician formations and faunas of South Korea, Part 9, Palaeontology 8—the Machari fauna. *Journal of the Faculty of Science, University of Tokyo*, 14(1), 1-152.

LAZARENKO, N. P., 1965—Nekotorye novye srednekembriiskie trilobity severa srednei Sibiri. *Uchenye zapiski NIIGA paleontologiya i biostratigrafiya*, Issue 7, pp. 14-36.

LORENZ, T., 1906—Beitrage zur Geologie und Palaeontologie von Ostasien. *Deutsche geologische Gesellschaft, Zeitschrift*, 58, 53-108.

LU Yen-Hao, 1957—Trilobites, *in* Index Fossils of China, 3, 249-94. *Institute of Palaeontology, Academia Sinica.*

MOORE, R. C., 1959 (Ed.)—TREATISE ON INVERTEBRATE PALAEONTOLOGY. Part O, Arthropoda, 1, pp. xix + 560. *Geological Society of America and Kansas University Press.*

NICOSIA, M. L., & RASETTI, F., 1970—Revisione dei trilobiti del Cambriano dell' Iglisiente (Sardegna) descritti da Meneghini. *Memorie Atti della Accademie Nazionale dei Lincai*, Serie VIII, Vol. X, Sezione II(1), pp. 1-20, pls. 1-3.

NOAKES, L. C., CARTER, E. K., & ÖPIK, A. A., 1959—Urandangi—4 mile Geological Series. *Bureau of Mineral Resources, Australia, Explanatory Notes* No. 1 (2nd Edition).

ÖPIK, A. A., 1956—Cambrian geology of Queensland. *In* RODGERS, J. (Ed.), 2, 1-24. Reprinted in ÖPIK & others, 1957—The Cambrian geology of Australia. *Bureau of Mineral Resources, Australia, Bulletin* 49.

ÖPIK, A. A., 1958—The Cambrian trilobite *Redlichia*: organisation and generic concept. *Bureau of Mineral Resources, Australia, Bulletin* 42.

ÖPIK, A. A., 1960—Cambrian and Ordovician; *in* The geology of Queensland. *Journal of the Geological Society of Australia*, 7, 91-103.

ÖPIK, A. A., 1961a—Alimentary caeca of agnostids and other trilobites. *Palaeontology*, 3(4), 410-38.

ÖPIK, A. A., 1961b—Cambrian geology and palaeontology of the headwaters of the Burke River, Queensland. *Bureau of Mineral Resources, Australia, Bulletin* 53.

ÖPIK, A. A., 1963—*Nepea* and the nepeids (trilobites, Middle Cambrian, Australia). *Journal of the Geological Society of Australia,* 10(2), 313-16.

ÖPIK, A. A., 1967a—The Mindyallan fauna of northwestern Queensland. *Bureau of Mineral Resources, Australia, Bulletin* 74.

ÖPIK, A. A., 1967b—The Ordian stage of the Cambrian and its Australian Metadoxididae. *Bureau of Mineral Resources, Australia, Bulletin* 92, pp. 133-69.

ÖPIK, A. A., 1968—Ordian (Cambrian) Crustacea Bradoriida of Australia. *Bureau of Mineral Resources, Australia, Bulletin* 103.

ÖPIK, A. A., 1979—Middle Cambrian agnostids: Systematics and biostratigraphy. *Bureau of Mineral Resources, Australia, Bulletin* 172 (2 vols.)

ÖPIK, A. A. CARTER, E. K., & NOAKES, L. C., 1961—Mount Isa—4 mile Geological Series. *Bureau of Mineral Resources, Australia, Explanatory Notes* No. 20.

ÖPIK, A. A., & others, 1961—Camooweal—4 mile Geological Series Map. *Bureau of Mineral Resources, Australia.*

PALMER, A. R., 1958—Morphology and ontogeny of a Lower Cambrian ptychoparioid trilobite from Nevada. *Journal of Paleontology,* 32(1), 154-70.

PALMER, A. R., 1962—Comparative ontogeny of some opisthoparian, gonatotoparian and proparian Upper Cambrian trilobites. *Journal of Paleontology,* 36(1), 87-96.

PALMER, A. R., 1968—Cambrian trilobites of east-central Alaska. *United States Geological Survey, Professional Paper* 559-B.

POULSEN, V., 1958—Contributions to the Middle Cambrian paleontology and stratigraphy of Argentina. *Mat. Fys. Medd. Dan. Vid. Selsk.,* 31(8), 1-22.

RASETTI, F., 1948—Middle Cambrian trilobites from the conglomerates of Quebec. *Journal of Paleontology,* 22(3), 315-39.

RASETTI, F., 1951—Middle Cambrian stratigraphy and faunas of the Canadian Rocky Mountains. *Smithsonian Institute, Miscellaneous Collections,* 116(6), 1-210.

RASETTI, F., 1952—Ventral cephalic sutures in Cambrian trilobites. *American Journal of Science,* 250, 885-98.

RASETTI, F., 1954—Phylogeny of the Cambrian trilobite family Catillicephalidae and the ontogeny of *Welleraspis. Journal of Paleontology,* 28(5), 599-612.

RASETTI, F., 1966—New Lower Cambrian trilobite faunule from the Taconic sequence of New York. *Smithsonian Institute, Miscellaneous Collections,* 148(9).

RASETTI, F., 1967—Lower and Middle Cambrian trilobite faunas from the Taconic sequence of New York. *Smithsonian Institute, Miscellaneous Collections,* 152(4).

RASETTI, F., 1973—Cambrian trilobite faunas of Sardinia. *Memorie Atti della Accademia Nazionale dei Lincai,* Serie VIII, Vol. XI, Sezione IIa, pp. 1-100, pls. I-XIX. (The memoir is for 1972 but was not published until 1973.)

RESSER, Ch. E., 1936—Second contribution to nomenclature of Cambrian trilobites. *Smithsonian Institute, Miscellaneous Collections,* 95 (4), pp. 1-29.

RESSER, Ch. E., 1939—The *Ptarmigania* strata of the northern Wasatch Mountains. *Smithsonian Institute, Miscellaneous Collections,* 98(24).

RESSER, Ch. E., 1942—Fifth contribution to nomenclature of Cambrian fossils. *Smithsonian Institute, Miscellaneous Collections,* 101(15), 1-58.

RESSER, Ch. E., & ENDO, R., 1937—The Sinian and Cambrian formations and fossils of southern Manchukuo. *Manchurian Science Museum Bulletin* 1.

ROBISON, R. A., 1964—Late Middle Cambrian faunas from western Utah. *Journal of Paleontology,* 38(3), 510-66.

ROBISON, R. A., 1967—Ontogeny of *Bathyuriscus fimbriatus* and its bearing on affinities of corynexochid trilobites. *Journal of Paleontology,* 41(1), 213-21.

RODGERS, J. (Ed.), 1956—El Sistema Cambrico, su paleogeografia y el problema de su base, Symposium. *20th International Geological Congress, Mexico.*

RUSHTON, A. W. A., 1966—The Cambrian trilobites from the Purley Shales of Warwickshire. *Palaeontographical Society Monograph* 120 (511), 1-55.

SHERGOLD, J. H., 1969—Oryctocephalidae (Trilobita: Middle Cambrian) of Australia. *Bureau of Mineral Resources, Australia, Bulletin* 104.

SUVOROVA, N. P., 1960—*In* TCHERNYSHEVA, N. E. (Ed.), 1960—Trilobity kembria vostoka sibirskoi platformy (Trilobites of the Cambrian east Siberian platform). *Paleontological Institute of the USSR Academy of Science, Trudy,* 84.

SUVOROVA, N. P., 1964—Trilobity koriniksokhidy i ikh istoricheskoye rasvitiye (Corynexochid trilobites and their historical development). *Paleontological Institute of the USSR Academy of Science, Trudy,* 103.

TCHERNYSHEVA, N. E. (Ed.), 1960—Arthropoda, Trilobitomorpha and Crustacea. *Osnovy Paleontologii* (in Russian).

TCHERNYSHEVA, N. E., 1961—Stratigrafiya Kembriya Aldanskoi antiklizy i paleontologicheskoye obosnovaniye amginskogo yarusa (Stratigraphy of the Aldanian anteclise and palaeontological evidence of separation of the Amga Stage). *Trudy VSEGEI,* n.s. 49.

THOMAS, D. E., & SINGLETON, O. P., 1956—The Cambrian stratigraphy of Victoria. *In* RODGERS, J. (Ed.), 1956, Vol. 2, pp. 149-63. Reprinted in ÖPIK & others, 1957.

WALCOTT, Ch. D., 1908—Cambrian geology and paleontology, No. 2, Cambrian trilobites. *Smithsonian Institute, Miscellaneous Collections,* 53, 13-52.

WALCOTT, Ch. D., 1910—Cambrian geology and paleontology, No. 6, *Olenellus* and other genera of the Mesonacidae. *Smithsonian Institute, Miscellaneous Collections,* 53(6), 231-392.

WALCOTT, Ch. D., 1911—Cambrian geology and palaeontology, II, No. 4, Cambrian faunas of China. *Smithsonian Institute, Miscellaneous Collections,* 57(4), 69-100, pls. 14-17.

WALCOTT, Ch. D., 1913—The Cambrian faunas of China. *In* Research in China, Vol. 3. *Publications of the Carnegie Institution, Washington,* 54, 1-375.

WALCOTT, Ch. D., 1916—Cambrian geology and paleontology, No. 5, Cambrian trilobites. *Smithsonian Institute, Miscellaneous Collections,* 64 (3), 157-256.

WALCOTT, Ch. D., 1917—Cambrian geology and paleontology, No. 2, The *Albertella* fauna in British Columbia and Montana. *Smithsonian Institute, Miscellaneous Collections,* 67(2).

WESTERGAARD, A. H., 1948—Non-agnostidean trilobites of the Middle Cambrian of Sweden, I. *Sveriges Geologiska Untersoknung Avh.,* 498, 1-32.

WHITEHOUSE, F. W., 1939—The Cambrian faunas of north-eastern Australia, Part III: The polymerid trilobites. *Memoirs of the Queensland Museum,* 11(3), 179-282.

WHITEHOUSE, F. W., 1940—Studies in the late geological history of Queensland. *Papers of the Department of Geology, University of Queensland,* 2(1), 1-74.

WHITEHOUSE, F. W., 1945—The Cambrian faunas of north-eastern Australia, Part 5: The trilobite genus *Dorypyge. Memoirs of the Queensland Museum,* 12(3), 117-23.

WHITTINGTON, H. B., 1957—The ontogeny of trilobites. *Biological Review,* 32, 421-69.

WHITTINGTON, H. B., 1957—Ontogeny of *Elliptocephala, Paradoxides, Sao, Blainia* and *Triarthreus* (Trilobita). *Journal of Paleontology,* 31 (5), 934-46.

WHITTINGTON, H. B., 1958—Ontogeny of the trilobite *Peltura scaraboides* from the Upper Cambrian of Denmark. *Palaeontology,* 1(3), 199-206.

INDEX OF SELECTED ITEMS

Prepared by W. H. Oldham

PLATE 1

Deiradonyx barklyensis sp. nov.
(p. 15)

Fig. 1 Holotype cranidium, CPC 18812; ×10.
Fig. 2 Cranidium, CPC 18813; ×9.
Fig. 3 Pygidium, CPC 18814; ×15.
Fig. 4 Pygidium, CPC 18815; ×7.5.
Templetonian, locality N27, Northern Territory.
Quartz crystals of the secondary matrix are visible in Figs. 1 and 3.

Deiradonyx toddi sp. nov.
(p. 18)

Fig. 5 Cranidium, CPC 18816, with shallow glabellar furrows; ×6.5.
Fig. 6 Holotype cranidium, CPC 18817; ×8.
Ordian, locality AS33, Northern Territory.

Parapoliella sp. nov.
(p. 14)

Fig. 7 Fragmentary cranidia, CPC 18818; ×5.
Ordian, chert, Camooweal area, locality C136, Northern Territory.

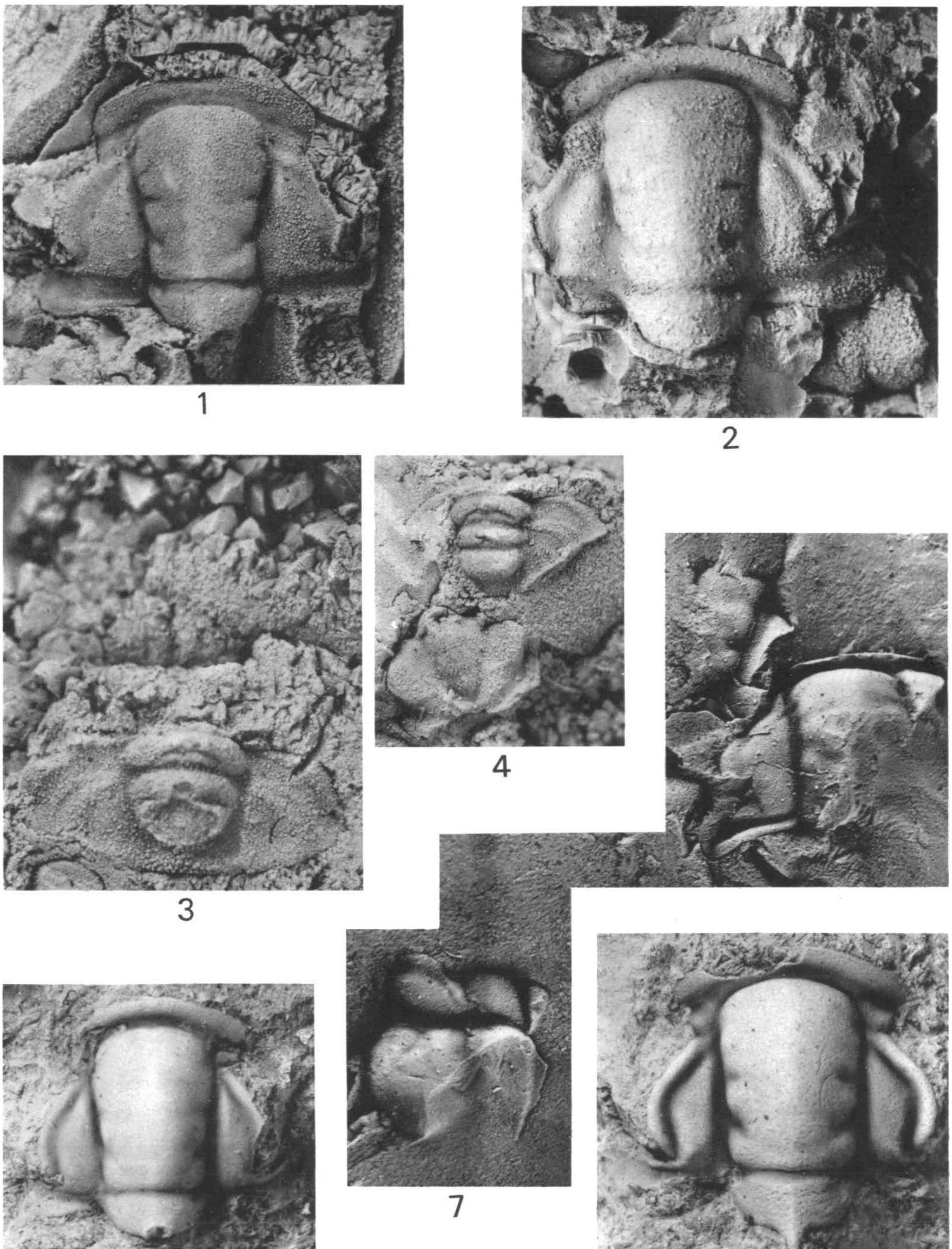

1
2
3
4
7
5
6

PLATE 2

Deiradonyx collabrevis sp. nov.
(p. 17)

Fig. 1 Holotype cranidium, CPC 18819; ×5.5.
Templetonian; 9 km northwest of Mount Wright, New South Wales.

Deiradonyx sp. aff. **collabrevis**
(p. 19)

Fig. 2 Cranidium, CPC 18820; ×8.
Templetonian (Beetle Creek); Mount Isa area, locality M434, Queensland.

Sestrostega tosta sp. nov.
(p. 19)

Figs. 3, 4 Holotype cranidium, CPC 18821, and associated fragment; ×8.
Templetonian (Beetle Creek); Mount Isa area, locality M188, Queensland.

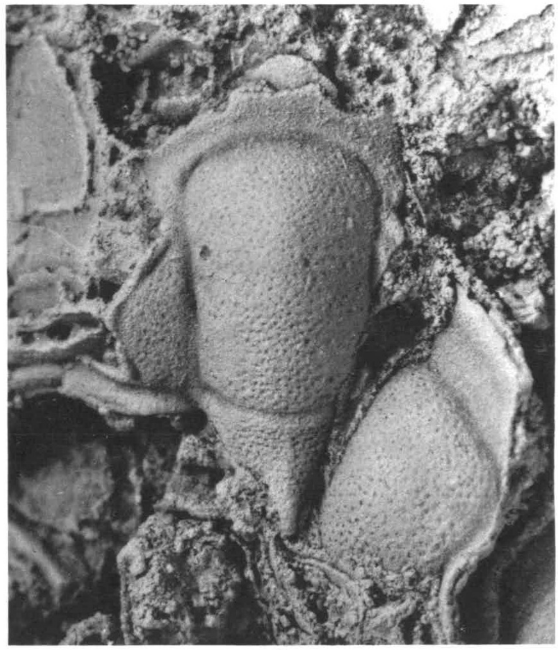
Fuchouia labda sp. nov.
(p. 39)

Fig. 5 Cranidium, CPC 18822; ×10.

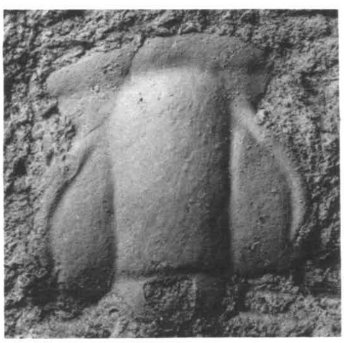
Fig. 6 Pygidium, CPC 18823; ×4.
Zone of *Ptychagnostus atavus;* bituminous limestone, locality H4, Northern Territory. (See also Pl. 3, fig. 1; Pl. 31, fig. 1)

1

2

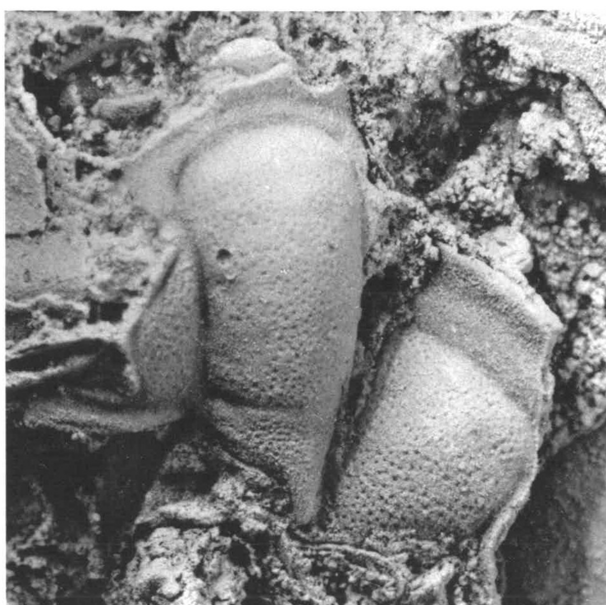


3



5

6



4

PLATE 3

Fuchouia labda sp. nov.

(p. 39)

Fig. 1 Free cheeks, CPC 18824; ×6.
Zone of *Ptychagnostus atavus;* locality H4, Northern Territory. (See also Pl. 2, figs. 5, 6; Pl. 31, fig. 1)

Fuchouia morstonensis sp. nov.

(p. 42)

Fig. 2 Free cheek, CPC 18825, associated with a ptychopariid, a cephalon of *Euagnostus,* and sponge spicules; ×3.5.

Fig. 3 Hypostoma, CPC 18826, associated with *Peronopsis* and a phosphatic brachiopod; ×6.

Fig. 4 Pygidium, CPC 18827; ×3.5.

Fig. 5 Holotype cranidium, CPC 18828; ×2.5.
Zone of *Euagnostus opimus;* chert lamina, Age Creek Formation, Camooweal area, locality M160, Queensland.

Fuchouia sp. aff. **fecunda**

(p. 39)

Fig. 6 Pygidium, rubber cast of CPC 18829; ×8.
Zone of *Euagnostus opimus;* siltstone, Inca Formation, Mount Isa area, locality M199, Queensland.

Fuchouia atopa sp. nov.

(p. 40)

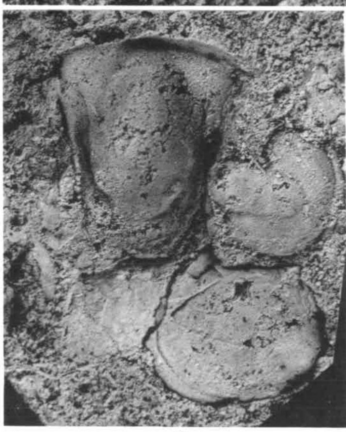
Fig. 7 Pygidium, CPC 18830, locality M180; ×3.

Fig. 8 Holotype cranidium, CPC 18831, locality M186; ×4.

Fig. 9 Cranidium, CPC 18832, locality M377; ×4.
Zone of *Euagnostus opimus*; limestone (Currant Bush), Lawn Hill area, Queensland, and adjacent part of Northern Territory; localities M180 and M186. (See also Pl. 9, fig. 3; Pl. 10, fig. 2.)

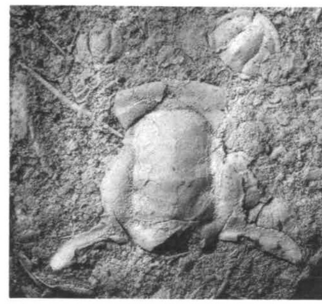
1

2



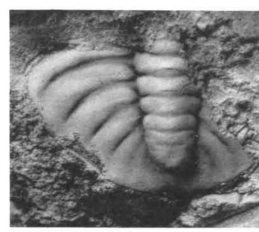
3

4

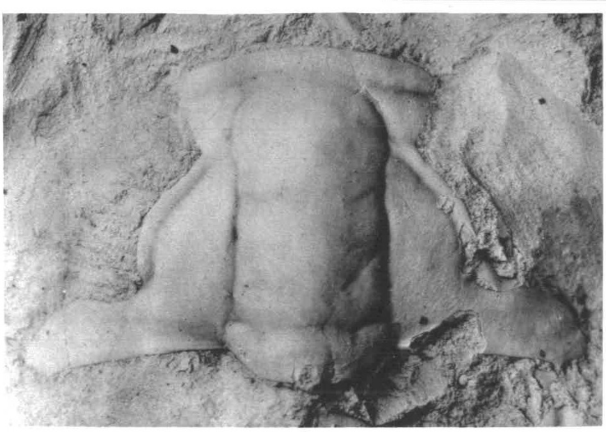


5

6



7



8

9

PLATE 4

Horonastes eminens sp. nov.

(p. 21)

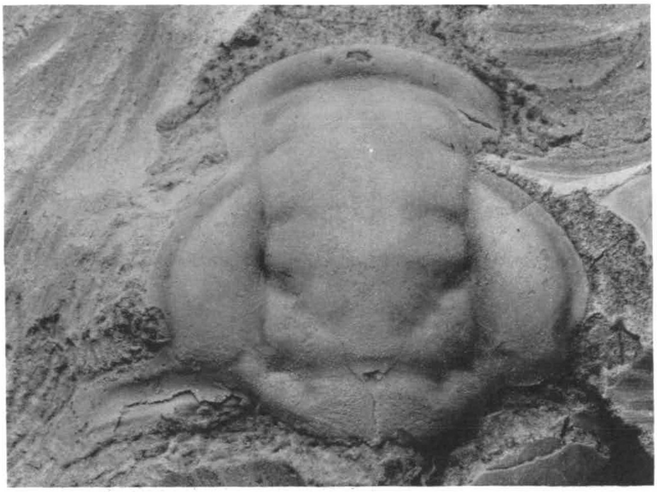
Figs. 1, 1a Cranidium, CPC 18833. 1 ×4; 1a ×3.

Figs. 2-2b Cranidium, CPC 18834. 2 ×5; 2a ×2.5; 2b ×3.

Fig. 3 Pygidium, CPC 18835; ×7.

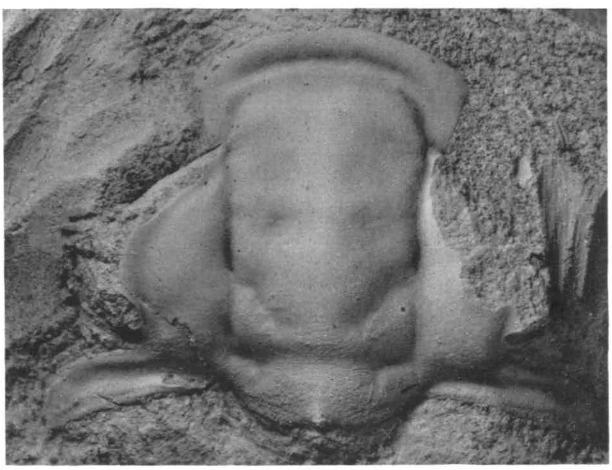
Fig. 4 Pygidium, CPC 18836; ×6.

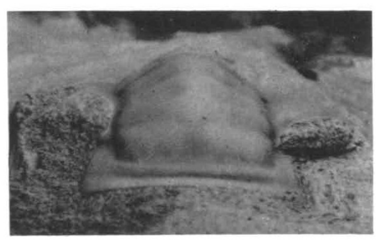
Zone of *Ptychagnostus atavus;* sandy limestone attributed to Currant Bush Limestone, M179, Northern Territory (adjacent to Lawn Hill area, Queensland).

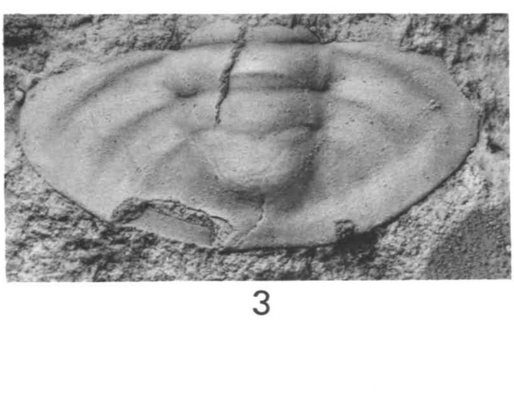

1


1a


2a


2


2b


3

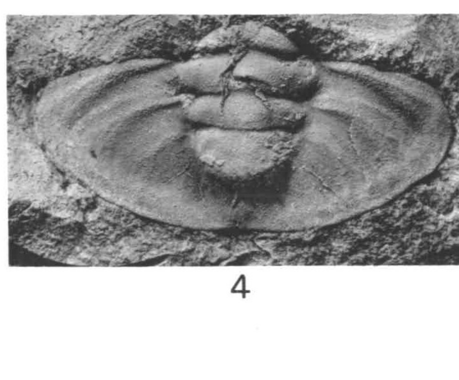

4

PLATE 5

Horonastes eminens sp. nov.
(p. 21)

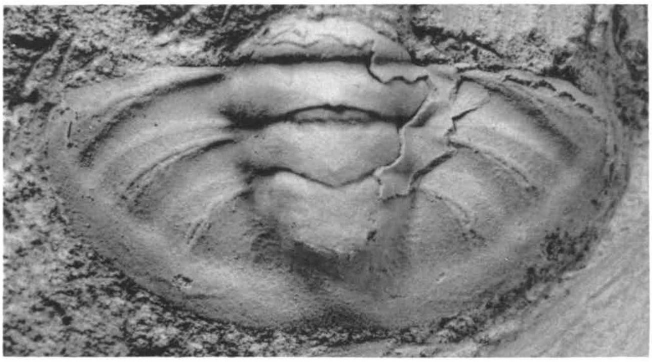
Fig. 1	Pygidium, CPC 18837; ×6.5.
Fig. 2	Holotype cranidium, CPC 18838, associated with a rostral shield; ×5.
Fig. 3	Hypostoma, CPC 18839; ×8.
Fig. 4	Free cheek, CPC 18840; ×8.
Fig. 5	Small cranidium, CPC 18841; ×7.
Fig. 6	Meraspis cranidium, CPC 18842; ×15.

Horonastes sp. A (aff. **eminens**)
(p. 26)

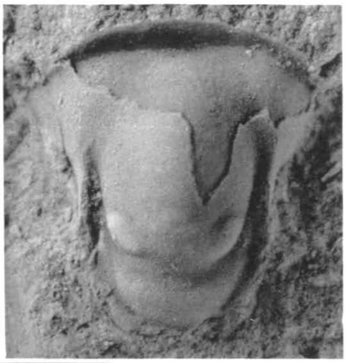
Fig. 7 Cranidium, CPC 18843; ×5.
Locality M179, Northern Territory (same as Plate 4)

Horonastes? sp. B (aff. **eminens**)
(p. 26)

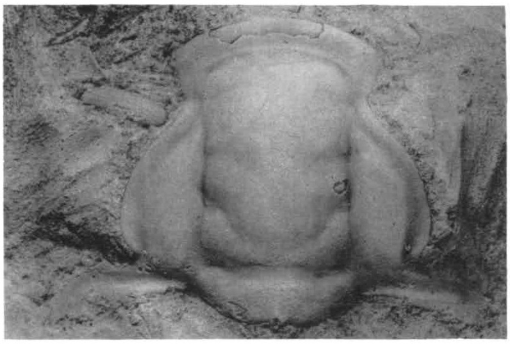
Fig. 8 Cranidium, CPC 18844; ×7.5.
Zone of *Ptychagnostus atavus;* limestone attributed to the Currant Bush Limestone, Lawn Hill area, locality M183, Queensland.



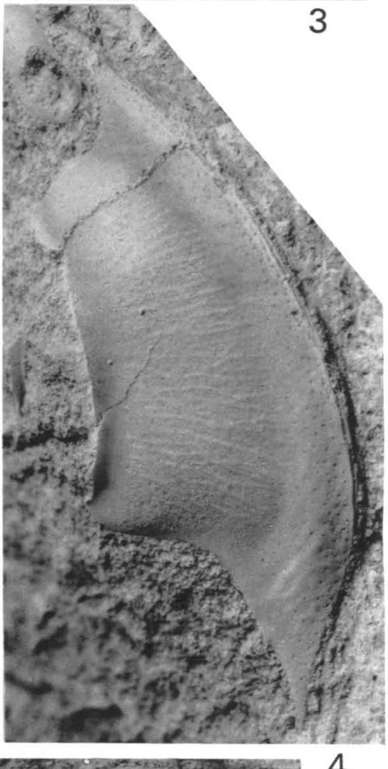
1



3



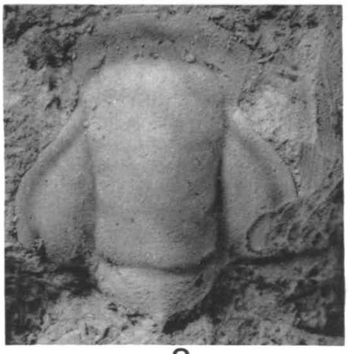
2



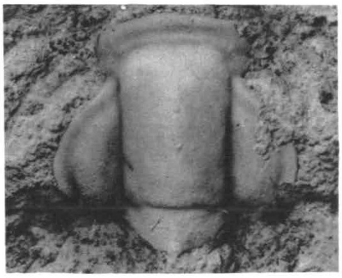
4

7

6



8



5

PLATE 6

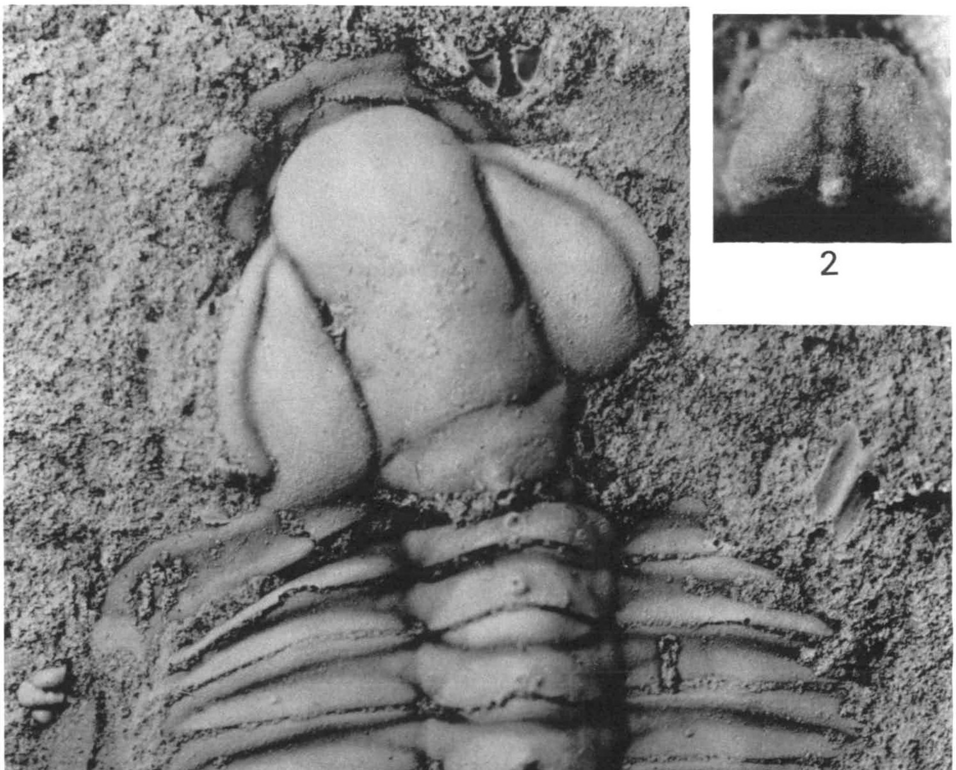
Fuchouia fecunda sp. nov.
(p. 27)

Fig. 1 Rubber cast of exoskeleton, CPC 18845; associated are two small meraspid cranidia; ×10.

Fig. 2 Metaprotaspis, CPC 18846; dorsal view of protocranidium; ×52.

Zone of *Euagnostus opimus;* limestone attributed to the Currant Bush Limestone; locality M180, Northern Territory (adjacent to the Lawn Hill area, Queensland).

See also Plates 7 and 8.



2

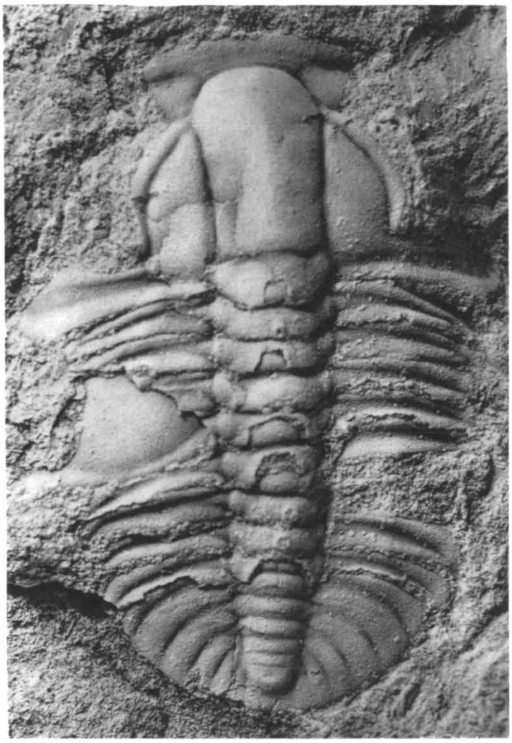
1

PLATE 7

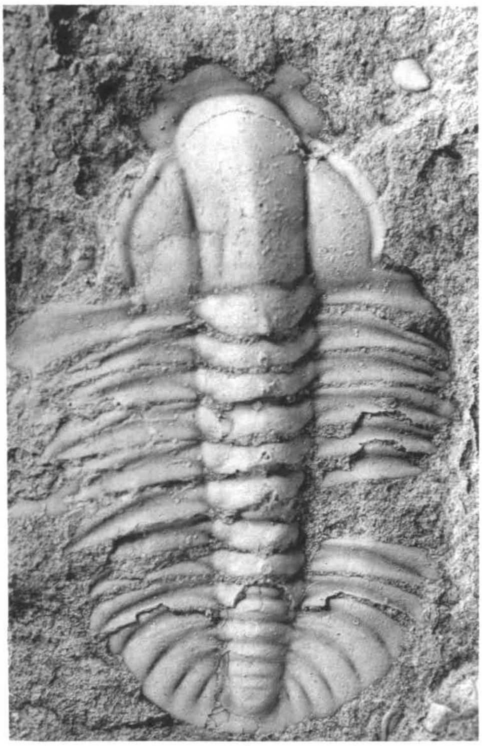
Fuchouia fecunda sp. nov.

(p. 27)

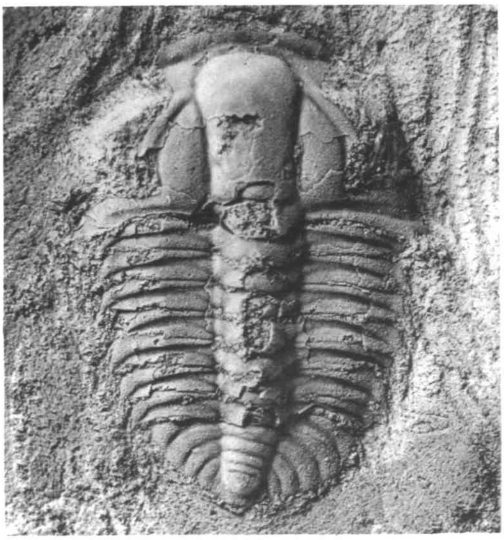
Figs. 1a, b	Holotype exoskeleton, CPC 18847; ×6.5. 1b is a rubber cast.
Fig. 2	Exoskeleton, CPC 18848, of a late meraspis; ×7.
Fig. 3	Exoskeleton, CPC 18849, of a small meraspis; ×26. (same specimen as Plate 12, fig. 8)
	Locality M180; for details see Plate 6.



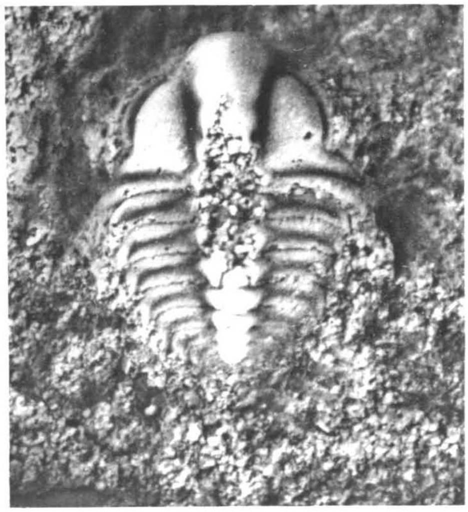
1a



1b



2

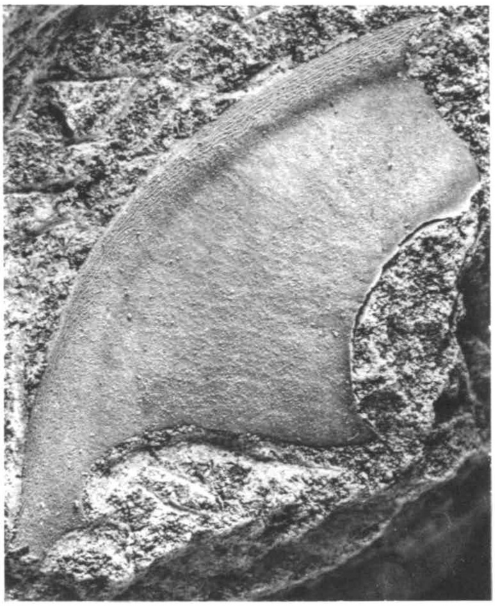


3

PLATE 8

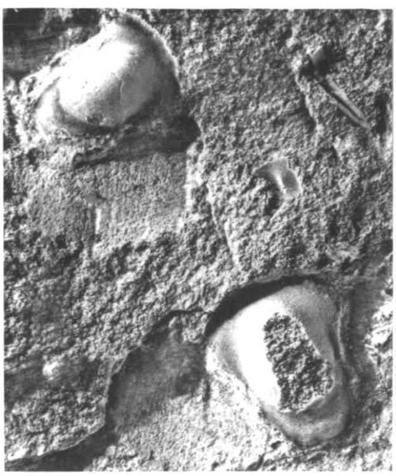
Fuchouia fecunda sp. nov.
(p. 27)

Fig. 1	Free cheek, CPC 18850; ×10.
Fig. 2	Free cheek, CPC 18851; ×14.
Fig. 3	Two hypostomata, CPC 18852; ×5.
Figs. 4-4b	Exoskeleton, CPC 18853. 4 ×3.6; 4a ×3; 4b ×5.
Fig. 5	Cranidium and part of thorax, CPC 18854; ×2.5.
	Locality M180; for details see Plate 6.

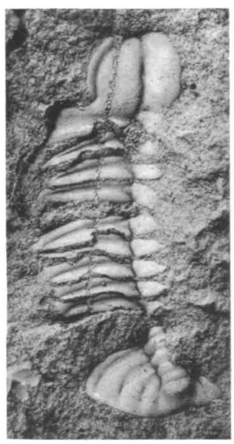


1

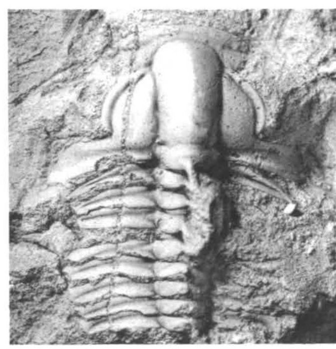
2



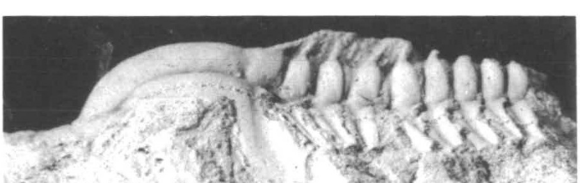
3



4



4a



4b

5

PLATE 9

Fuchouia fecunda sp. nov.
(p. 27)

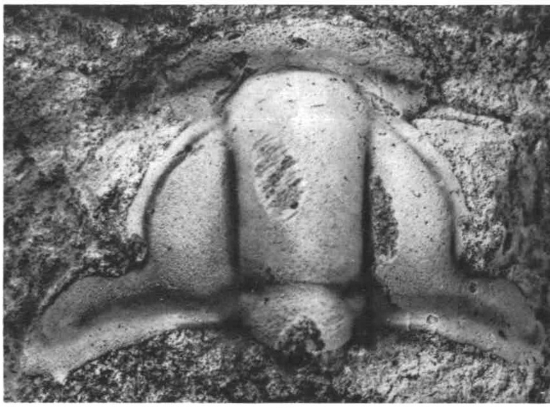
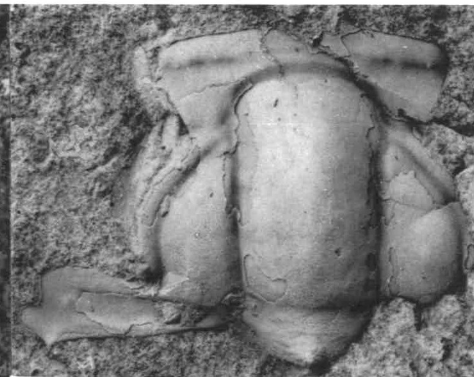
Fig. 1 Cranidium, CPC 18855; ×9.

Fuchouia sp. nov. aff. **atopa**
(p. 42)

Fig. 2 Cranidium, rubber cast of CPC 18856; ×6.
Locality M180; for details see Plate 6.

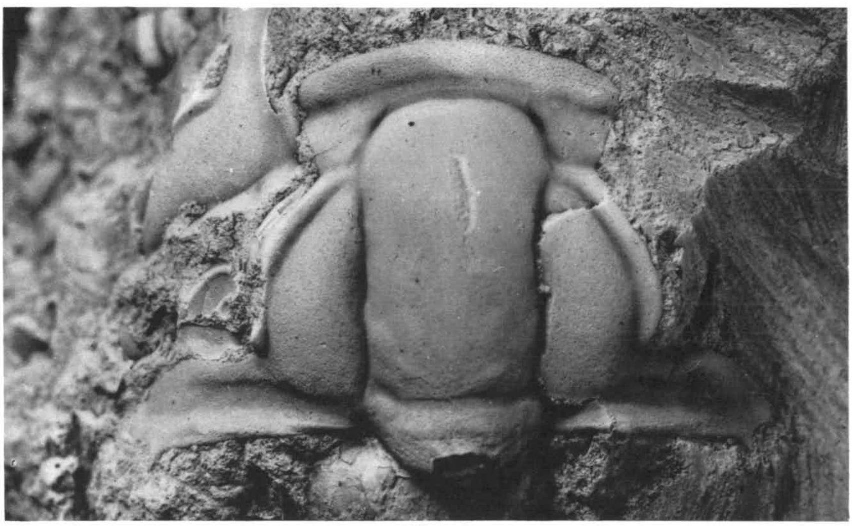
Fuchouia atopa sp. nov.
(p. 40)

Figs. 3a-c Cranidium, CPC 18857; ×7.5.
Locality M186; for details see Plate 3, fig. 8.

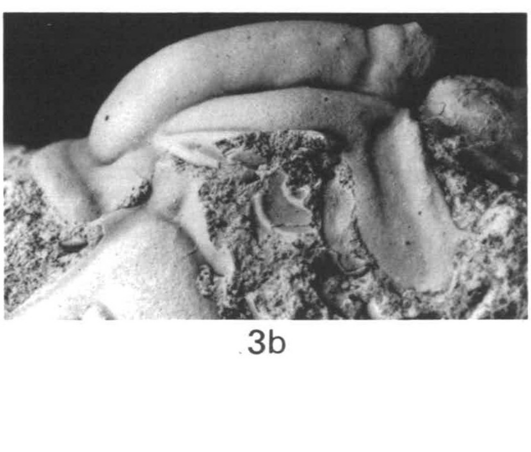



2

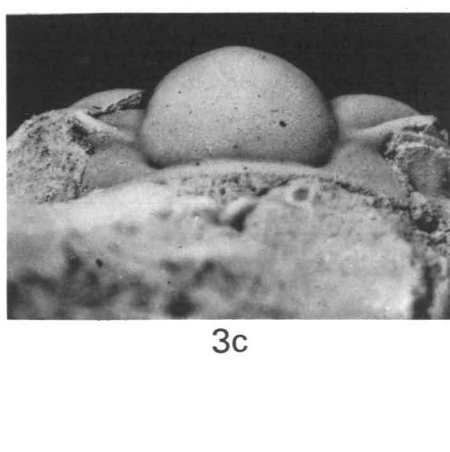
1



3a



3b



3c

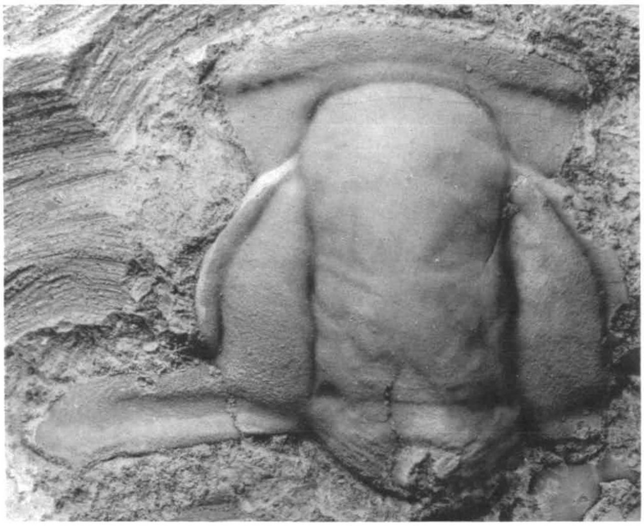
PLATE 10

Fuchouia atopa sp. nov.
(p. 40)

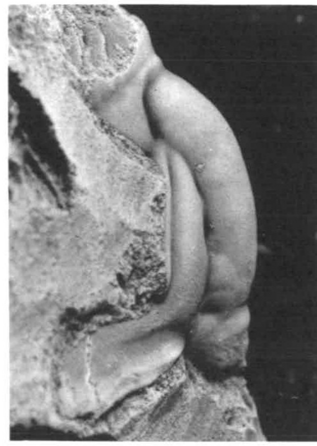
Fig. 1	Cranidium, CPC 18858; ×6.5.
Figs. 2a,b	Cranidium, CPC 18859; ×5.

Fuchouia fecunda sp. nov.
(p. 27)

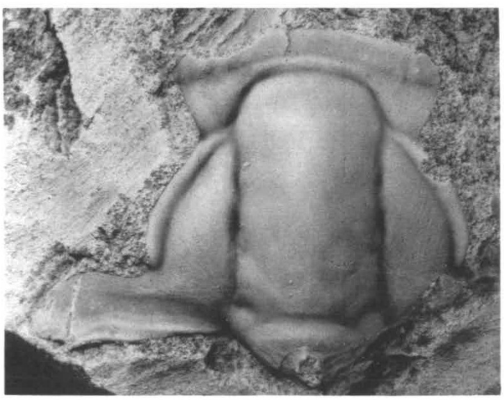
Fig. 3	Free cheek, CPC 18860; ×5.5. The principal vein is visible.
Fig. 4	Pygidium, CPC 18861; ×10. Same specimen as Plate 11, fig. 6. Locality M180; for details see Plate 6.



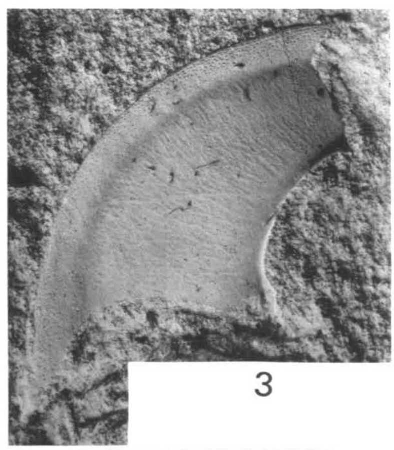
1



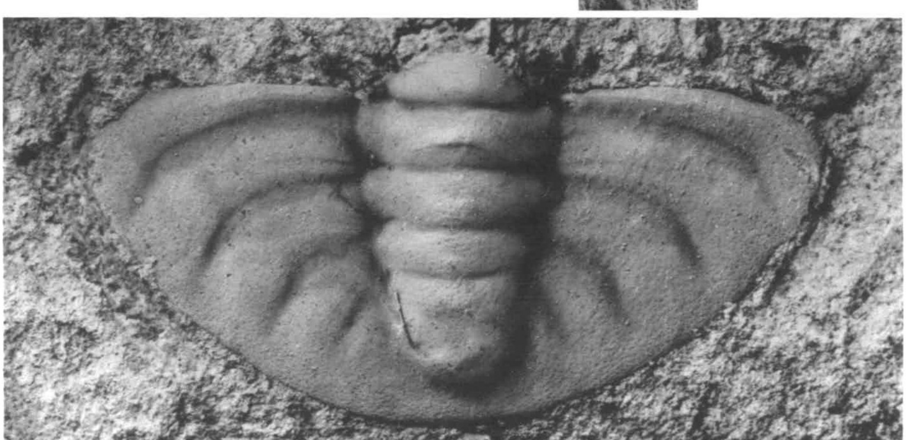
2b



2a



3



4

PLATE 11

Fuchouia fecunda sp. nov.

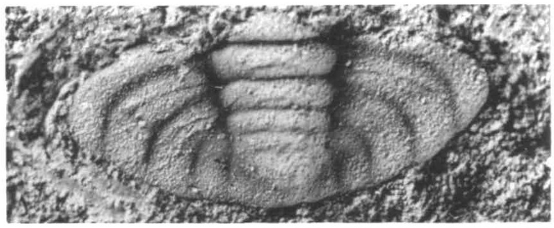
(p. 27)

Isolated pygidia arranged according to size.
Fig. 1 is 1.0 mm and Fig. 10 is 8.3 mm. See descriptions in the text.

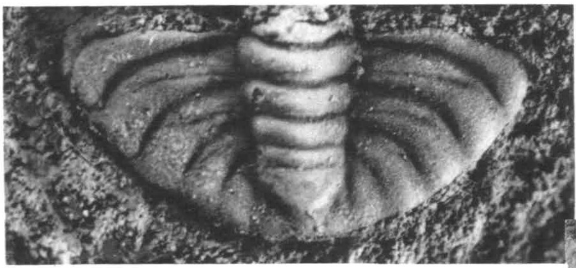
Fig. 1	CPC 18862; ×22.
Fig. 2	CPC 18863; ×20.
Fig. 3	CPC 18864; ×15.
Fig. 4	CPC 18865; ×7.
Fig. 5	CPC 18866; ×9.6.
Fig. 6	CPC 18867; ×5.
Fig. 7	CPC 18868; ×5.
Fig. 8	CPC 18869; ×5.
Fig. 9	CPC 18870; ×4.
Fig. 10	CPC 18871; ×3.

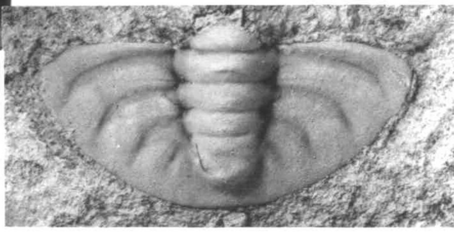
The specimen in Fig. 9 comes from locality M377; all others from locality M180; for which further details are given in Plate 6.

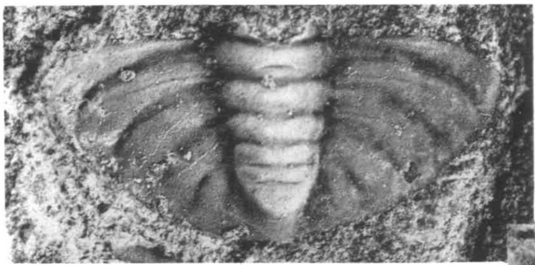

1

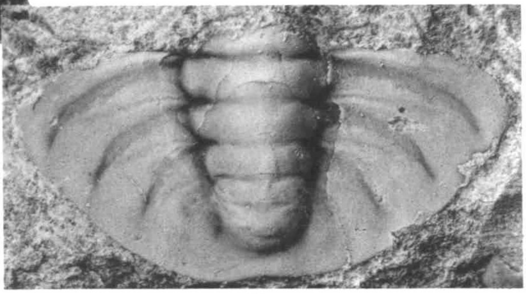

2

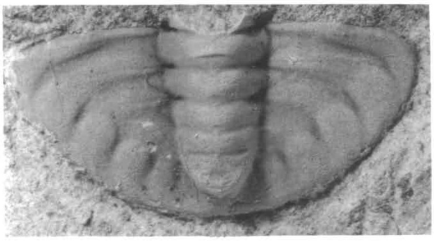

4

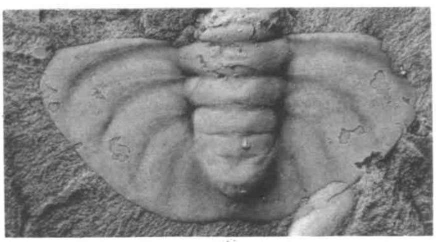

3


6


5


8


7


9

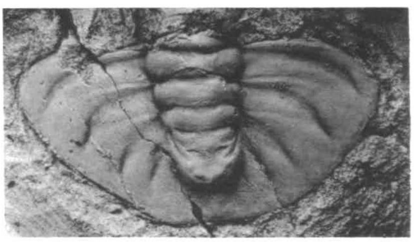

10

PLATE 12

Fuchouia fecunda sp. nov.

(p. 27)

Growth series (protaspides and meraspid cranidia) described in detail on page 35 and arranged in order of increasing length. The protaspides, Figures 1a-d and 2, are about 0.4 mm long; the meraspid cranidium Figure 11 is 1.3 mm long. Note also the metaprotaspis of Plate 6, fig. 2.

Figs. 1a-d	CPC 18872; ×40.
Fig. 2	CPC 18873; ×35.
Fig. 3	CPC 18874; ×33.
Fig. 4	CPC 18875; ×30.
Figs. 5a,b	CPC 18876; ×25.
Figs. 6a-c	CPC 18877; ×28.
Fig. 7	CPC 18878; ×28.
Fig. 8	Same specimen as Plate 7, fig. 3; ×14.
Fig. 9	CPC 18879; ×24.
Fig. 10	CPC 18880; ×24.
Fig. 11	CPC 18881; ×24.

Locality M180; for details see Plate 6.

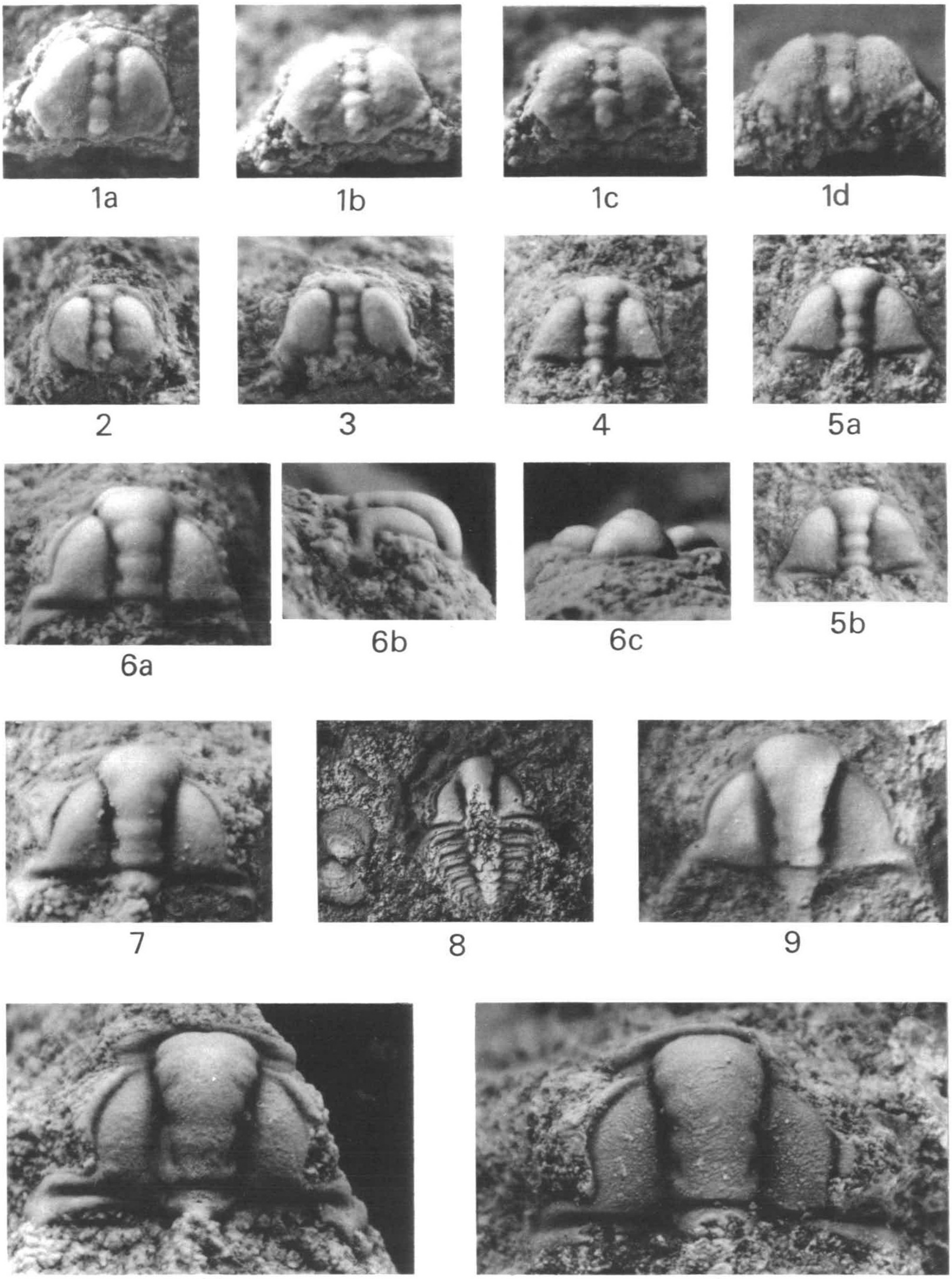
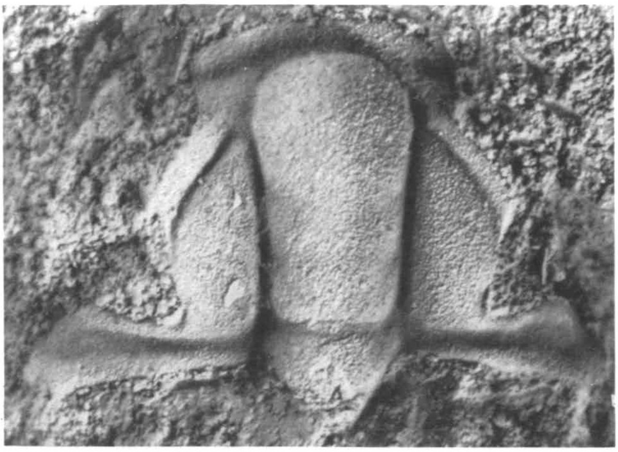

1a
1b
1c
1d
2
3
4
5a
6a
6b
6c
5b
7
8
9
10
11

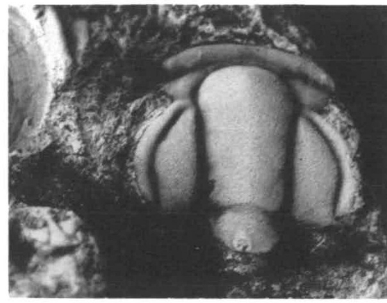
PLATE 13

Fuchouia fecunda sp. nov.
(p. 27)

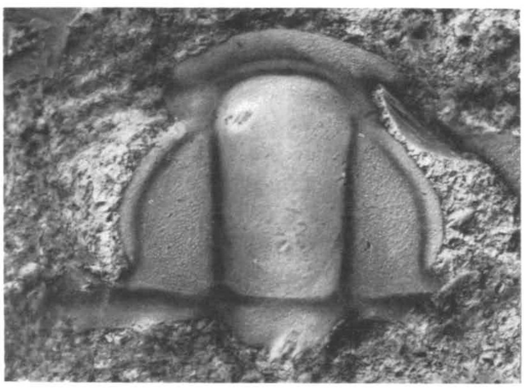
Fig. 1	Meraspid cranidium, CPC 18882; ×20.
Fig. 2	Meraspid cranidium, CPC 18883; ×18.
Figs. 3,3a	Meraspid cranidium, CPC 18884, ×9, and part of its surface ×25.
Fig. 4	Cranidial fragment associated with the specimen of Fig. 3; ×25. The test is worn and punctae are showing.



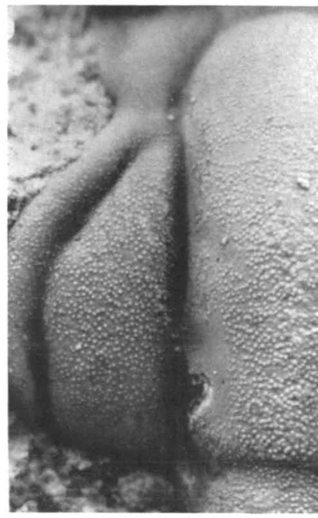
1



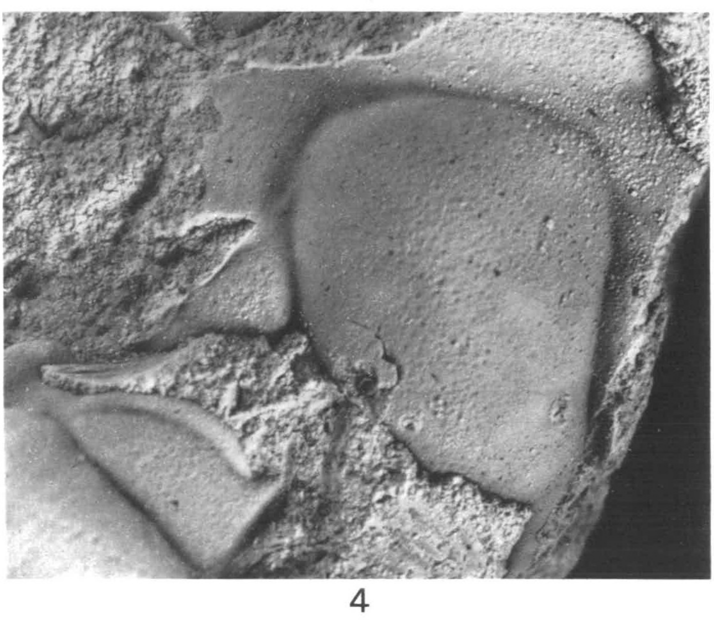
3



2



3a

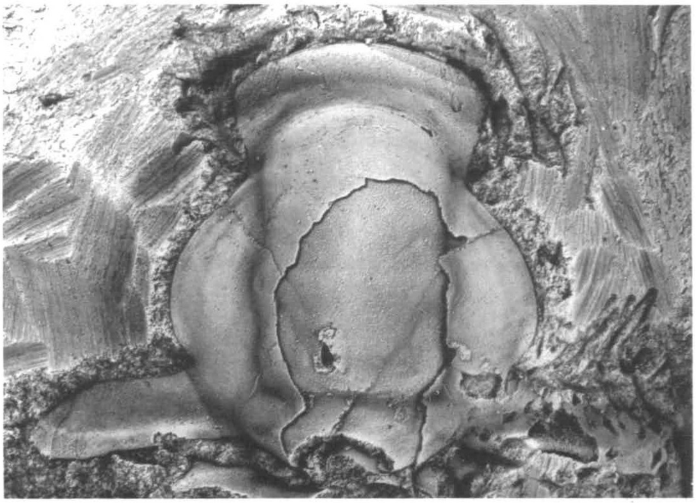


4

PLATE 14

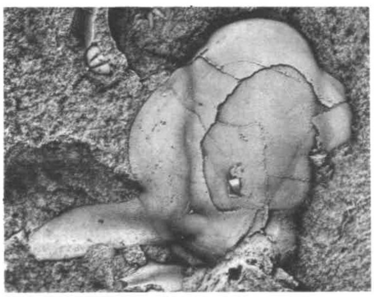
Itydeois elegans sp. nov.
(p. 49)

Figs. 1a,b	Holotype cranidium, CPC 18885. Figure 1b is a rubber cast. 1a ×5; 1b ×3.5.
Fig. 2	Free cheek, CPC 18886; ×4.3.
Figs. 3a,b	Pygidium, rubber cast of CPC 18887. 3a ×2.7; 3b ×2.5. Locality M161, Currant Bush Limestone.
Fig. 4	Cranidium, CPC 18888, flattened and silicified; ×4.2.
Fig. 5	Pygidium, CPC 18889, associated with Fig. 4; ×6.5. Zone of *Euagnostus opimus*, locality M123, chert in Currant Bush Limestone.

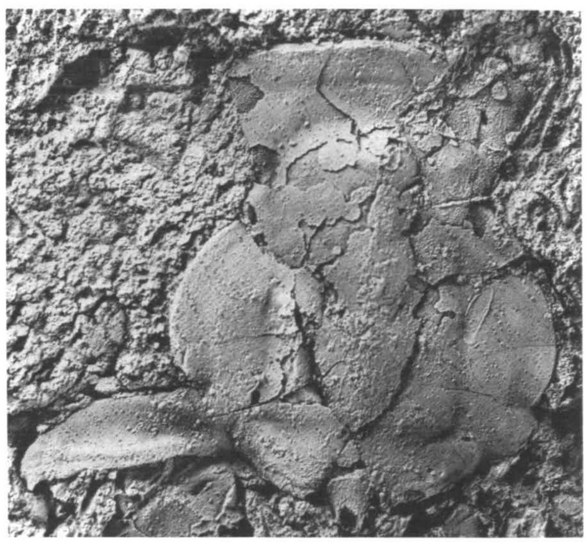


1a

2



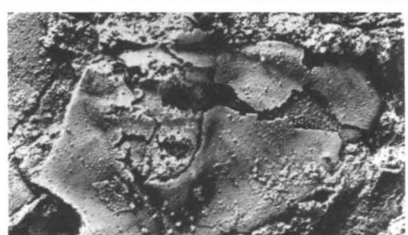
1b



4

3a

3b



5

PLATE 15

Itydeois vultuosa sp. nov.
(p. 51)

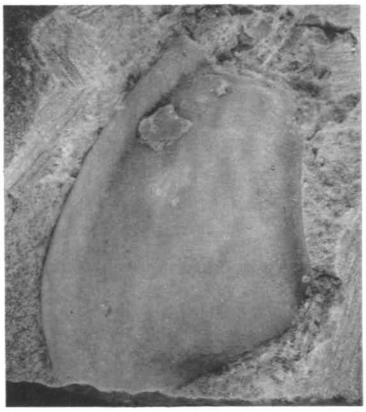
Fig. 1 Holotype cranidium, CPC 18890; ×3.6.
Fig. 2 Free cheek, CPC 18891, with the margin exorbitant; ×3.
Fig. 3 Pygidium, CPC 18892; ×3.
Zone of *Euagnostus opimus,* locality M123, Currant Bush Limestone.

Itydeois balli sp. nov.
(p. 52)

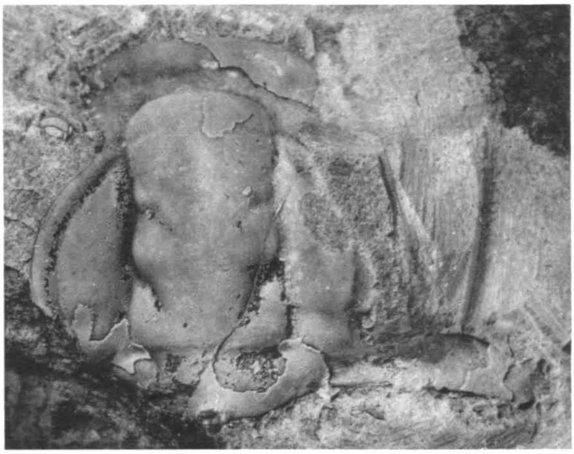
Fig. 4 Holotype cranidium, CPC 18893; ×4.
Fig. 5 Pygidium, CPC 18894; ×4.
Zone of *Euagnostus opimus,* locality M180, Northern Territory, adjacent to Lawn Hill area, Queensland.
Limestone attributed to the Currant Bush Limestone.

Dolicholeptus ansatus sp. nov.
(p. 44)

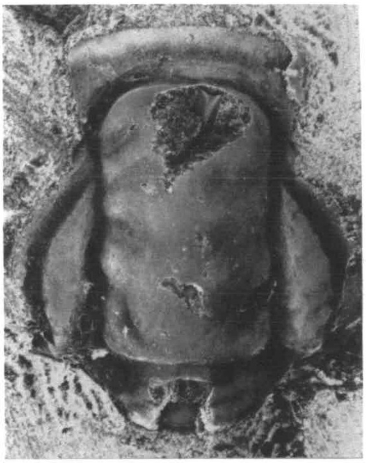
Fig. 6 Cranidium, rubber cast of CPC 18895; ×5.
Fig. 7 Holotype cranidium, CPC 18896; ×5.
Zone of *Doryagnostus notalibrae,* locality M54, V-Creek Limestone.



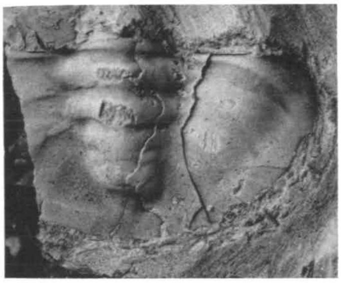
2



1

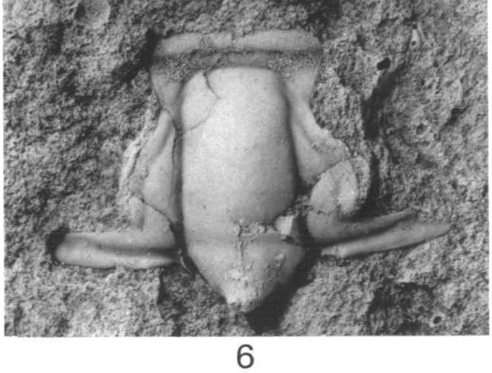


4

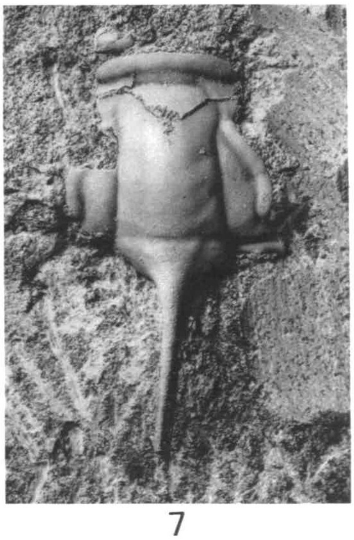


5

3



6



7

PLATE 16

Dolicholeptus ansatus sp. nov.
(p. 44)

Fig. 1 Pygidium, CPC 18897; ×6.

Fig. 2 Pygidium, CPC 18898; ×8.
Locality M54, V-Creek Limestone.

Fig. 3 Cranidium, CPC 18899, associated with a cranidium of *Asthenopsis;* ×3.4.
Locality M52, chert lamina high in the V-Creek Limestone.

Fig. 4 Pygidium, CPC 18900; ×4.
Locality M41, chert lamina high in the V-Creek Limestone.

Dolicholeptus cf. **ansatus** (?sp. nov.)
(p. 46)

Fig. 5 Cranidium, CPC 18901; ×7.5.
Zone of *Doryagnostus notalibrae,* locality M247, V-Creek Limestone. See also Plate 17, fig. 7.

Fig. 6 Cranidium, CPC 18902; ×7.
Zone of *Ptychagnostus punctuosus,* locality M64, top of Currant Bush Limestone.

Dolicholeptus licticallis sp. nov.
(p. 46)

Fig. 7 Two cranidia illustrated separately in Plate 17; ×2.

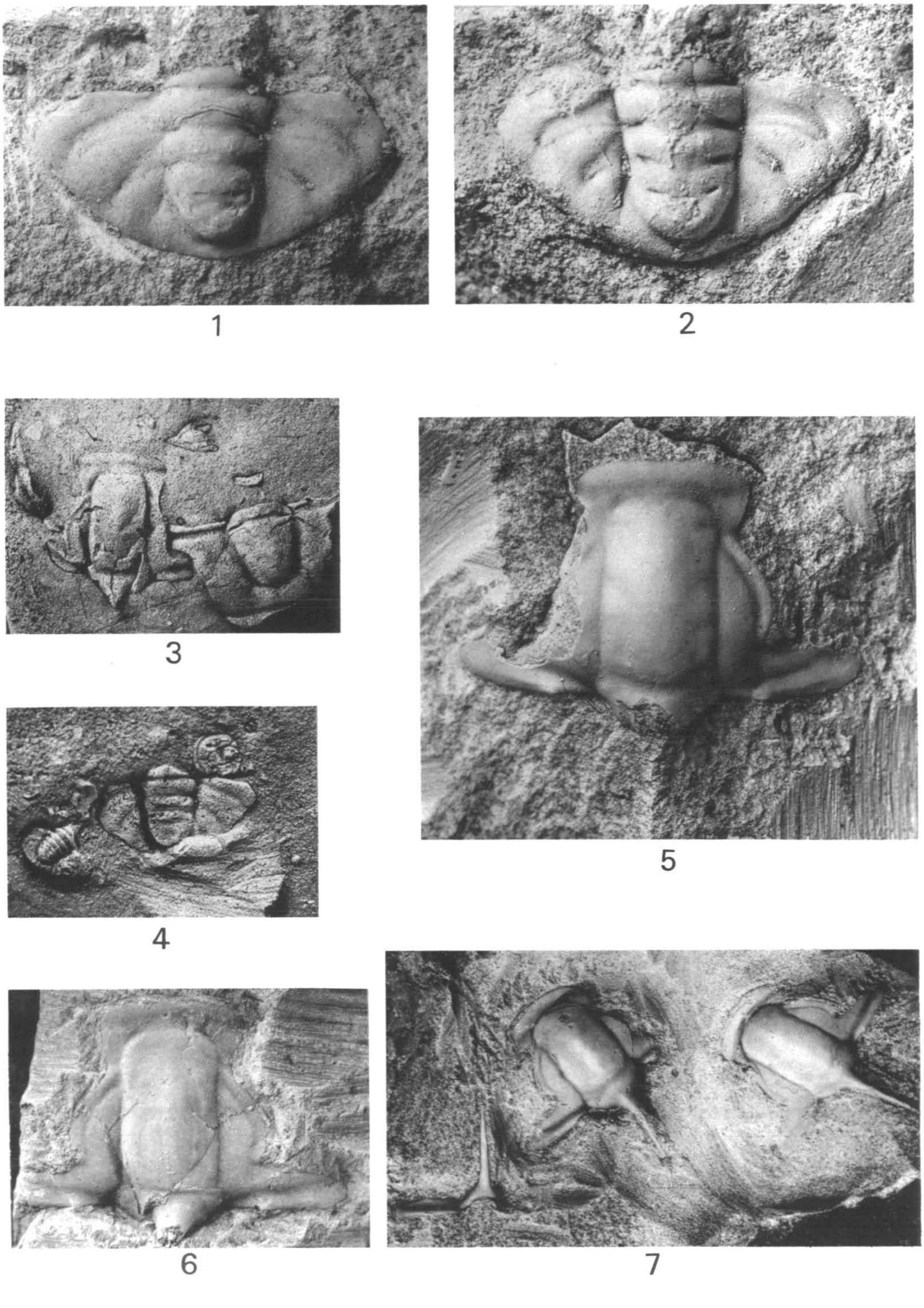

1
2
3
4
5
6
7

PLATE 17

Dolicholeptus licticallis sp. nov.
(p. 46)

Figs. 1a,b	Cranidium, CPC 18903. 1a ×5; 1b ×8.
Fig. 2	Holotype cranidium, CPC 18904; ×10.
Fig. 3	Free cheek, CPC 18905; ×4.
Fig. 4	Segment of thorax, CPC 18906; ×4.
Fig. 5	Pygidium, CPC 18907; ×6. Note the structure of the terminus. Zone of *Ptychagnostus punctuosus,* locality M41, in a creek channel, low in the V-Creek Limestone. See also Plate 17, fig. 7 and Plate 32, fig. 5.
Figs. 6a,b	Cranidium, CPC 18908. Fig. 6b is a rubber cast. Zone of *Ptychagnostus punctuosus,* locality M118.

Dolicholeptus cf. **ansatus** (?sp. nov.)
(p. 46)

Fig. 7	Cranidium, CPC 18909; ×4. Zone of *Doryagnostus notalibrae,* locality M247, V-Creek Limestone. Specimen is associated with the specimen of Plate 16, fig. 5.

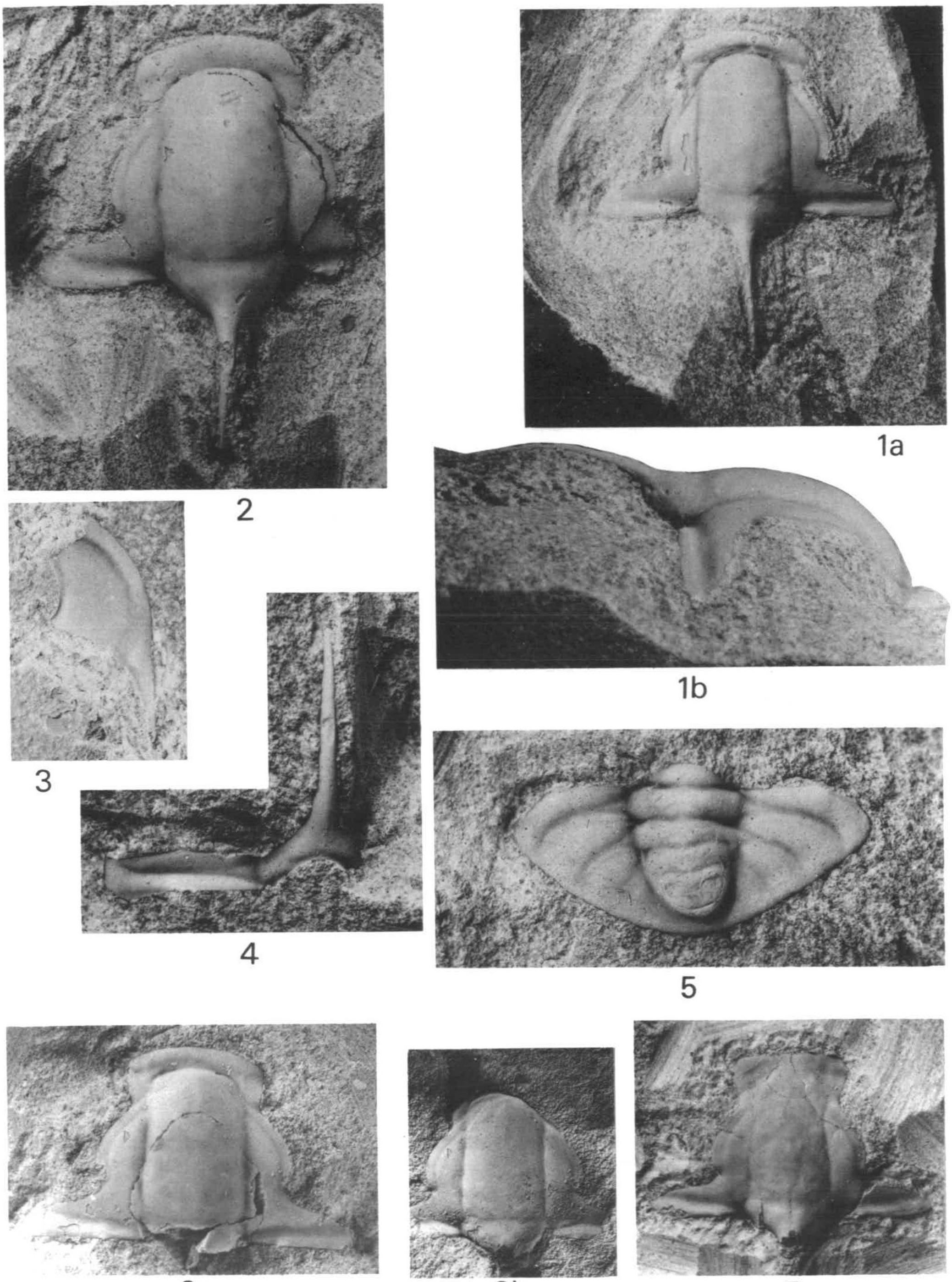
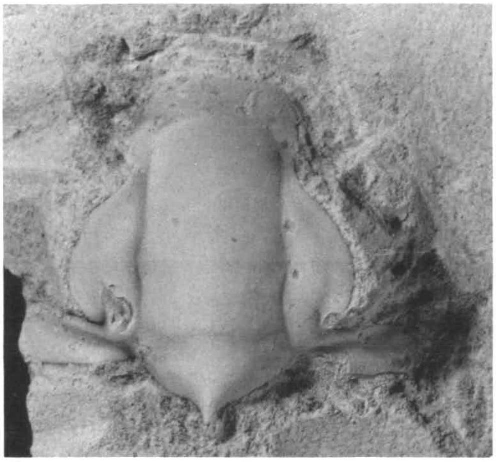

1a
2
1b
3
4
5
6a
6b
7

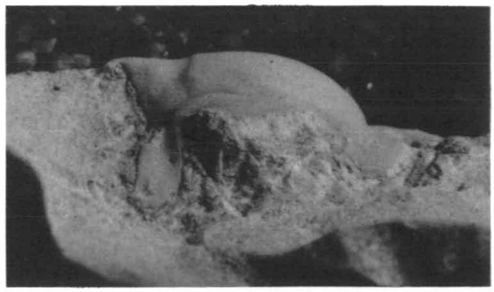
PLATE 18

Undillia rustica sp. nov.
(p. 54)

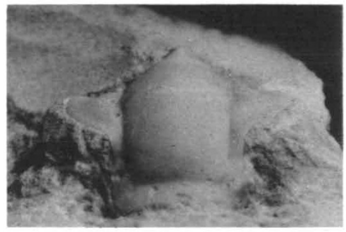
Figs. 1a-c	Cranidium, CPC 18910; 1a ×6.2; 1b ×5.2.
Figs. 2a,b	Holotype cranidium, CPC 18911; ×4.
Fig. 3	Free cheek, CPC 18912; ×4. Specimen singed by fire.
Fig. 4	Hypostoma, CPC 18913; ×14.
Fig. 5	Hypostoma and free cheek, CPC 18914: ×14.
	Zone of *Doryagnostus notalibrae,* locality M54, V-Creek Limestone. See also Plate 19.



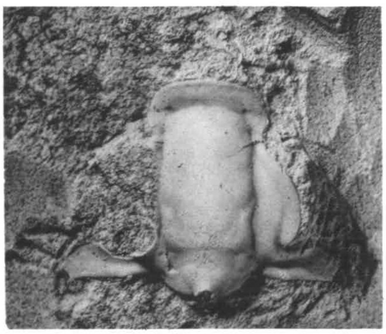
1a



1b

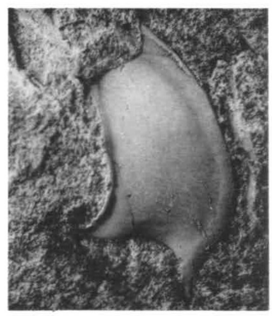


1c

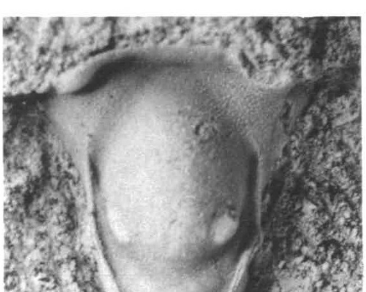


2a

2b



3



4

5

PLATE 19

Undillia rustica sp. nov.
(p. 54)

Fig. 1 Cranidium and free cheek, CPC 18915; ×8.
Fig. 2 Pygidium, rubber cast of CPC 18916; ×4.3.
Fig. 3 Pygidium, CPC 18917; ×4.5.

Sunia cornunda sp. nov.
(p. 67)

Fig. 4 Free cheek, CPC 18918; ×3.7.
Zone of *Doryagnostus notalibrae,* locality M54 (same as Plate 18), V-Creek Limestone.

Sunia lorenzi sp. nov.
(p. 72)

Figs. 5a,b Holotype cranidium, CPC 18919; ×3.
Fig. 6 Overturned free cheek, CPC 18921; ×4.5.
Fig. 7 Pygidium and cranidium, CPC 18920; ×2.3.
Zone of *Doryagnostus notalibrae,* locality M136, chert in dolomite, Age Creek Formation.

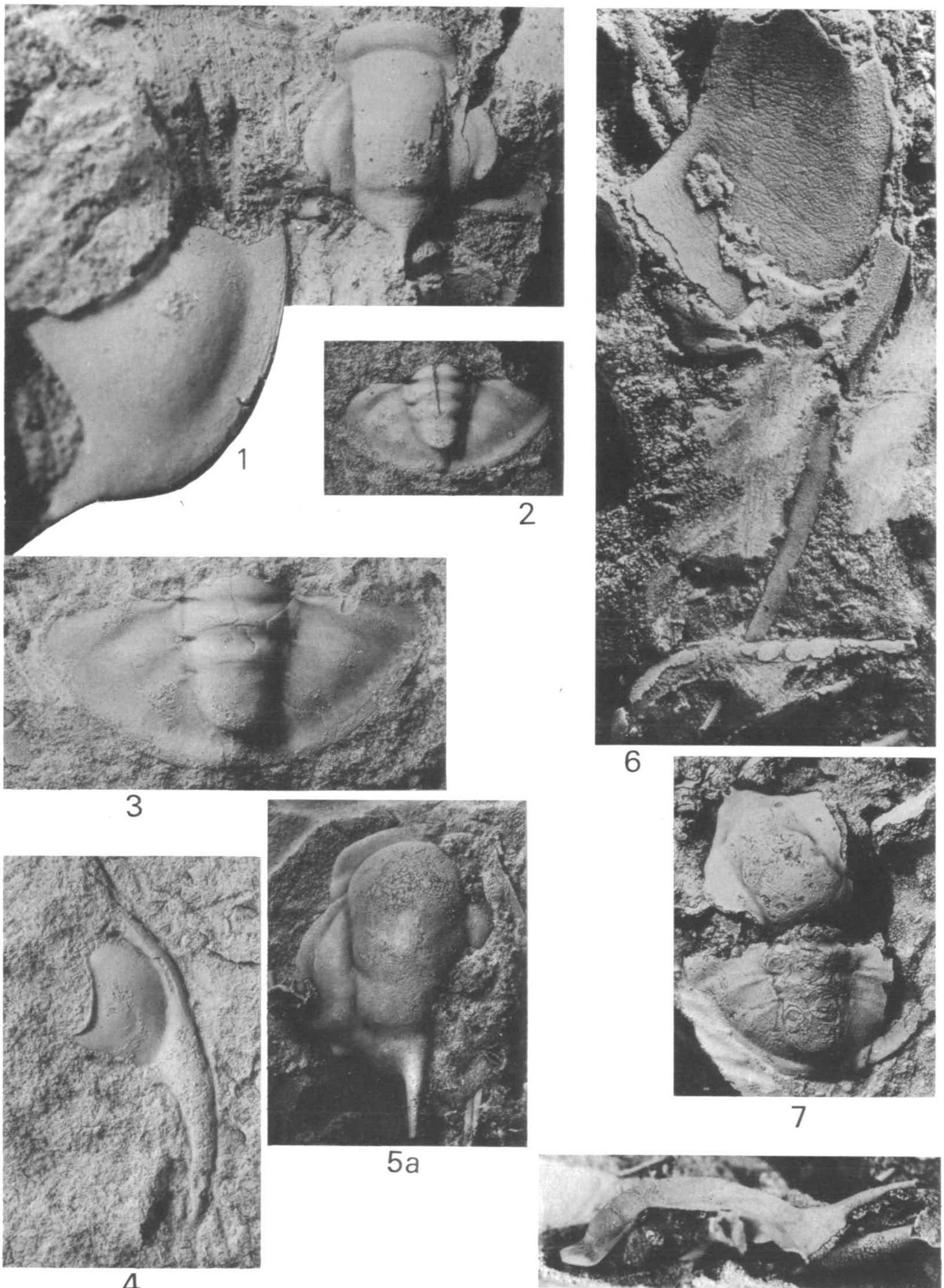

1
2
3
4
5a
5b
6
7

PLATE 20

Eurodeois serotina (Whitehouse)
(p. 62)

Fig. 1 Cranidium, CPC 18922; ×8.

Dolichometopidae, pygidium No. 2
(p. 77)

Fig. 2 Pygidium, CPC 18923; ×5.7.
Zone of *Doryagnostus notalibrae,* locality M52, V-Creek Limestone.

Undillia lara sp. nov.
(p. 56)

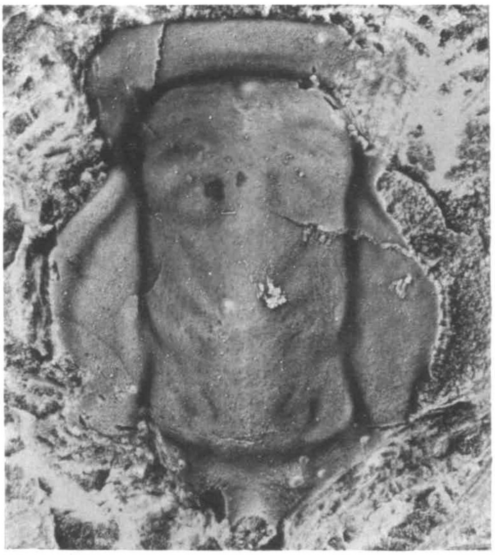
Figs. 3a,b Holotype cranidium, CPC 18924. 3a ×4; 3b ×2.3.

Dolicholeptus baiatus sp. nov.
(p. 48)

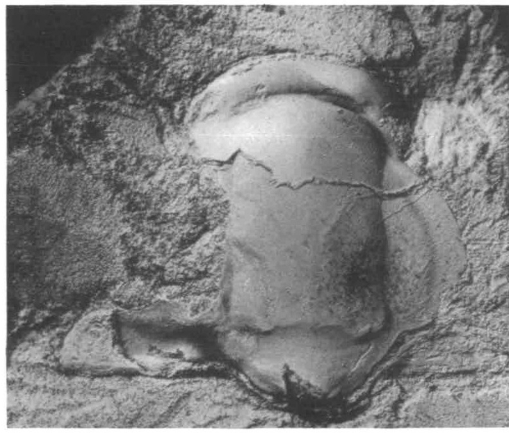
Fig. 4 Holotype cranidium, CPC 18925; ×5.
Early in the Zone of *Doryagnostus notalibrae* (overlap with Zone of *Pt. punctuosus*), locality M409, V-Creek Limestone (low in its sequence).

Eurodeois deois (Walcott)
(p. 58)

Fig. 5 Free cheek, CPC 18926; ×6.5.
Zone of *Ptychagnostus punctuosus,* locality M30, top of Currant Bush Limestone.

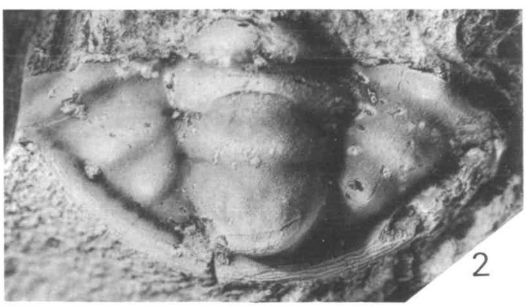


1

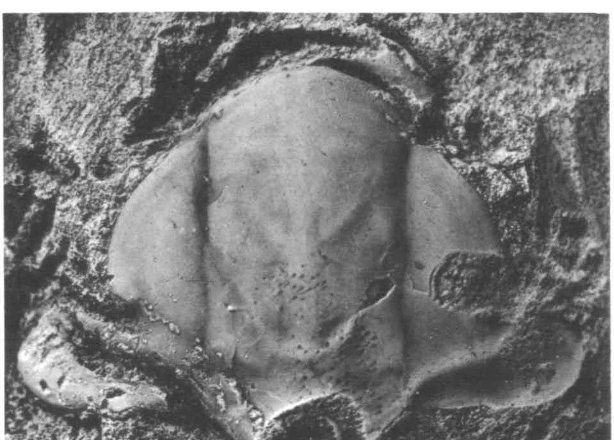


3a

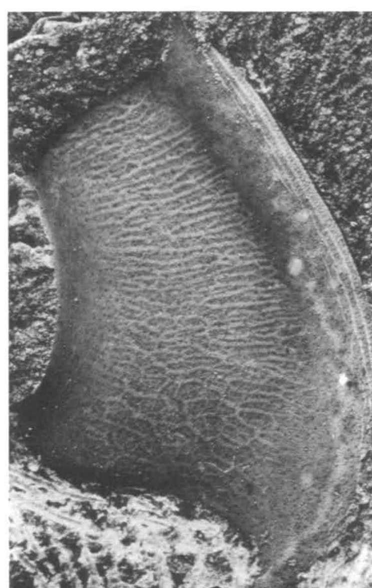
3b



2



4



5

PLATE 21

Eurodeois sp. nov. aff. **serotina**

(p. 62)

Figs. 1a-c Cranidium, CPC 18927. 1a ×2.4; 1b ×2; 1c ×3.

Fig. 2 Pygidium, CPC 18928; ×3.

Zone of *Ptychagnostus punctuosus,* locality M157, limestone interbed in the Age Creek Formation.

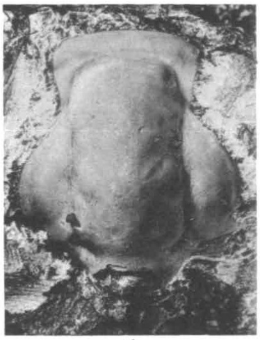
Eurodeois marginicrassa sp. nov.

(p. 60)

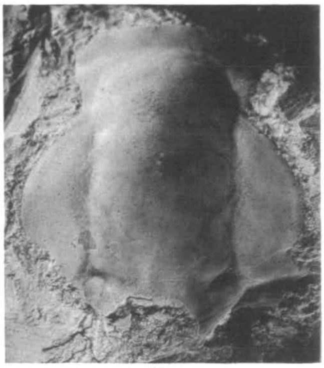
Figs. 3a-d Holotype cranidium, CPC 18929. 3a ×5; 3b ×4.5; 3c lateral view ×5; 3d frontal view ×6.5.

Fig. 4 Free cheek, CPC 18930; ×8.

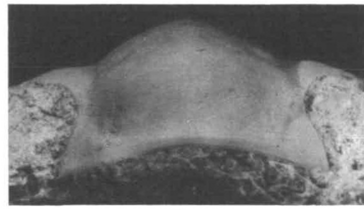
Zone of *Doryagnostus notalibrae,* locality M65; limestone, a faulted interbed in the Age Creek Formation. See also Plate 26, figs. 1 and 2.



1a

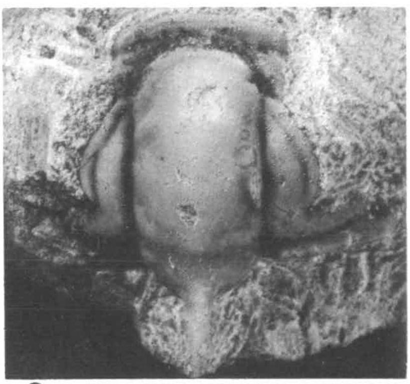


1b



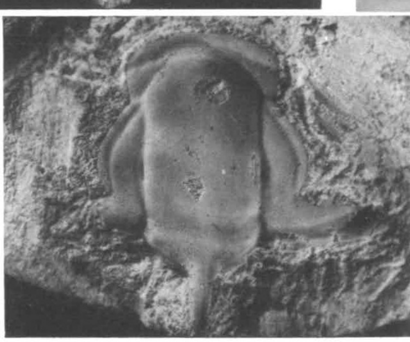
1c

2

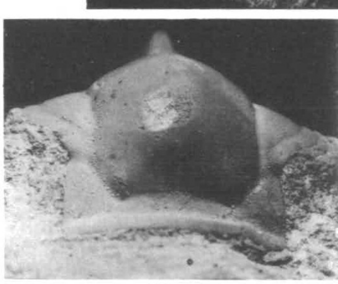


3a

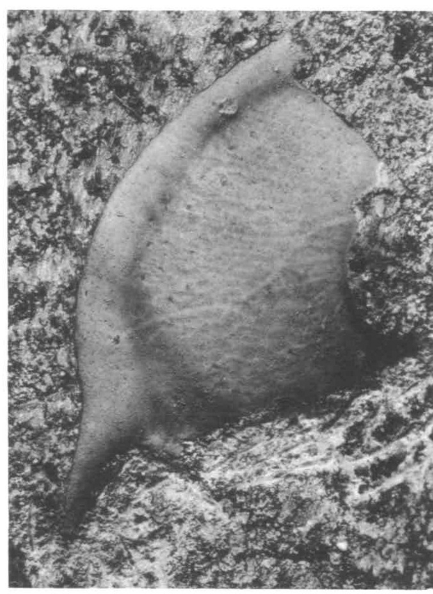
3d



3b



3c



4

PLATE 22

Eurodeois sp., cf. **marginicrassa**
(p. 66)

Fig. 1 Hypostoma, CPC 18931; ×8.

Sunia elissa sp. nov.
(p. 70)

Fig. 2 Cranidium, CPC 18932; ×2.4.
Fig. 7 Pygidium, CPC 18937; ×7. See also Plate 25, figs. 3, 4.

Eurodeois adelpha sp. nov.
(p. 59)

Fig. 3 Holotype cranidium, CPC 18933; ×3.8.
Fig. 10 Free cheek, CPC 18940; ×6.

Eurodeois aff. **Dolichometopus dirce** Walcott
(p. 60)

Fig. 4 Cranidium, CPC 18934; ×17.
Fig. 5 Immature cranidium, CPC 18935; ×17.
Locality M89, calcite pod in V-Creek Limestone.

Eurodeois? sp. indet.
(p. 66)

Fig. 6 Cranidium, CPC 18936; ×2.
Locality M227, chert in V-Creek Limestone.

Undillia sp. nov. A
(p. 57)

Fig. 8 Pygidium, CPC 18938; ×5.

Dolichometopidae gen. nov., sp. nov., pygidium No. 3
(p. 77)

Fig. 9 Pygidium, CPC 18939; ×7.
Locality M89, calcite pod in V-Creek Limestone.

Sunia sp. indet., pygidium No. 1
(p. 76)

Fig. 11 Pygidium, CPC 18941; ×3.4.
Locality M41, V-Creek Limestone (high in the sequence).
All specimens in Plate 22 belong to the Zone of *Doryagnostus notalibrae*.

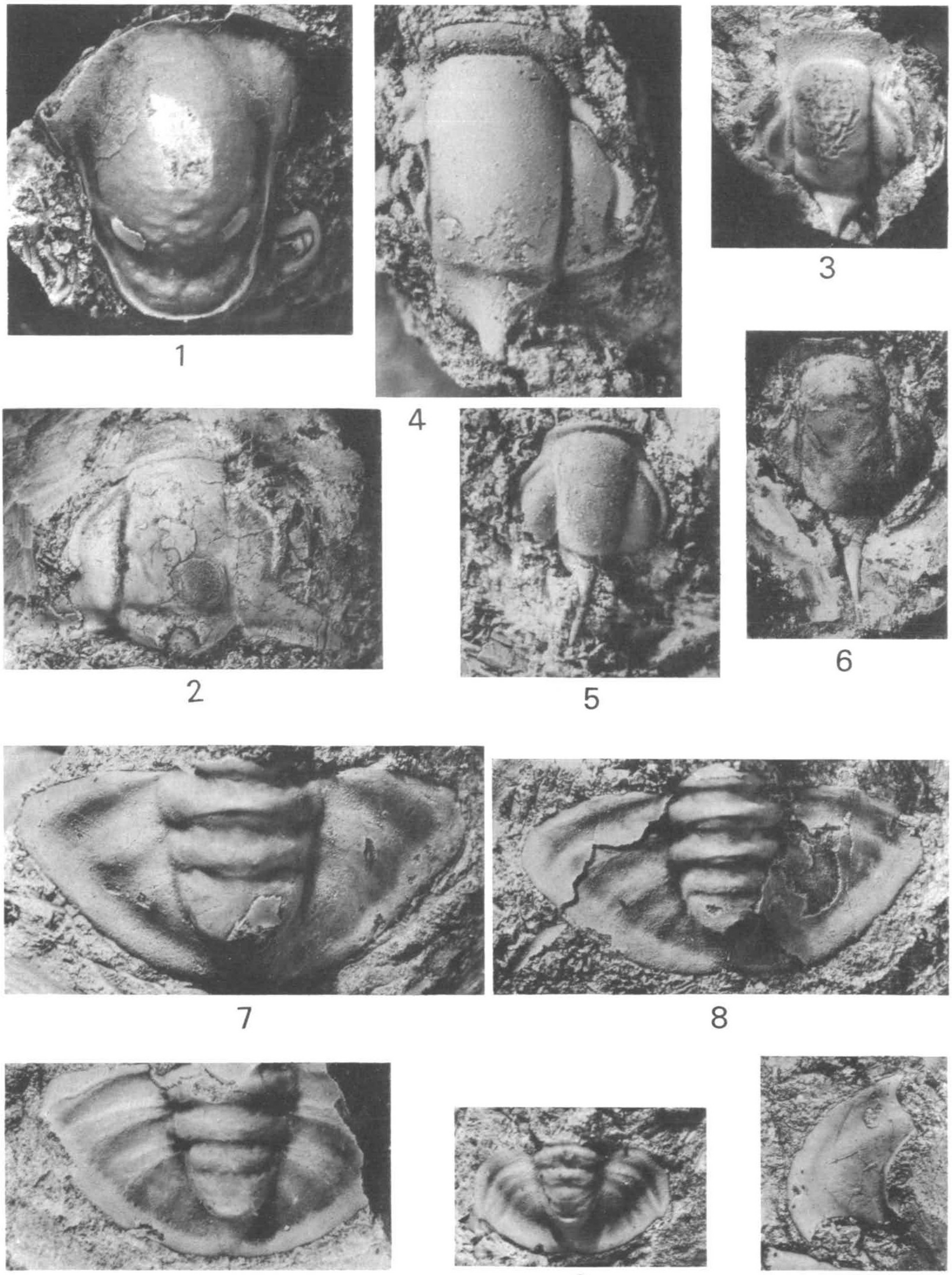
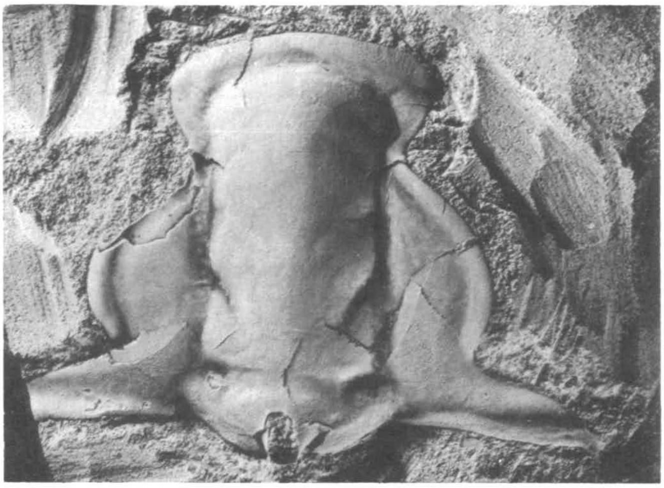

1
2
3
4
5
6
7
8
9
10
11

PLATE 23

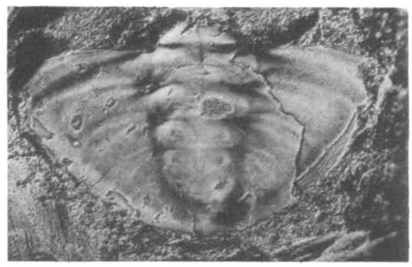
Sunia cornunda sp. nov.
(p. 67)

Figs. 1a,b	Cranidium, CPC 18942. 1a ×3.6; 1b ×2.5.
Fig. 2	Holotype cranidium, CPC 18943; ×5.2. Same specimen as Plate 24, fig. 1.
Fig. 3	Pygidium, CPC 18944; ×2.5.
Fig. 4	Segment of thorax, CPC 18945; ×5.
Fig. 5	Segment of thorax, CPC 18946; ×5. Zone of *Doryagnostus notalibrae,* locality M57, V-Creek Limestone (high in the sequence).

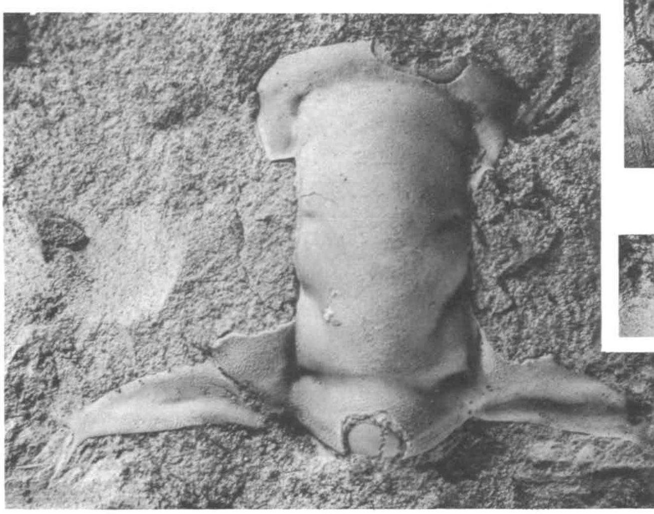


1a

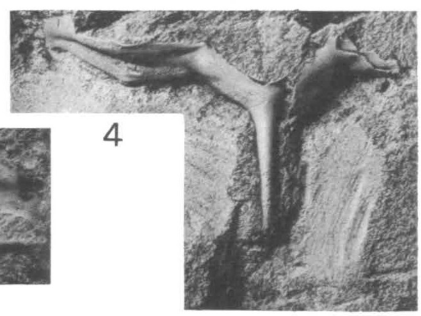
1b



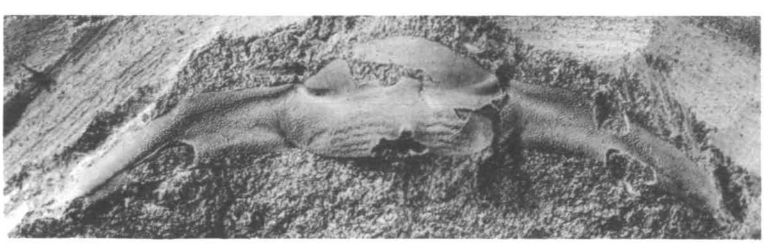
3



2



4

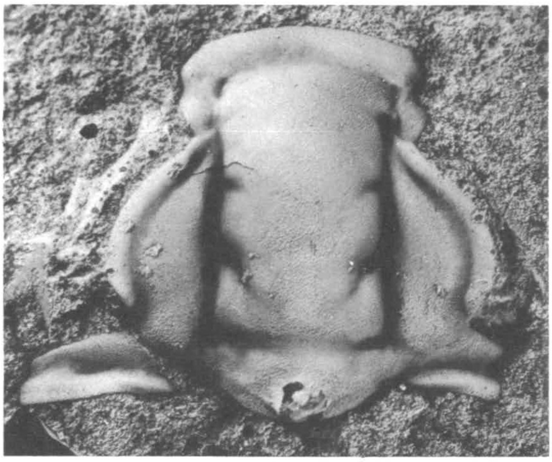


5

PLATE 24

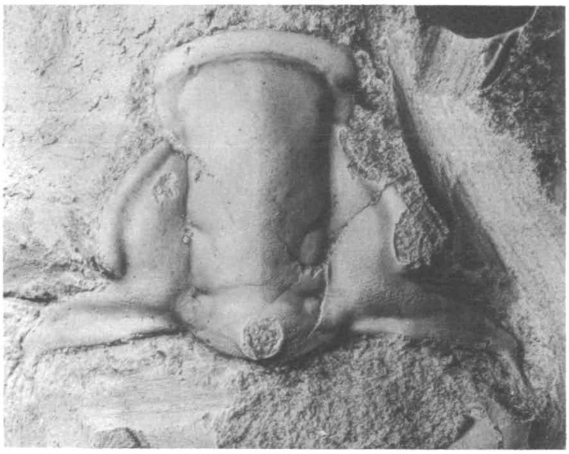
Sunia cornunda sp. nov.
(p. 67)

Fig. 1	Holotype cranidium, rubber cast of CPC 18943; ×4.8. (Same specimen as Plate 23, fig. 2.) Zone of *Doryagnostus notalibrae,* locality M57, V-Creek Limestone (high in the sequence).
Fig. 2	Free cheek, CPC 18947; ×5.3. See also Plate 19, fig. 4.
Figs. 3a,b	Cranidium, CPC 18948. 3a ×4; 3b ×2.6.
Fig. 4	Hypostoma, CPC 18949; ×5.4.
Fig. 5	Pygidium, CPC 18950; ×3.4. Zone of *Doryagnostus notalibrae,* locality M416, V-Creek Limestone.

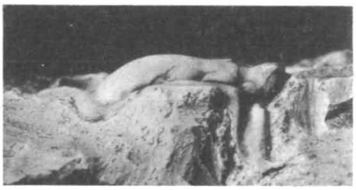


1

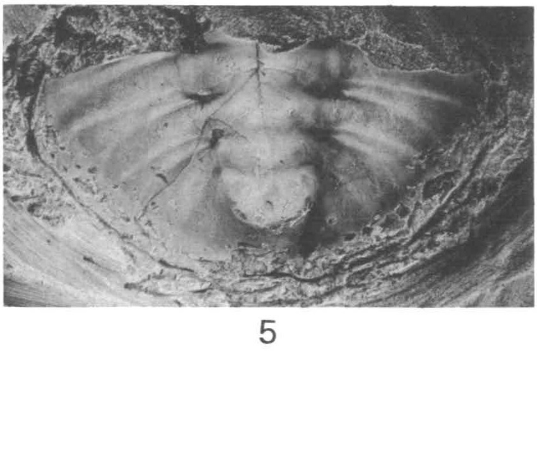
2



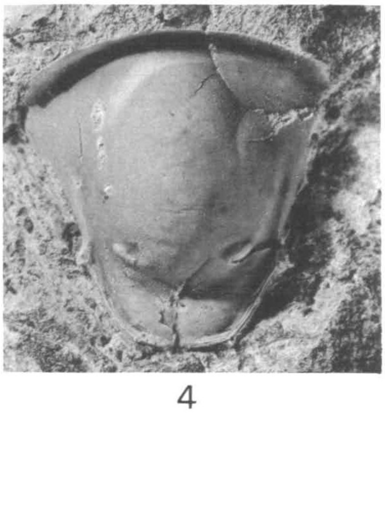
3a



3b



5



4

PLATE 25

Sunia idica sp. nov.
(p. 67)

Fig. 1 Holotype cranidium, CPC 18951; ×8.
Zone of *Goniagnostus nathorsti,* locality M416, V-Creek Limestone.

Fig. 2 Cranidium, CPC 18952; ×4.
Zone of *Goniagnostus nathorsti,* locality M226, Split Rock Sandstone.

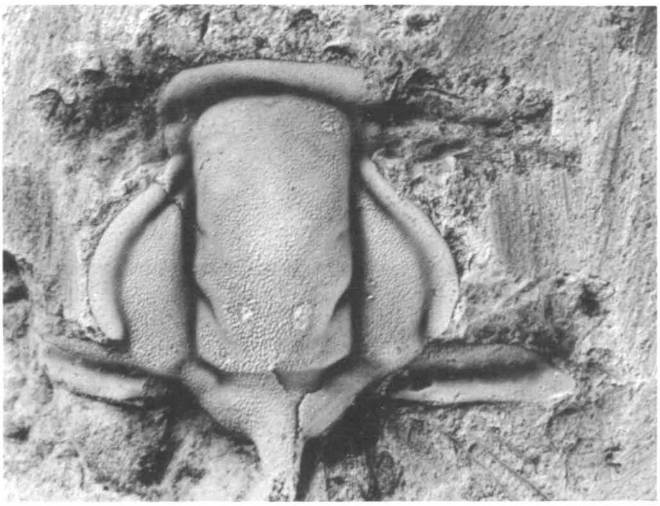
Sunia elissa sp. nov.
(p. 70)

Figs. 3a,b Holotype cranidium, CPC 18953. 3a ×4; 3b ×3.

Fig. 4 Free cheek, CPC 18954; ×2.5.

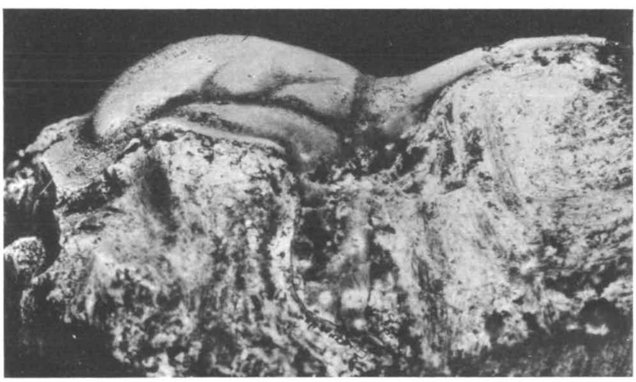
Eurodeois sp., cf. **marginicrassa**
(p. 66)

Fig. 5 Pygidium, CPC 18955; ×4. See also Plate 22, fig. 1.
Zone of *Doryagnostus notalibrae,* locality M89, calcite pod in V-Creek Limestone.

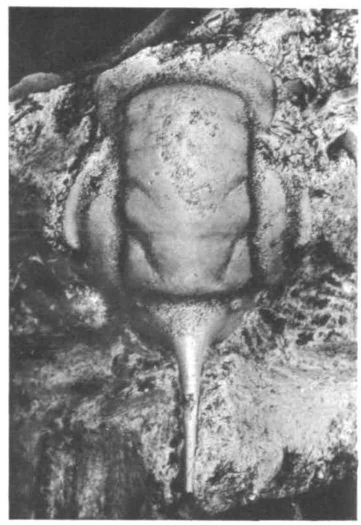


1

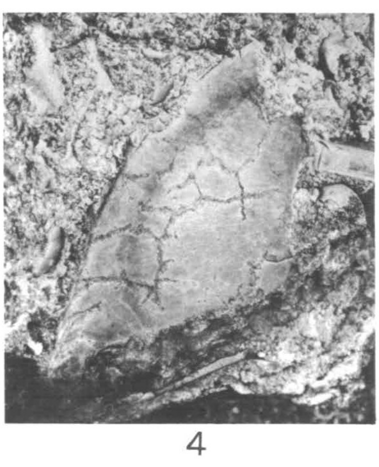
2



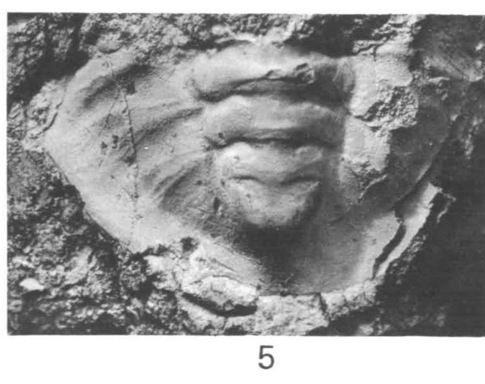
3b



3a



4



5

PLATE 26

Eurodeois marginicrassa sp. nov.
(p. 60)

Fig. 1 Pygidium, CPC 18956; ×3.2.
Zone of *Doryagnostus notalibrae,* locality M247, V-Creek Limestone.

Fig. 2 Pygidium, CPC 18957; ×2.
Locality M41, V-Creek Limestone (high in the sequence).

Dolicholeptus ansatus sp. nov.
(p. 44)

Fig. 3 Hypostoma, CPC 18958; ×3.
Locality M41, V-Creek Limestone (high in the sequence).
Zone of *Doryagnostus notalibrae.*

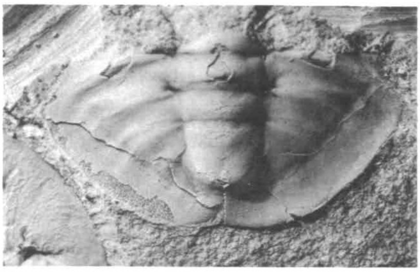
Sunia sp. indet., pygidium with reticulate veins
(p. 76)

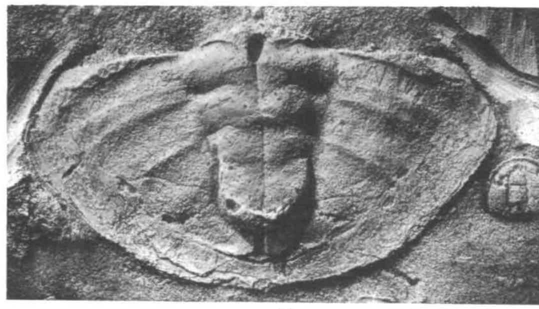
Figs. 4a,b Pygidium, CPC 18959, 4a ×2.5; 4b ×7.
Zone of *Goniagnostus nathorsti,* locality M19, Mail Change Limestone.

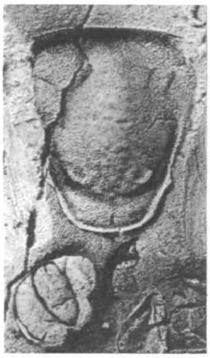
Sunia colainis sp. nov.
(p. 76)

Figs. 5a,b Holotype pygidium, CPC 18960. 5a ×5; 5b ×3.

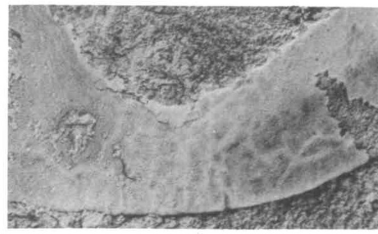
Figs. 6a,b Hypostoma, CPC 18961; ×7.3.
Late Zone of *Goniagnostus nathorsti,* locality M226, silicified siltstone, Split Rock Sandstone.

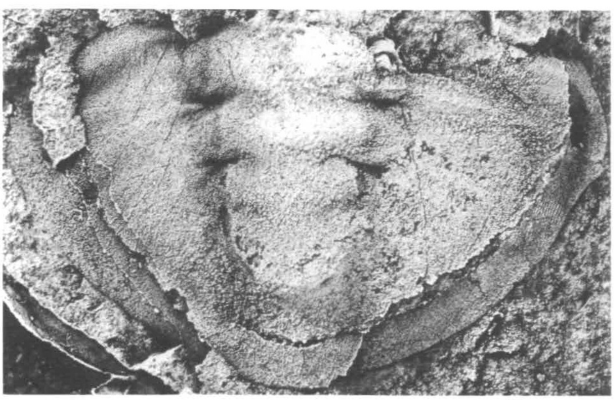

1


2


3


4a


4b


5a


6a


5b


6b

PLATE 27

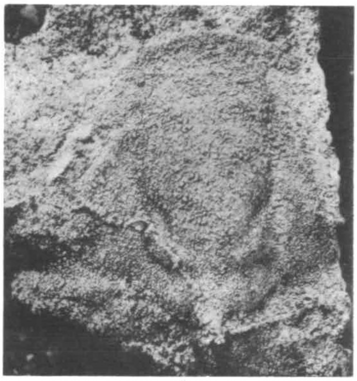
Sunia russa sp. nov.
(p. 74)

Figs. 1a,b	Holotype cranidium, CPC 18962; ×3.2. Fig. 1b is a rubber cast.
Fig. 2	Pygidium and hypostoma, CPC 18963; ×2.3.
Fig. 3	Pygidium, CPC 18964; ×2.
Fig. 4	Pygidium, CPC 18965; ×2.3.

Eurodeois anepsia sp. nov.
(p. 63)

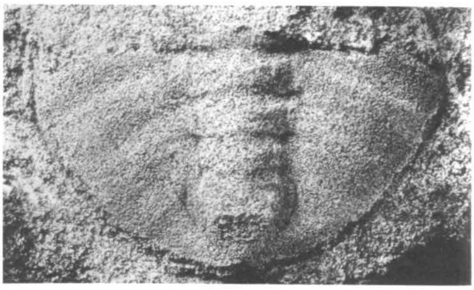
Fig. 5	Free cheeks in sandstone, CPC 18966; ×2.
	Late Zone of *Goniagnostus nathorsti,* locality M141, Split Rock Sandstone.


1a


1b


3


2


4


5

PLATE 28

Sunia rutilata sp. nov.
(p. 75)

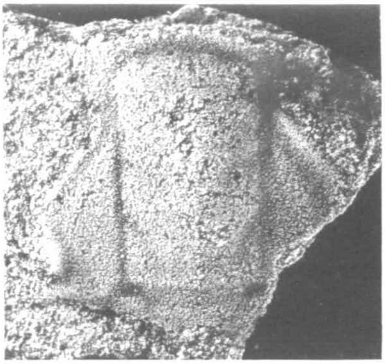
Fig. 1 Holotype cranidium, CPC 18967; ×3.5.
Fig. 2 Cranidium, CPC 18968; ×2.5.
Fig. 3 Hypostoma, CPC 18969; ×4.
Fig. 4 Free cheek, CPC 18970; ×3.5.
Figs. 5a,b Pygidium, CPC 18971. 5a ×2; 5b ×2.3.
Figure 5a is a rubber cast.
Late Zone of *Goniagnostus nathorsti,* locality M133, Split Rock Sandstone.

Sunia cf. **rutilata**
(p. 76)

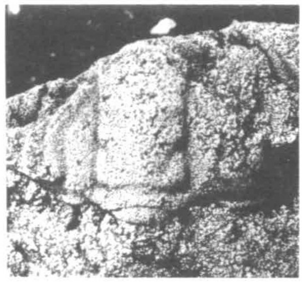
Figs. 6a,b Pygidium, CPC 18972, two different rubber casts. 6a ×3; 6b ×2.

Eurodeois anepsia sp. nov.
(p. 63)

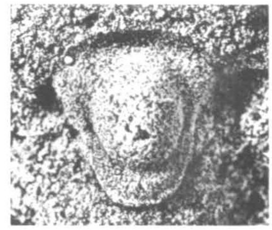
Figs. 7a,b Pygidium, CPC 18973. 7a ×1; 7b ×2.
Late Zone of *Goniagnostus nathorsti,* locality M417, Split Rock Sandstone.



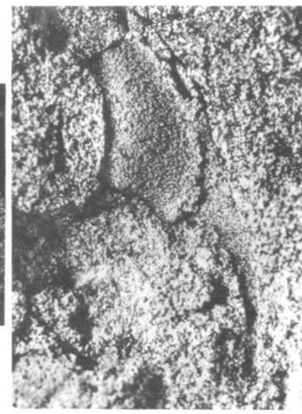
1



2



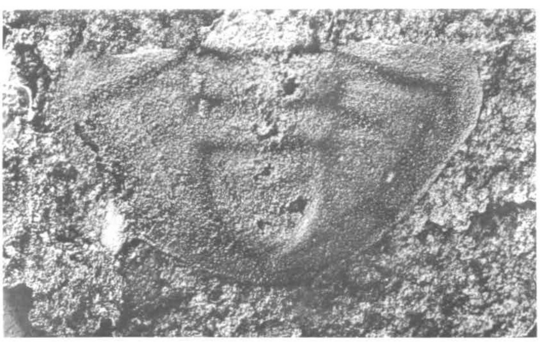
3



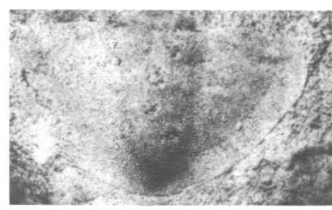
4

5a

5b



6a



6b

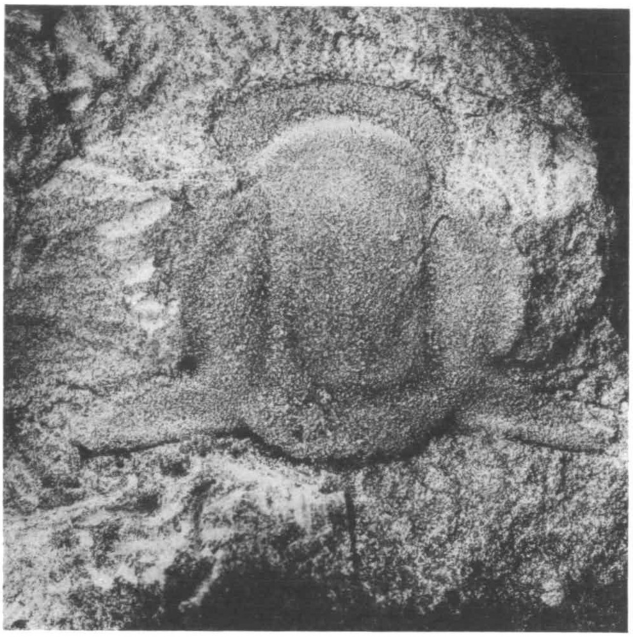
7a

7b

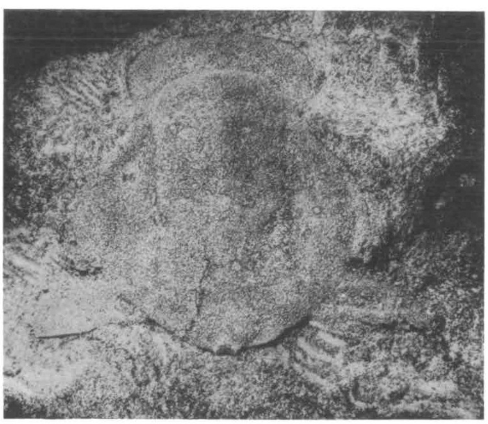
PLATE 29

Eurodeois anepsia sp. nov.
(p. 63)

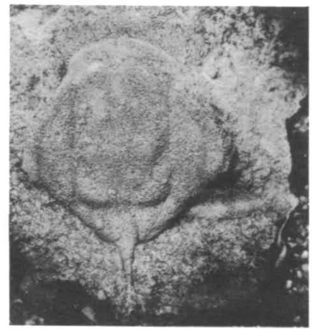
Fig. 1 Holotype cranidium, CPC 18974; ×2.5.
Fig. 2 Cranidium, CPC 18975; ×2.
Fig. 3 Cranidium, rubber cast of CPC 18976; ×1.8.
Fig. 4 Free cheek, CPC 18977; ×1.2.
Fig. 5 Hypostoma, CPC 18978; ×4.
Fig. 6 Segment of thorax, CPC 18979; ×3.
Late Zone of *Goniagnostus nathorsti,* locality M417, Split Rock Sandstone.



1



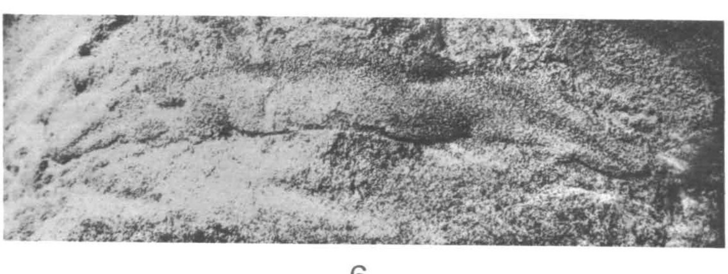
2



3

4

5



6

PLATE 30

Eurodeois anepsia sp. nov.
(p. 63)

Figs. 1a,b	Pygidium, CPC 18980; ×2. Figure 1a is a rubber cast.
Fig. 2	Pygidium, CPC 18981; ×1.7.
Fig. 3	Pygidium, CPC 18982; ×1.4. Locality M417.
Figs. 4a,b	Cranidium, CPC 18983; ×1.5. Locality M415 (M296?)
Fig. 5	Cranidium, CPC 18984; ×2. The front is deformed. Locality M417. Late Zone of *Goniagnostus nathorsti,* Split Rock Sandstone.

Dolicholeptus kallalicus sp. nov.
(p. 48)

Figs. 6a,b	Holotype cranidium, CPC 18985; ×1.6. Zone of *Leiopyge laevigata,* locality D54, Urandangi area, Steamboat Sandstone.

1a

1b

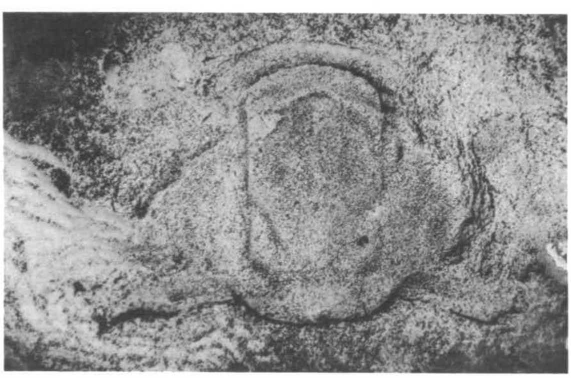
2

3

4a

4b

6a



5

6b

PLATE 31

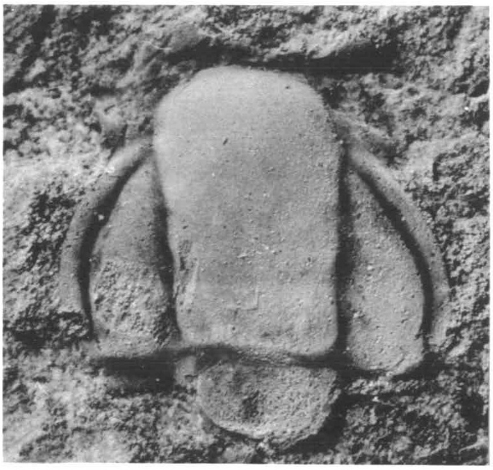
Fuchouia labda sp. nov.
(p. 39)

Fig. 1 Holotype cranidium, CPC 18986; ×8.
Zone of *Ptychagnostus atavus,* locality H4, Northern Territory.

Horonastes satelles sp. nov.
(p. 25)

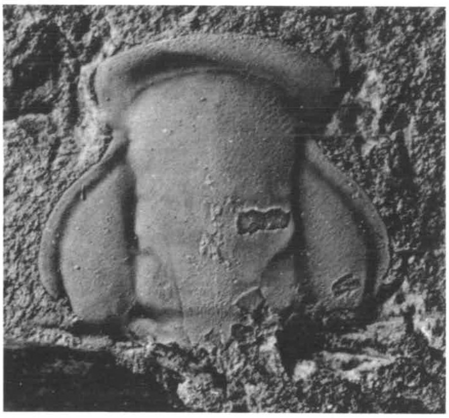
Figs. 2a-c Holotype cranidium, CPC 18987. 2a ×4.5; 2b,c ×6.

Figs. 3a,b Cranidium, CPC 18988; ×6.
Zone of *Ptychagnostus atavus,* locality M179, Northern Territory, close to Queensland border, limestone attributed to the Currant Bush Limestone ("Louie Creek Limestone").



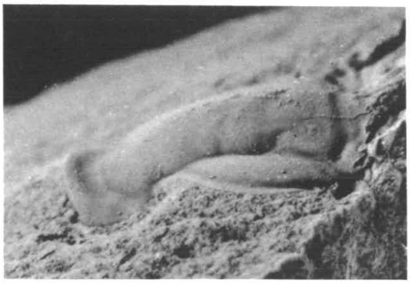
1

2a

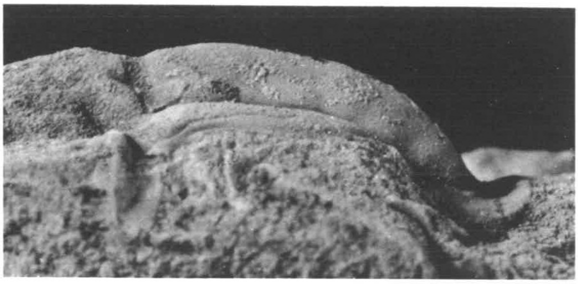


3a

2b



3b



2c

PLATE 32

Horonastes satelles sp. nov.
(p. 25)

Figs. 1a,b Cranidium, CPC 18989; 1a ×6; 1b ×12.

Fig. 2 Free cheek, isolated rostral shield, and a small cranidium, CPC 18990; ×6.
Locality M179. For details see Plate 31.

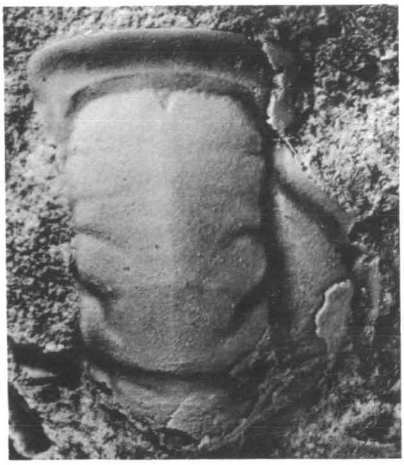
Itydeois sp. nov. aff. **vultuosa**
(p. 53)

Fig. 3 Cranidium, CPC 18991; ×5.

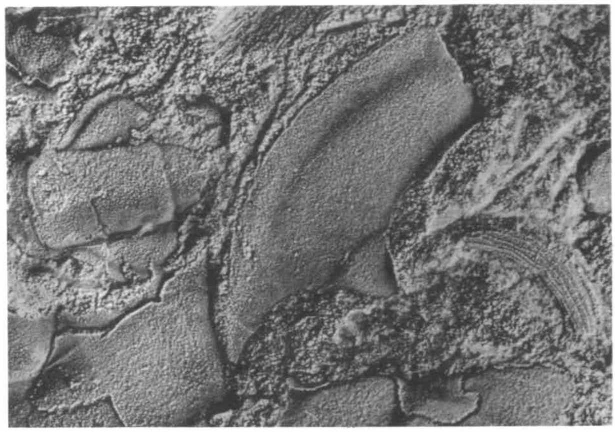
Fig. 4 Cranidium, CPC 18992; ×6.
Zone of *Euagnostus opimus*, locality M160, Age Creek Formation.

Acontheus tenebrarum sp. nov.
(p. 77)

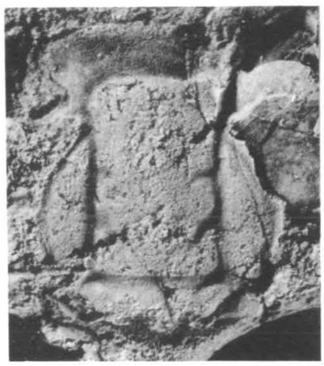
Fig. 5 Holotype exoskeleton, CPC 18993; ×30.
Early Zone of *Doryagnostus notalibrae* (overlap with Zone of *Pt. punctuosus*), locality M41, V-Creek Limestone.



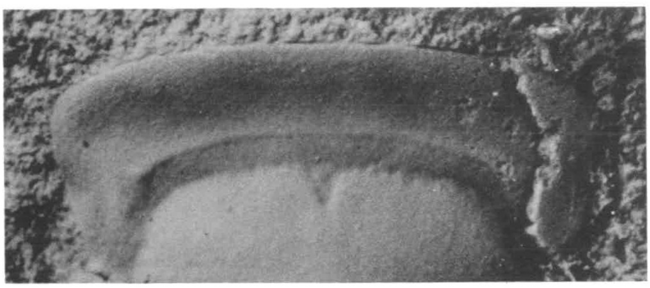
1a



2

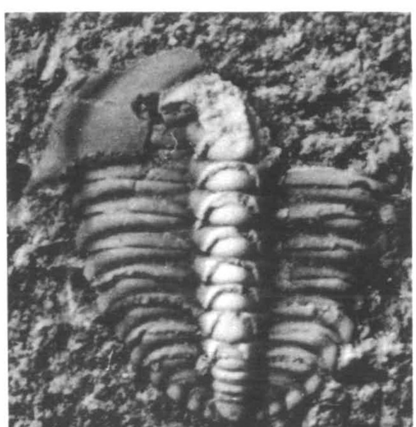


3



1b

4



5