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REVISION OF A LATE MIDDLE CAMBRIAN TRILOBITE FAUNULE FROM NORTHWESTERN QUEENSLAND[1]

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ABSTRACT

Three species, each belonging to a different genus, are shown to be represented by previously figured types of *Euagnostus opimus* Whitehouse, 1936, which is the nominate species of the commonly cited *Euagnostus opimus* Zone in Australia. The holotype of *E. opimus* is here reassigned to *Peronopsis* Corda, 1847, and *Euagnostus* Whitehouse, 1936, is thereby suppressed as a subjective junior synonym of *Peronopsis*. This action necessitates a change in biostratigraphic terminology from *Euagnostus opimus* Zone to *Peronopsis opimus* Zone. Because of the taxonomic and biostratigraphic importance of these conclusions, all trilobites from the type collection of *E. opimus* are described or redescribed and evaluated. These include the miomeroids *Baltagnostus australis* n. sp., *Doryagnostus deltoides* n. sp., *Hypagnostus?* sp., *Opsidiscus microspinus* Jell, and *Peronopsis opimus* (Whitehouse) as well as the polymeroids *Chondranomocare confertum* (Whitehouse), *Penarosa retifera* Öpik, *Prodamesella biserrata* n. sp., and *Sudanomocarina changi* n. gen. and n. sp. Also, type specimens of *Baltagnostus damesi* (Resser & Endo) from Manchuria are redescribed and refigured for comparison with *B. australis,* and a lectotype for *B. damesi* is designated.

INTRODUCTION

Euagnostus has been a poorly understood Middle Cambrian trilobite genus. Its type species, *E. opimus,* was described in 1936 from northwestern Queensland by the late F. W. Whitehouse. Recent examination of the type collection of *E. opimus* has led us to the conclusion that the holotype and two of Whitehouse's figured paratypes of *E. opimus* actually represent three species, each belonging to a different genus. We have also concluded that the holotype of *E. opimus* should be reassigned to *Peronopsis* Corda (in Hawle & Corda, 1847), leaving *Euagnostus* a subjective junior synonym of *Peronopsis*. Figured paratypes of *E. opimus* include a pygidium of a new species of *Baltagnostus* Lochman in Lochman and Duncan, 1944, and a cephalon of a new species of *Doryagnostus* Kobayashi, 1939. Revised taxonomic assignment of these specimens has additional significance because Öpik (1970) has defined an *Euagnostus opimus* Zone in Australia that has been cited in several subsequent publications (e.g., Hill, Playford, & Woods, 1971; Jell, 1975; Shergold & others, 1976). Because of the taxonomic and biostratigraphic importance of Whitehouse's material, all trilobites from his

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original collection are described or redescribed and evaluated in this paper.

Whitehouse's collection from the Currant Bush Limestone, which was made in 1932, is housed in the Department of Geology and Mineralogy, University of Queensland, and is labeled with the locality number UQL256. Figured specimens are entered on the Register of Fossils of the same institution and are identified by numbers with the prefix UQF. For comparative purposes, a few specimens of *Baltagnostus damesi* (Resser & Endo) are figured from the collections of the U.S. Museum of Natural History, Washington, D.C., and these are designated by numbers with the prefix USNM.

Systematic descriptions of the agnostoid trilobites have been prepared by R. A. Robison and those for an eodiscoid and the polymeroids are by P. A. Jell. Morphological terms are mostly those defined by Harrington, Moore, and Stubblefield (1959, p. O117-O126); however, notations for glabellar segmentation of the polymeroids follow Richter and Richter (1940) and some agnostoid terminology is from Robison (1964). As used for polymeroids, the term "glabella" includes the occipital ring.

Acknowledgments.—W. T. Chang of the Nanking Institute of Geology and Palaeontology provided photographs of *Prodamesella convexa* Chang as well as useful correspondence with P. A. Jell concerning this faunule. F. J. Collier arranged for the loan of specimens from the U.S. Museum of Natural History, and A. R. Palmer and A. J. Rowell critically reviewed the manuscript. Research by R. A. Robison was supported by National Science Foundation grants GA-43723 and EAR76-10953, and the Wallace E. Pratt Research Fund, which was provided by Exxon U.S.A. Foundation and administered by the University of Kansas.

LOCALITY

The exact location of UQL256 is a subject of some confusion (Fig. 1). In the description of the species, Whitehouse (1936, p. 87) gave as the locality for *Euagnostus opimus* "the *Anomocare* Stage, 52 miles from Camooweal on the road from Camooweal to Thorntonia Station," and in the section of the same paper titled "Notes on the Faunal Stages" he (p. 76) mentioned that the *Anomocare* Stage "at the road crossing of Harris Creek north-east of Camooweal" contained *Anomocare, Euagnostus, Phalacroma,* and brachiopods. This is basically the fauna of UQL256, but whether or not the type locality of the stage is geographically separate from that of *Euagnostus opimus* was not indicated. In 1939 Whitehouse (p. 224) gave as the locality for *Anomocare confertum* "the *Anomocare* Stage, five miles east of Harris Creek on the old main road from Camooweal to Burketown, *via* Thorntonia Station (52 miles from Camooweal)." In the same paper (p. 270) he listed the coordinates of the "road crossing of Harris Creek (Camooweal to Old Thorntonia)" as 138°43′ E.; 19°26′ S. In 1945 (p. 121) he mentioned that *Dorypyge tenella* came from beds "about four miles east of Douglas Creek on the old Burketown road. (This locality is about three-quarters of a mile west of the type locality for *Anomocare confertum.*)"

Whitehouse's field notes in the Fryer Library of the University of Queensland clear away some of the confusion. His entry for January 14, 1938, explains that since he was last in the area, the Thorntonia homestead had been moved from its original location on the main Thornton River to a place on the West Thornton River about 10 miles upstream from its junction with the Thornton. Also, the main Camooweal to Burketown road had been realigned so as still to pass by the homestead. These two roads and homestead sites are marked on the Camooweal 1:253,440 and 1:250,000 geological maps (the old road is dashed on these maps).

On January 15, 1938, Whitehouse wrote that he "ran onto Harris Creek (locally called the Douglas) and followed it down to Undilla." He also mentioned "Magenta Creek (locally known as Harris)." A search of the state government maps of the area has shown that these local usages subsequently received official recognition. The terminology used by Whitehouse in 1936 and 1939 was used as late as 1951 on a map of the state's stock routes. However, on the 1960 geological map and the 1968 official parish map, the name of Harris Creek (with Undilla homestead adjacent) is changed to Douglas Creek and the name of the more easterly Magenta Creek is changed to Harris

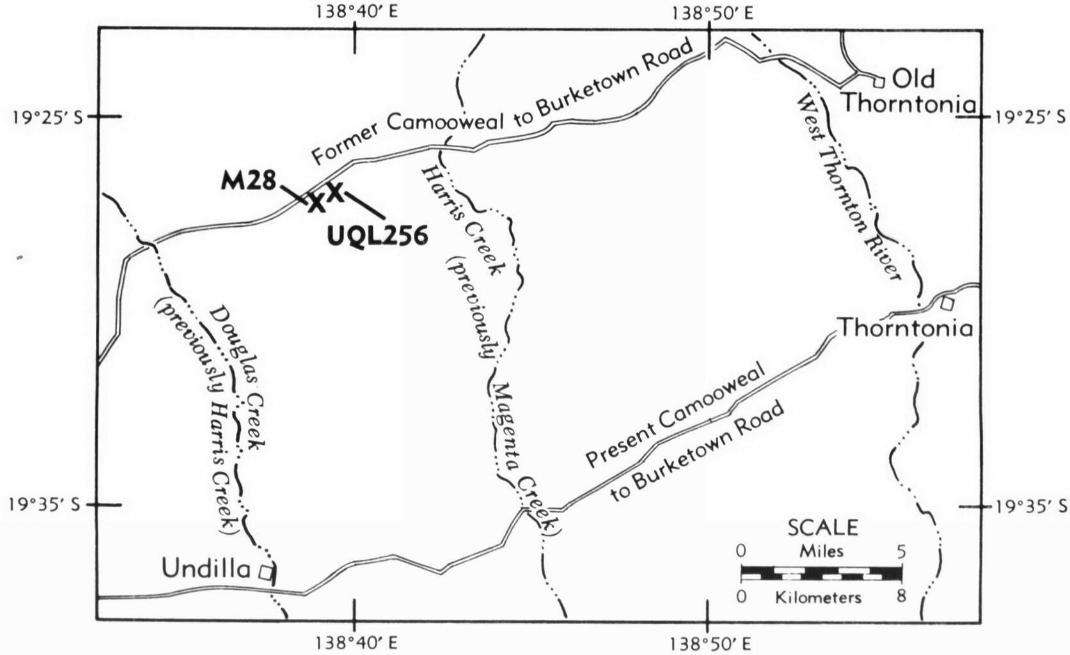

FIG. 1. Index map of the Thorntonia area, northwestern Queensland.

Creek. Clearly, Whitehouse used the newer terminology in his 1945 paper.

The locality 52 miles from Camooweal is about five miles east of Douglas Creek (formerly Harris Creek). Whitehouse's field notes for a later visit (1939) reveal that the position of the road crossing quoted for the *Anomocare* Stage in 1936 is in error. Coordinates quoted refer to modern Harris Creek (formerly Magenta) on the old Camooweal to Burketown road, an area of almost unfossiliferous and older limestone, of a lithology quite different (sandy, dolomitic, almost massive) from that of the *Anomocare* Stage. One can only assume that the newly noticed (1937-38 field notebook) changes in geographic names contributed to Whitehouse's error.

Locality UQL256 is, therefore, reasonably well identified and a similar fauna has been collected by one of us (P.A.J.) from that general area, but the precise location of Whitehouse's collecting site is almost impossible to determine because the limestone strata lie almost flat and consequently are widespread. (Indeed, Whitehouse's 1939 field notes mention stopping at several places that he took to be the type locality, but which turned out to be unfossiliferous or to contain a different faunule.) The exact location is somewhere just east of Bureau of Mineral Resources (BMR) locality 28 marked on the Camooweal Geological Map (same as M28 on Fig. 1), and the sequence from the *Ptychagnostus atavus* to *Ptychagnostus punctuosus* zones is known in several northeast to southwest sections across the Currant Bush Limestone from BMR locality 28 to as far as five miles south of the present Thorntonia homestead.

One new species, *Sudanomocarina changi,* is not well represented in Whitehouse's collection (UQL256), and supplementary material from UQL463 has been used to complete the description. UQL463 is on top of a hill 5.6 km (3.5 mi) south of Thorntonia homestead on the left bank of the West Thornton River and has been located and recollected by one of us (P.A.J.). It includes the same fauna as UQL256 but has some additional species. To complete the revision of material referred to *Euagnostus* by Whitehouse (1939, p. 260) a pygidium, UQF69639, from a locality near the Camooweal to Burketown road crossing of V Creek is also described.

On the Camooweal Geological Map, localities UQL256 and 463 are in the outcrop area of the Currant Bush Limestone. Locality UQL463 has also been mapped as such by deKeyser and Cook (1972, p. 27).

CONTENT, AGE, AND DISTRIBUTION OF FAUNULE

The following trilobite taxa have been identified from collection UQL256:

Miomeroids

Peronopsis opimus (Whitehouse, 1936)
Doryagnostus deltoides Robison, n. sp.
Baltagnostus australis Robison, n. sp.
Hypagnostus? sp.
Opsidiscus microspinus Jell, 1975

Polymeroids

Chondranomocare confertum (Whitehouse, 1939)
Sudanomocarina changi Jell, n. gen. and n. sp.
Prodamesella biserrata Jell, n. sp.
Penarosa retifera Öpik, 1970
gen. and sp. undet. (dorypygid? cranidium)

The fauna, with some additions and deletions, is well known locally from several sections along the northeastern margin of the Undilla basin, where it overlies a *Ptychagnostus atavus* fauna and underlies a fauna containing *Ptychagnostus punctuosus*. In considering these relationships, Öpik (1970, p. 4) recognized that the fauna represented the same period of time as the late Middle Cambrian *Hypagnostus parvifrons* Zone of Scandinavia. In the absence of *H. parvifrons* in Australia, he assigned the equivalent interval to the *Euagnostus opimus* Zone. Because the nominate species of that zone is here shown to represent three separate species among its previously figured types, and because *Euagnostus* is here suppressed as a subjective junior synonym of *Peronopsis,* the name of the biostratigraphic unit is here changed to the *Peronopsis opimus* Zone.

Chondranomocare and *Sudanomocarina* are present in the upper half of the Amga Stage of Siberia in association with *Ptychagnostus gibbus* so that the occurrence in UQL256 extends their known ranges by two agnostoid zones. In Manchuria these genera occur in the *Mapania* Zone. *Prodamesella* occurs in the same zone but at different localities in China, and apparently is not associated with either *Chondranomocare* or *Sudanomocarina*. According to Chang (1957) and Lu (1960), the *Mapania* Zone (or lower part of the *Amphoton* Zone) may correlate with the *Ptychagnostus gibbus* Zone, and therefore, the Chinese faunas of the *Mapania* Zone may also be slightly older than the Australian faunule containing *Prodamesella* and *Sudanomocarina.*

SYSTEMATIC DESCRIPTIONS

Agnostoid Trilobites

[by R. A. Robison]

Because of the current inadequacy of agnostoid classification, names of supergeneric taxa are not used in this paper, and genera are arranged alphabetically.

Genus BALTAGNOSTUS Lochman

Baltagnostus Lochman in Lochman & Duncan, 1944, p. 138; Palmer, 1955, p. 718; Howell, 1959, p. O184; Robison, 1964, p. 525-526; Öpik, 1967, p. 77.

Type species.—Proagnostus? centerensis Resser, 1938, p. 48, by original designation.

Diagnosis.—Small agnostoids; length of complete carapace usually less than 6 mm, maximum probably less than 9 mm.

Cephalon subquadrate to transversely subrectangular. Axial furrow well defined. Glabella bipartite (sag.) and slightly tapered forward; length approximately two-thirds that of cephalon; median node weak or effaced; posterior end constricted by slight indentations to accommodate inward displacement of simple basal lobes, commonly with tiny median ridge above cephalic recess. Genae smooth. Preglabellar median furrow incomplete; deepest near glabella, shallower toward anterior, and usually disappears before reaching border furrow. Lateral sides of acrolobes almost parallel or slightly tapered toward anterior. Border furrow wide and border narrow.

Pygidium subquadrate to transversely subrectangular. Axial furrow well defined. Axis relatively broad, slightly constricted at second segment, and may or may not extend to border furrow; transaxial furrows usually effaced on external surface, but may be faintly developed at distal ends; median tubercle moderately large, with circular to oval base. Acrolobes unconstricted to barely constricted. Border furrow moderately wide. Border with pair of posterolateral spines, posterior section between spines medially (sag.) widened and crescentiform.

Discussion.—On the basis of further study, and because of apparent gradational characters, particularly among Manchurian specimens figured by Endo and Resser (1937), Robison's (1964) concept of *Baltagnostus* is here modified and expanded to include species in which the pygidial axis is separated from the posterior border furrow. Representatives of the genus in North America are known to include *B. centerensis* (Resser, 1938), *B. eurypyx* Robison, 1964, *B. marginalis* (Rasetti, 1948), and at least two undescribed species in Nevada and Utah. *Proagnostus maryvillensis* Resser, 1938, is probably a synonym of *B. centerensis*. A new species from Australia, *B. australis*, is added here. *Agnostus rakuroensis* Kobayashi, 1935, from South Korea was reassigned to *Peronopsis* (Kobayashi, 1939, 1962), but is here transferred to *Baltagnostus* (see discussion of *B. damesi*). Species from Manchuria include *B. damesi* (Resser & Endo in Endo & Resser, 1937), which may be a junior synonym of *B. rakuroensis*, and possibly some of the specimens assigned to *Agnostus comes* by Resser and Endo (in Endo & Resser, 1937, pl. 30, fig. 17).

Two species from Argentina, *Baltagnostus hospitus* Poulsen and *B. mendozensis* Poulsen, are more difficult to evaluate. The pygidium of *B. mendozensis* appears to lack the crescentiform posterior border that is characteristic of *Baltagnostus*, and its taxonomic assignment is further hampered by lack of knowledge of the cephalon. According to Poulsen (1960, p. 7-8), *B. hospitus* has confluent genae. Further, the cephalon appears to have a broadly rounded rather than a constricted posterior glabella, and the pygidium lacks a prominent axial node as well as a crescentic posterior border. Therefore, neither of these species may represent *Baltagnostus*.

Öpik (1967, p. 113) concluded that *Baltagnostus beltensis* Lochman (in Lochman & Duncan, 1944) probably belongs to *Ammagnostus*, but could possibly represent *Kormagnostus*. I agree that the species should not be assigned to *Baltagnostus*, but have not further analyzed its appropriate generic assignment.

Baltagnostus sp. has been listed from the Upper Cambrian of the northwestern Siberian platform by Lazarenko and Datsenko (1967, p. 19, table 1). The entry in that list is probably based on the pygidium described and figured as *Baltagnostus* (?) sp. by Lazarenko and Nikiforov (1968, p. 24, pl. 4, fig. 21), but that specimen appears to represent *Ammagnostus* or a related genus rather than *Baltagnostus*, and thus an unequivocal occurrence of *Baltagnostus* in the Upper Cambrian remains to be documented.

In previous description and discussion, Robison (1964, p. 525-527) indicated that the glabellar node of *Baltagnostus* had the form of a low, short, median ridge on the posterior end of the glabella. Specimens of *B. australis* and *B. damesi* exhibit such a posterior ridge as well as a typical, though weak, median node near the midpoint of the posterior glabellar lobe (Pl. 1, figs. 1, 2, 5). Thus, the true glabellar node appears to be effaced on species such as *B. eurypyx*, and the posteromedial ridge appears to be a separate feature that characterizes at least *B. australis, B. damesi*, and *B. eurypyx*. Because of either poor preservation or inadequate illustration of some specimens, it is not possible at this time to determine whether or not a posteromedial glabellar ridge is a characteristic feature of all species of *Baltagnostus*.

As here redefined, *Baltagnostus* has an observed stratigraphic range through most of the late Middle Cambrian (*Ptychagnostus atavus* to *Lejopyge calva* assemblage-zones). Its occurrence in the early Middle Cambrian is questionable (see discussion of *B. damesi*). Representatives have been described from Australia (Queensland), Canada (Quebec), China (Manchuria, Shantung), North Korea, South Korea, and the United States (Alabama, Nevada, Tennessee, Texas, and Utah). Reported occurrences in Argentina (Poulsen, 1960) and Siberia (Lazarenko & Nikiforov, 1968) are probably in error.

BALTAGNOSTUS AUSTRALIS Robison, n. sp.

Plate 1, figures 3, 5-7, 9-11

Euagnostus opimus Whitehouse (part), 1936, p. 87, pl. 8, fig. 12 (*not* figs. 10, 11).

Holotype.—Cephalon, UQF69629 (Pl. 1, fig. 5).

Other material.—Twenty-eight cephala and 27 pygidia.

Description.—Cephalon subrectangular; length and width of largest specimen 3.1 by 3.5 mm. Glabella distinctly narrower than adjacent genae (measured at position of transglabellar furrow); anterior lobe about one-third of glabellar length; posterior lobe with weak median node at or slightly behind midpoint and a small median ridge just above cephalic recess. Genae wide. Lateral sides of acrolobes almost parallel or slightly tapered toward anterior.

Thorax unknown.

Pygidium subrectangular; length and width of largest specimen 2.7 by 3.1 mm. Axis relatively short and well separated from posterior border furrow; posterior part (behind second segment) tapering to slightly acute point. Postaxial median furrow usually deep and moderately wide. Acrolobes unconstricted to barely constricted. Border furrow moderately wide and posterior part may have anteromedial bend.

Discussion.—*B. australis* is characterized by its narrow glabella, relatively short pygidial axis, and well-developed postaxial median furrow. It most closely resembles *B. damesi* (Resser & Endo), but differs from that species by having a narrow glabella, a median node situated at or slightly behind the midpoint of the posterior glabellar lobe, a shorter pygidial axis, and narrower postaxial median furrow.

BALTAGNOSTUS DAMESI (Resser & Endo)

Plate 1, figures 1, 2, 4, 8

Agnostus damesi Resser & Endo in Endo & Resser, 1937, p. 157-158, pl. 30, figs. 1-5; Kobayashi, 1939, p. 579.

Euagnostus damesi (Resser & Endo) Whitehouse, 1939, p. 261; Lu and others, 1965, p. 51-52.

Agnostus liaotungensis Resser & Endo in Endo & Resser, 1937, p. 160, pl. 30, figs. 8-11.

Euagnostus liaotungensis (Resser & Endo) Whitehouse, 1939, p. 261.

Peronopsis liaotungensis (Resser & Endo) Ivshin, 1953, p. 11.

Agnostus viator Resser & Endo in Endo & Resser, 1937, p. 158-159, pl. 30, fig. 6.

Euagnostus viator (Resser & Endo) Whitehouse, 1939, p. 261.

Peronopsis viator (Resser & Endo) Ivshin, 1953, p. 12.

Lectotype.—Pygidium, USNM 57829a (Pl. 1, fig. 4), designated here.

Description.—Cephalon subrectangular, length and width of largest observed specimen 3.5 by 3.9 mm. Glabella approximately equal in width to adjacent genae (measured at position of transglabellar furrow); anterior lobe about one-third glabellar length; posterior lobe with weak median node slightly anterior from midpoint, and tiny median ridge just above cephalic recess. Genae of intermediate width. Lateral sides of acrolobes slightly tapered toward anterior.

Thorax unknown.

Pygidium subrectangular, length and width of lectotype 2.9 by 3.6 mm. Axis variable in length, reaching posterior border furrow in young holaspides, but usually separated from border furrow in older holaspides. Posterior axis tapering to slightly acute point. In specimens with shorter axis, postaxial median furrow is wide and deep. Acrolobes slightly constricted. Border furrow wide.

Discussion.—*B. damesi* is characterized by a glabella of intermediate width, a glabellar node that is situated slightly anterior from the midpoint of the posterior lobe, indentation of the posterior glabellar lobe by the basal lobes, and a pygidial axis of intermediate and ontogenetically variable length. It closely resembles and may be a junior synonym of *B. rakuroensis,* which Kobayashi (1935, p. 103-104) originally assigned to *Agnostus* and later (1939, p. 189; 1962, p. 28-29) reassigned to *Peronopsis.* The partial preglabellar median furrow, wide pygidial axis, crescentiform posterior pygidial border and posterolateral border spines of *rakuroensis* are characteristic features of *Baltagnostus* and the species is here assigned to that genus. Kobayashi (1962, p. 29) noted the similarity of *damesi* and *rakuroensis,* but distinguished them on the basis of the complete preglabellar median furrow that was erroneously added to illustrations of *damesi* by Endo and Resser (1937). All illustrated specimens of *B. rakuroensis* are relatively small (young holaspides?) and rather poorly preserved. The cephalon of at least one specimen of *B. rakuroensis* (Kobayashi, 1962, pl. 3, fig. 1) has a glabella that is considerably wider than is usual for *B. damesi* and the pygidial axis appears to be relatively broader and less tapered. Therefore, without access to comparative material of *B. rakuroensis,* especially mature holaspides, I tentatively retain *B. damesi* as a separate species.

B. damesi also closely resembles *B. australis* n. sp., and the discussion of that species contains a comparison of the two taxa. *B. damesi* can be most easily distinguished from North American species of *Baltagnostus* by its shorter pygidial axis, which is less tumid at the posterior end.

Three species, *Agnostus damesi, A. viator,* and *A. liaotungensis,* were described by Endo and Resser (1937) from the same locality of the Mapan Formation in Manchuria. Examination of the type specimens showed that cephalic illustrations of *A. damesi* (Endo & Resser, 1937, pl. 30, figs. 1, 2) have been erroneously retouched to show a complete preglabellar median furrow. The same specimens are refigured here for comparison (Pl. 1, figs. 1, 2), and they show only a partial preglabellar median furrow as well as other cephalic features that are characteristic of *Baltagnostus. A. viator* is based on a single small holaspid pygidium and *A. liaotungensis* is based on a few relatively small specimens that together appear to represent no more than early holaspides of *A. damesi.* Therefore, I consider the three species to be synonyms, and *A. damesi,* the senior synonym, is transferred to *Baltagnostus.* The length of the pygidial axis is somewhat variable, extending almost to the posterior border furrow in young holaspides, and becomes shorter with concomitant appearance of a postaxial median furrow in older holaspides.

A redescription of *B. damesi* is presented in this paper because of the erroneous concept of the species given by the retouched photographs accompanying the original description, and because the taxon is so similar to *B. australis.* Whitehouse (1939, p. 261) also remarked on the similarity of these forms and suggested that the concept of *Euagnostus* "should be restricted to such types." What he did not recognize, however, is that the holotype pygidium of the type species of *Euagnostus* is a representative of *Peronopsis,* and application of the concept of *Euagnostus* to forms such as *B. damesi* is inappropriate.

Occurrence.—B. damesi has been reported from the Mapan Formation on Tschang-hsing-tao (island southwest of Fu-chou, Pechili district), Liao-tung, Manchuria. The Mapan Formation was regarded by Endo (in Endo & Resser, 1937, p. 37-38) to be the basal Middle Cambrian stratigraphic unit in southern Manchuria, and he correlated its fauna with those of the lower Middle Cambrian "North America Ptarmigan and Langston formations in the Rocky Mountains." Endo (p. 38) further noted "that some mixture of Mapan and Taitzu fossils exists in our collections, particularly those made years ago, so that the placing of certain species is no doubt in error."

Elsewhere in the world, *Baltagnostus* is not certainly known from rocks older than the middle Middle Cambrian (*Ptychagnostus atavus* Assemblage-zone). On the basis of evolutionary aspect, I suggest that *B. damesi* is probably of late rather than early Middle Cambrian age. Moreover, it seems to be one of the undesignated species referred to by Endo for which former stratigraphic placement "is no doubt in error."

Genus DORYAGNOSTUS Kobayashi, 1939

The generic concept of *Doryagnostus* is revised and discussed in an accompanying paper (Robison, 1978).

DORYAGNOSTUS DELTOIDES Robison, n. sp.

Plate 2, figures 7-9, 12

Euagnostus opimus Whitehouse (part), 1936, p. 87, pl. 8, fig. 10 (*not* figs. 11, 12); Hill, Playford, & Woods, 1971, p. 18, pl. 9, fig. 4.

Holotype.—Cephalon UQF69624 (Pl. 2, fig. 9).

Other material.—One cephalon (UQF3194) and two pygidia (UQF69625, 69626).

Description.—Cephalon subcircular; length and width of paratype 4.5 by 4.6 mm, holotype 4.7 by 5.0 mm. Glabella of intermediate width, approximately equal to that of adjacent genae at level of transglabellar furrow; anterior part ogiviform with slight anteromedial point; position of median node on posterior lobe undetermined. Genae smooth. Border furrow of intermediate width, with well-developed deltoid area.

Thorax unknown.

Pygidium subcircular; length and width of two known specimens 3.4 by 4.0 and 4.7 by 5.4 mm. Transaxial furrows effaced or only faintly developed near junction with axial furrow. Central depression of posterior part weak or absent. Posteromedial border furrow has slight forward bow and posteromedial border slightly widened. Posterolateral border spines broken on both specimens; stubs of intermediate size.

Discussion.—D. deltoides is characterized by its large, well-developed deltoid area (for definition, see Robison, 1978) that extends almost to the glabella, and which is the basis for the species name. It is further characterized by a glabella of intermediate width, a weak or absent median depression on the posterior part of the pygidial axis, and a slight forward bow in the posteromedial border furrow.

Other recognized species of *Doryagnostus* are *D. incertus* (Brögger) and *D. wasatchensis* Robison, which are described and further discussed in an accompanying paper (Robison, 1978). *D. deltoides* differs from both of those species by its larger deltoid area. Its glabella is narrower and anteromedially more pointed than that of *D. wasatchensis* and broader than that of *D. incertus*. In addition, its posterior pygidial axis is less centrally depressed and slightly less acuminate than that of *D. incertus*.

For a comparison with other agnostoids in collection UQL256, refer to the discussion of *Peronopsis opimus*.

Genus HYPAGNOSTUS Jaekel, 1909

HYPAGNOSTUS cf. H. CLIPEUS Whitehouse

Plate 2, figure 11

Euagnostus sp. WHITEHOUSE, 1939, p. 260-261.

Discussion.—In his documentation of trilobites from northwestern Australia, Whitehouse (1939, p. 260-261) referred one pygidium to *Euagnostus* sp., but did not figure it. That specimen is here illustrated for the first time. It is characterized by an unfurrowed axis that is nearly parallel sided in the anterior two-thirds of its length and tapers in the posterior one-third to a slightly acute point. The axial tubercle is weak; the postaxial furrow is short and wide, and merges with a posteromedially widened border furrow; and the border widens appreciably from anterior to posterior, and is nonspinose. All of these characters are typical of some species of *Hypagnostus*.

The pygidium and a large complete specimen of *Doryagnostus incertus* (Robison, 1978, pl. 2, fig. 8) are preserved together on a piece of limestone, and are from the same locality as the holotype of *Hypagnostus clipeus* Whitehouse. By comparison, figured pygidia of *H. clipeus* (Whitehouse, 1939, pl. 25, figs. 25, 26; Hill, Playford & Woods, 1971, pl. 9, fig. 5) are somewhat crushed and appear to have a narrower posterior border. Therefore, taxonomic assignment of this pygidium is questionable, but it appears likely to be a variant individual of *H. clipeus*.

Occurrence.—One pygidium, UQF69639, from the V Creek Limestone at the road crossing of V Creek between "Undilla" and Thorntonia, Queensland. Its age is late Middle Cambrian (*Ptychagnostus nathorsti* Zone).

HYPAGNOSTUS? sp.

Plate 2, figure 10

A single poorly preserved quadrate cephalon with effaced frontal glabellar lobe is present in collection UQL256. Because of the tendency toward effacement of the frontal glabellar lobe in *Peronopsis opimus*, assignment to that species cannot be entirely ruled out. However, the quadrate cephalic outline is different from the more subcircular outline of *P. opimus*. Also, in regard to the posterior glabellar lobe, the lateral sides are more tapered, the anterolateral corners are more rounded, and the anterior furrow is more deeply incised than in *P. opimus*. On the other hand, the characters correspond closely to those of most species of *Hypagnostus*. Therefore, until more material becomes available for comparison, the specimen is questionably assigned to *Hypagnostus*.

The specimen differs from *H. parvifrons*, of similar age, by its quadrate outline, and its glabella is more than half the cephalic length.

Genus PERONOPSIS Corda

Peronopsis CORDA in HAWLE & CORDA, 1847, p. 115; ROBISON, 1964, p. 529-530 (for additional and nearly complete synonymy to 1964); ÖPIK, 1967, p. 75; PALMER, 1968, p. 31; PEK & VANEK, 1971, p. 269-270; PALMER & GATEHOUSE, 1972, p. 9; JAGO, 1976, p. 136.

Euagnostus WHITEHOUSE, 1936, p. 87; HOWELL, 1959, p. 184; LU and others, 1965, p. 51; ÖPIK, 1967, p. 78. NEW SYNONYMY.

Type species.—*Battus integer* BEYRICH, 1845, p. 44, by monotypy.

Diagnosis.—*Peronopsis* is characterized by a bipartite glabella with simple basal lobes and absence of a preglabellar median furrow. The axial furrow is generally well defined, but rarely may be shallow around the anterior glabella; genae and pleural fields are usually smooth; and transverse furrows of the pygidial axis are commonly effaced or only poorly developed. Characters such as shape and segmentation of the pygidial axis, position of the glabellar node, width of border furrows and borders, and presence or absence of pygidial border spines or swellings vary within the genus, but tend to be fairly stable within given populations. Therefore, those kinds of features are considered to be of value for differentiation of species. Other characters, such as outlines of the cephalon and pygidium, relative size of the axial lobe, and presence or absence of a postaxial median furrow, may vary during ontogeny. Thus, usually less taxonomic importance is attached to those kinds of features.

Discussion.—A detailed analysis and discussion of *Peronopsis* is in preparation for separate publication by Robison. For purposes of this paper, only the new synonomy of *Euagnostus* is considered.

Whitehouse (1936, p. 87) described *Euagnostus* as a new genus and designated *E. opimus* as its type species. He also figured and assigned three specimens (one cephalon and two pygidia) to that species. In a later brief discussion, Öpik (1967, p. 78) noted that "the holotype of *E. opimus* is an imperfect pygidium which recalls a *Hypagnostus*; the associated cephalon, however, may belong to a species related to *Ptychagnostus convexus* Westergaard or *P. stenorhachis* Grönwall." In concluding the same discussion, he also noted that "it is still not impossible that the holotype pygidium and the cephalon are conspecific." Subsequently, and without further taxonomic remark, Öpik (1970, p. 4) proposed substitution of *Euagnostus opimus* for *Hypagnostus parvifrons* as a zonal name in Australia because *H. parvifrons* was unknown in that country. The name, *Euagnostus opimus* Zone, has been cited in a number of succeeding Australian publications. In 1971, Hill, Playford, and Woods (p. 18, pl. 9, fig. 4) refigured the paratype cephalon of *E. opimus* and gave an abbreviated description of that specimen.

During 1972, Robison discovered *Euagnostus*-like trilobites in the middle Middle Cambrian of northern Utah. On the basis of available descriptions and illustrations, those specimens were tentatively identified as *Euagnostus opimus* and have been mentioned as such in one faunal list (Robison, 1976, p. 105). An opportunity to examine Whitehouse's collection UQL256 during the summer of 1976 led to the conclusion that the three specimens illustrated and assigned to *E. opimus* by Whitehouse (1936) actually represent three species each belonging to a different genus. Moreover, it is further concluded that the specimens from Utah represent a new species, which is described as *Doryagnostus wasatchensis* in an accompanying paper (Robison, 1978).

All of the agnostoids from Whitehouse's collection UQL256 are redescribed in this paper, and the holotype of *E. opimus* is now assigned to *Peronopsis,* whereas the two figured paratypes are reassigned to *Baltagnostus australis,* n. sp., and *Doryagnostus deltoides,* n. sp. Because of the change in generic assignment of the holotype of its type species, *Euagnostus* is suppressed as a subjective junior synonym of *Peronopsis*. Additional documentation and support for these actions are contained in the separate discussions of each of the species mentioned.

PERONOPSIS OPIMUS (Whitehouse)

Plate 1, figures 1-6

Euagnostus opimus WHITEHOUSE (part), 1936, p. 87, pl. 8, fig. 11 (*not* figs. 10, 12).

Holotype.—Pygidium, UQF3195 (Whitehouse, 1936, pl. 8, fig. 11; refigured here Pl. 1, fig. 4).

Other material.—Ten cephala and three pygidia in collection UQL256.

Description.—Cephalon subcircular, width about 10 percent greater than length; maximum observed length 4.8 mm. Axial furrow moderately developed posteriorly, weak or nearly effaced around anterior glabellar lobe. Glabella slightly tapered; anterior lobe low, and may have obtuse anteromedian point; posterior lobe tumid, with faint axial node situated well forward from midpoint. Border furrow narrow. Border narrow to moderately wide.

Thorax unknown.

Pygidium subcircular to subrectangular, width about 15 to 20 percent greater than length; maximum observed length (holotype) 3.9 mm. Axis tapering unevenly to acute point, extending almost to posterior border furrow; transaxial furrows effaced; median tubercle slightly elongate (sag.), of moderate size. Postaxial median furrow short and wide; almost eliminated by near merger of axial and border furrows. Border furrow narrow to moderately wide. Border narrow anteriorly, widening appreciably toward posterior; with obvious posterolateral swellings, but with true spines.

Discussion.—*P. opimus* is characterized by the weak or nearly effaced axial furrow around the anterior glabellar lobe, anterior position of its glabellar node, tapered and elongate pygidial axis with effaced transaxial furrows, and a pair of posterolateral swellings on the pygidial border. Of the many species of *Peronopsis, P. opimus* most closely resembles *P. interstricta* (cf. Robison, 1964, pl. 82, figs. 1-15, 18). These species can be distinguished fairly easily, however, by the more effaced anterior axial furrow, more anteriorly situated glabellar node, and more elongate pygidial axis and shorter postaxial median furrow of *P. opimus*. Also, the glabella of *P. opimus* tends to have a slight anteromedian point, whereas such a feature is usually not present on *P. interstricta*.

P. opimus also closely resembles some specimens of *P. scutalis* that were illustrated by Westergård (1946, pl. 4, figs. 4-11), but differs from that species by its more effaced anterior axial furrow, more anteriorly situated glabellar node, broader pygidium, and prominent pygidial border swellings, which are only faint or absent on *P. scutalis*. On the basis of a bimodal difference in axial length on the pygidium, it appears likely that two species may actually be included within the *P. scutalis* of Westergård.

P. brighamensis is one of the few other species of *Peronopsis* characterized by a pair of swellings on the posterolateral pygidial border; however, *P. brighamensis* differs from *P. opimus* by its narrower glabella, less conical pygidial axis, moderately- to well-defined transaxial furrows, and larger median tubercle on the pygidium.

Whitehouse (1936) failed to recognize differences between forms in collection UQL256 that are here assigned to *Peronopsis opimus* (cf. Pl. 2, fig. 4a-c), *Doryagnostus deltoides* (cf. Pl. 2, fig. 7a, b), and *Baltagnostus australis* (cf. Pl. 1, fig. 9a, b); however, these species differ in many characters. Cephala can be most readily distinguished by the lack of a preglabellar median furrow in *P. opimus*, the presence of an incomplete preglabellar median furrow that is best developed posteriorly in *B. australis*, and the presence of a complete preglabellar median furrow and distinctive deltoid area in *D. deltoides*. Also, the glabella is relatively broader in *P. opimus* and *D. deltoides* than in *B. australis*, and the anterior axial furrow is less well defined in *P. opimus* than in *D. deltoides* and *B. australis*. On the pygidial border, *D. deltoides* and *B. australis* each have a pair of posterolateral spines, whereas *P. opimus* has only a corresponding pair of swellings. The pygidial axis of *B. australis* is more tumid immediately behind the second segment than are the other two species, and *D. deltoides* has an appreciably longer postaxial median furrow than does *P. opimus* or *B. australis*.

Near effacement of the anterior axial furrow of *P. opimus* results in a form that is transitional between *Peronopsis* and *Hypagnostus*. Nevertheless, because its stratigraphic occurrence is considerably higher than the lowest known occurrence of species of *Hypagnostus, P. opimus* can be excluded as a possible ancestor of *Hypagnostus*. The form does, however, provide an indication of possible homeomorphy among species that have been assigned to *Hypagnostus*.

Eodiscoid Trilobite

[by P. A. Jell]

Family EODISCIDAE Raymond, 1913

Genus OPSIDISCUS Westergård, 1949

OPSIDISCUS MICROSPINUS Jell

Plate 4, figures 8a, b

Opsidiscus microspinus Jell, 1975, p. 80, pl. 24, figs. 1, 2, 4; pl. 26, figs. 3, 4, 7, 8.

Material.—One cephalon in collection UQL256.

Remarks.—The almost unsegmented and anteriorly pointed glabella, weak border scrobicules, well-impressed border furrow, and steep prominent facets are indicative of *O. microspinus*. Spaces for the eyes are clearly exhibited high on the cheeks, and facial sutures are absent. Damage to the occipital spine and lack of a pygidium prevent conclusive taxonomic assignment; however, available features leave little doubt about the identity of this cephalon.

Polymeroid Trilobites

[by P. A. Jell]

Family ANOMOCARIDAE Poulsen, 1927

Öpik (1967, p. 212) removed the genera *Westergaardella* Kobayashi, 1962, *Chondranomocare* Poletaeva in Chernysheva and others, 1956, *Pseudanomocarina* Chernysheva in Chernysheva and others, 1956, and *Schoriella* Sivov in Khalfin, 1955, from the Anomocaridae. These, along with *Auritama* Öpik, 1967, were placed in a new family, Auritamidae, which Öpik diagnosed as "Anomocaracea with a long parallel-sided glabella and a relatively small pygidium." None of these genera are known from articulated specimens, and therefore relative pygidial size is a poor diagnostic character. Of the two Middle Cambrian genera, *Pseudanomocarina* is here considered to be a synonym of *Chondranomocare,* and all species of *Pseudanomocarina* except the type, *P. plana,* are assigned to a new genus *Sudanomocarina,* which along with *Chondranomocare,* contains several species in which the glabella is not long (i.e., does not reach the border furrow) and it tapers anteriorly. Pygidial characters of these two genera are also quite distinct from those of *Auritama,* particularly in the lack of spines. The genus *Schoriella* is based on the early Late Cambrian species *S. schorica* Sivov (in Khalfin, 1955) from southern Siberia, which superficially resembles some species of *Chondranomocare,* but the possibility of homeomorphy makes the relationship of these species uncertain. Most other species previously referred to *Schoriella* are more correctly placed in the genus *Schoriecare* Rozova, 1964. Close relationship may exist between the other two Late Cambrian genera, *Auritama* and *Westergaardella,* but *Schoriella* is certainly distinct from these with respect to its anteriorly tapered glabella and palpebral lobes close to the glabella. Therefore, I cannot accept the grouping of these five genera into a separate family. Moreover, if the Auritamidae is to be accepted, a better diagnosis must be provided. I retain *Chondanomocare (= Pseudanomocarina),* the new genus *Sudanomocarina,* and tentatively *Schoriella,* in the Anomocaridae even though its taxonomy is poorly understood and a worldwide review is long overdue.

Genus CHONDRANOMOCARE Poletaeva

Chondranomocare POLETAEVA in CHERNYSHEVA and others, 1956, p. 169; EGOROVA in KHALFIN, 1960, p. 214; CHERNYSHEVA, 1961, p. 196; PALMER & GATEHOUSE, 1972, p. 21.

Pseudanomocarina CHERNYSHEVA in CHERNYSHEVA and others, 1956, p. 166; CHERNYSHEVA, 1961, p. 187. NEW SYNONYMY.

Type species.—Chondranomocare bidjensis POLETAEVA in Chernysheva and others, 1956, p. 170, by original designation.

Diagnosis (translated from Poletaeva in Chernysheva and others, 1956, p. 169, by P.A.J.).—Trilobites of less than average size. Cephalon not much larger than pygidium. Glabella tapers slightly forward, rounded-angular or rounded anteriorly, weakly inflated, having a weak median longitudinal keel. Glabellar furrows usually absent. In some species one or two pairs of very indistinct, broad, shallow furrows are outlined on the glabella.

Fixed cheeks narrow. Palpebral lobe [eyelid] quite large, with an angular break toward the rear of its length. Eye surface not present. Frontal limb quite wide, with a moderately prominent, low terrace extending parallel to the anterior margin of the cranidium and situated at different distances from the glabella in different species. Anterior border furrow distinct or vague. Border narrow, flat, slightly upturned. Facial suture in front of eye diverging in bow-shaped curve as it extends to the anterior margin.

Pygidium slightly drawn out in width, having weakly concave posterior margin. Axis high, rounded posteriorly, having longitudinal keel on the posterior margin. On the axis and on the flat pleural areas, well-impressed furrows produce undulating rounded curves on the segmental cross section.

Discussion.—Chondranomocare was not compared with other genera at the time of its erection by Poletaeva (in Chernysheva and others, 1956), and only Chernysheva (1961, p. 197) and Palmer and Gatehouse (1972, p. 21) have discussed it subsequently. Chernysheva recognized similarities between *Chondranomocare* and *Pseudanomocarina* in glabellar outline and segmentation, in dimensions and form of the fixigenae, and in dimensions and position of the palpebral lobes. The only distinctive difference that she noted is the structure of the preglabellar part of the cranidium.

One important feature—glabellar shape—was mentioned in the original diagnosis of *Pseudanomocarina* as being rectangular or just slightly tapered forward, and this has been incorporated into the generic concept (not based on the type species) by subsequent Russian authors. In combination, the rectangular glabella and very short or absent preglabellar field distinguish a group of Russian species and one new Australian species that I refer to the new genus *Sudanomocarina.* The holotype of the type species of *Pseudanomocarina, P. plana,* lacks this combination of characters. Furthermore, because of its rounded glabellar anterior, tropidium behind a very shallow border furrow, and similar frontal area, *P. plana* is here considered to belong to *Chondranomocare* and to be fairly closely related to *C. bidjensis*. Comparison of the holotype of *P. plana* (Chernysheva, 1961, pl. 22, figs. 1a, b) with the remaining cranidia assigned to the species (Chernysheva, 1961, pl. 22, figs. 2-8) clearly illustrates these significant differences.

Palmer and Gatehouse (1972, p. 21) stated that "the concave rather than flat or convex border distinguishes *Chondranomocare* from *Pseudanomocarina*," but the original diagnoses stated that *Chondranomocare* has a flat border whereas *Pseudanomocarina* has a convex or concave one. I do not consider the shape of the border's lateral profile to be a diagnostic feature of either genus.

If visible, lateral glabellar furrows consist of three pairs in species of *Chondranomocare:* 1P divide adaxially and are directed strongly posteriorly; 2P and 3P are narrower and more transverse. The terrace (or tropidium) on the preglabellar field (frontal limb of Poletaeva's diagnosis) is a variable feature. It is present on most figured specimens, but some do not appear to exhibit the feature (e.g., Chernysheva, 1961, pl. 25, fig. 8; Egorova in Egorova & Savitsky, 1969, pl. 38, figs. 17, 18; pl. 40, fig. 2; Palmer & Gatehouse, 1972, pl. 3, figs. 18, 19).

On the originally figured pygidium of *Chondranomocare bidjensis* (Chernysheva and others, 1956, pl. 31, fig. 4) the axis is extremely short, but on other figured pygidia (*C. eminens* Chernysheva, 1961, pl. 25, fig. 10; *C. exilis* Egorova in Egorova & Savitsky, 1969, pl. 40, fig. 7; *C. speciosum* M. Romanenko (figured by Egorova, 1969, pl. 39, fig. 20); *C. bucculentum* Lazarenko, 1965, pl. 1, fig. 18; *C. australis* Palmer & Gatehouse, 1972, pl. 3, fig. 24) it is proportionally longer. Another consistent feature of the pygidium is the pair of angularities in the margin adjacent to the abaxial ends of the anterior pleural furrows.

Distinguishing *Chondranomocare* from other genera in the family is easy at present, but I expect that a full review of the family will show considerable intrageneric variation, making generic definition more difficult. Two genera are mentioned in this regard. *Anomocare* Angelin, 1854, based on *A. laeve* (Angelin, 1851) from the late Middle Cambrian Andrarum Limestone of Sweden, has several distinguishing features: its palpebral lobes terminate some distance from the axial furrow, both anteriorly and posteriorly, and are more evenly rounded; the frontal area lacks a terrace; the long genal spine is equal in length to the remainder of the librigena; the pygidial margin is well rounded; and the transverse pleural and interpleural furrows do not abaxially swing strongly toward the posterior. *Sudanomocarina* is more difficult to distinguish from *Chondranomocare,* and the pygidia are indistinguishable. Cranidia of *Sudanomocarina* have no terrace on the preglabellar field. Indeed, there is virtually no preglabellar field, as the glabella reaches almost to the border furrow and is more quadrate and proportionally wider.

Two other genera that deserve mention are *Schoriella* and *Schoriecare*. As already mentioned, the Late Cambrian *Schoriella schorica* is a possible homeomorph of the Middle Cambrian *Chondranomocare confertum,* and it can be distinguished only by its better impressed border furrow and more strongly tapered anterior glabella, which also appears to taper posteriorly. *S. schorica* is known from a single figured cranidium, however, and is too poorly known to warrant more comment. Like *C. confertum,* and apparently *Schoriella, Schoriecare* has an extreme posterior extension of the palpebral lobe, being distinguished by its much longer and more expanded frontal area and its pygidial characters.

Occurrence.—*Chondranomocare* is known from the late Amga Stage of Siberia and from equivalent strata of the *Hypagnostus parvifrons* Zone in northwestern Queensland. Age of *C. australis* in Antarctica is uncertain, but is said to be early late Middle Cambrian, and may be contemporaneous with *C. confertum* from Australia.

CHONDRANOMOCARE CONFERTUM (Whitehouse)

Figure 2; Plate 3, figures 1-19

Anomocare confertum WHITEHOUSE, 1939, p. 223, pl. 23, figs. 22-28.

Holotype.—Cranidium UQF3354 (Whitehouse, 1939, pl. 23, fig. 22; refigured here, pl. 3, fig. 11a-c).

Other material.—In the type collection are an additional 12 cranidia, 4 librigenae, and 8 pygidia, including the figured specimens. I have collected the species from contemporaneous strata at several other localities in the Undilla basin near Thorntonia homestead, and it is present in several undescribed collections from the same area made by F. W. Whitehouse and deposited at the University of Queensland.

Diagnosis.—Cranidium as long as wide, transverse profile weakly convex, but lateral profile strongly downturned in anterior part; ornament finely granulose. Glabella 0.8 cranidial length, tapering slightly forward, sides straight, anterolateral corners somewhat angular, anterior margin nearly straight to slightly convex; three pairs of lateral furrows poorly developed, midline with a weak but distinct longitudinal keel. Preglabellar field short, 0.1 cephalic length, with single transverse terrace (not visible on all specimens) near border furrow. Anterior border flat to slightly convex, upturned. Palpebral area of fixigena narrow, flat to slightly convex, widest adjacent to furrow 1P and tapered to anterior point; palpebral lobe wide (half width of fixigena at midpoint), long (0.6 cephalic length), joined to anterior glabellar lobe, straight anteriorly then strongly curved to termination opposite midlength of occipital ring; posterior area of fixigenae wide, short, well beneath posterior of palpebral lobe, angled slightly down. Anterior facial sutures diverging strongly from points near glabella. Librigena relatively flat with shallow border furrow, strong genal spine, and steep to vertical posteroproximal extremity.

Pygidium moderately convex. Axis 0.75 pygidial length, with four poorly defined ring furrows. Pleural furrows transverse adaxially but exsagittal abaxially (i.e., with sharp bend near midlength). Margin weakly angulate adjacent to termination of anterior pleural furrows, slightly indented behind axis. Pleural furrows extend almost to margin. Shallow furrow just adaxial from inner doublural margin.

Description.—Lateral glabellar furrows very poorly impressed, defined by lack of ornamentation; 1P directed back at 45° from sagittal line, long, with marked curve just inside axial furrow; 3P transverse, with marked elongate transverse anteromedian muscle scar and slight anterior constriction adjacent to palpebral lobe. Occipital furrow mostly well impressed with gently sloping walls, but extremely steep near axial furrow; lateral muscle scars prominent. Occipital ring flat (sag.), of constant length, with tubercle at midlength; posterior margin almost straight except for slight anterior curve near axial furrow. Axial furrow for most of its length barely more than a change in slope from glabella to genae, poorly impressed posteriorly. Low parafrontal band across front of glabella with extremely faint bounding furrows.

Anterior fixigenae strongly expanded into triangular areas abaxially (Pl. 3, fig. 11), sometimes of almost uniform length (Pl. 3, fig. 13). Border furrow very shallow; in some specimens posteromedially expanded with slight pits immediately lateral from expansion, pits possibly relating to slight anterior convexities in terrace on preglabellar field. Border of near constant width except laterally where cut by oblique facial suture.

Palpebral furrow poorly impressed throughout, weakest near midlength, roughly paralleling outer margin of palpebral lobe, curving posteriorly into border furrow. Palpebral lobe very slightly convex (tr.), slightly wider posteriorly; in a few specimens with faint indication of a furrow bisecting it lengthwise.

Librigena with very low but distinct eye socle. Subocular area with faint genal caeca, narrowest anteriorly, expanding to posterior border furrow. Border 0.35 of total width anteriorly, weakly convex (tr.), greatly expanded at base of genal spine, then tapering strongly toward axis on short posterior part. Facial suture runs obliquely across the border furrow and posterior border to posterior margin. Extremely faint epiborder furrow apparent on posterior edge just adaxial from genal spine. Genal spine flat to slightly convex, with broad base, tapering strongly on proximal third, continuing even curve of cephalic margin. Border furrow slightly wider, deeper, more U-shaped in section toward posterior.

Hypostoma convex with stout anterior wings; border anteriorly short, strongly upturned, tapering strongly toward posterior; lateral border furrow broad and shallow anteriorly, narrowing posteriorly. Ornamentation on main body consisting of large low tubercles.

Thoracic segments short with strongly curved and pointed pleural tips. Axial ring convex with short (0.2 length) articulating half ring, moderately impressed articulating furrow, and long flat articulating lobe that is slightly longer abaxially. Pleural furrow moderately impressed, with slight pit just beyond fulcrum, anterior wall steep and posterior wall gentle; extending from anterior of segment at axial furrow to midlength at fulcrum, terminating well down pleural spine near posterior margin.

Pygidium with poorly defined axial furrow, steep slope from rear of axis to border, short articulating half ring, and articulating furrow no better developed than ring furrows, articulating facets not apparent on available material. Axis tapering slightly toward posterior, terminus rounded with two large rounded knobs. Low sagittal ridge extending from posterior axis almost to margin. Faint furrow just anterior from first ring furrow separates a structure equal in area and shape to articulating half ring. Pleural furrows moderately deep, extending almost to margin at anterior, very weak and not extending laterally beyond inner margin of doublure at posterior. Doublure narrow anteriorly and posteriorly, extremely wide (0.8 axial width) in between; very closely oppressed beneath dorsal exoskeleton. A faint but distinct furrow just inside inner margin of the doublure terminates at right angles to anterior pleural furrow, and a broad shallow border furrow is situated abaxially to it.

Remarks.—*Chondranomocare confertum* is a distinctive species separated from all others in the genus by the termination of its palpebral lobes opposite the occipital ring. It is perhaps most similar to *C. exilis* Egorova (in Egorova & Savitsky, 1969), but its anterior border furrow is less distinct, its anterior border is less upturned, it is narrower between facial sutures at the anterior palpebral lobes, and its pygidium is more quadrate.

Although *C. confertum* could be removed to a monotypic genus, I refrain from such action because the species is probably part of a lineage arising from *Chondranomocare,* and until this lineage is better understood, it is pointless to create a new generic name. With regard to variation within the genus, it should be kept in mind that *C. confertum* is on the periphery.

The specimen described by Egorova (in Egorova & Savitsky, 1969, p. 209, pl. 40, fig. 1) as *Stella* sp. should probably be referred to *C. exilis.* It also has librigenae almost identical with those of *C. confertum.*

Morphogeny.—By means of coordinate transformation (Fig. 2), four growth stages of *C. confertum* are used to illustrate a reduction in relative length of the glabella and its separation from the anterior margin, a migration of the facial suture closer to the glabella, a narrowing of the anterior cranidium, a transition from a rectangular to anteriorly tapering glabella, and a narrowing of the fixigenae.

Genus SUDANOMOCARINA Jell, n. gen.

Type species.—*Sudanomocarina changi* Jell, n. sp.

Other included species.—*Pseudanomocarina acutata* Bognibova in Bognibova and others, 1971; *P. aojiformis* Chernysheva in Chernysheva and others, 1956; *P. bella* Hajrullina in Repina and others, 1975; *P. eldachica* Bognibova in Bognibova and others, 1971; *P. horrida* Chernysheva, 1961; *P. parva* Chernysheva, 1961; *P. tabatica* Repina in Khalfin, 1960. Except for the holotype, all specimens referred to *P. plana* by Chernysheva (1961, pl. 22, figs. 2-10) belong to *Sudanomocarina,* but need a new species name.

Diagnosis.—Cranidium weakly convex; glabella rectangular or slightly tapered, lateral furrows absent or very weakly impressed, occipital ring flat and lengthened medially, with or without pointed median tubercle; palpebral areas of fixigenae very narrow (less than 0.33 glabellar width), weakly convex; palpebral lobe wide, arcuate, situated on posterior half of cranidium, about half length of glabella; preglabellar field short or absent; anterior border weakly convex or concave; anterior facial sutures diverging in bow-shaped curve. Librigena convex with long spine.

Thorax unknown.

Pygidium transverse with curved anterior border, sometimes with a slight indentation on posterior margin; greatest width near midlength; axis not reaching posterior border, generally with 5 or 6 poorly defined axial rings; pleural areas weakly convex toward axis, but weakly concave toward border; pleural ribs distinctly turned toward posterior near midwidth, distinctly divided by interpleural furrow; surface smooth.

Discussion.—*Sudanomocarina* is erected to replace the name *Pseudanomocarina* because the holotype of the type species of *Pseudanomocarina, P. plana,* is transferred to *Chondranomocare.* Other species that have previously been assigned to *Pseudanomocarina* are here transferred to *Sudanomocarina.*

A close relationship between *Sudanomocarina* and *Chondranomocare* is apparent and their geographic and stratigraphic association is compatible with this conclusion. Presence or absence of a tropidium has apparently been used by some Russian workers to distinguish species of *Chondranomocare* from species formerly assigned to *Pseudanomocarina*; however, variability of that feature in *Chondranomocare confertum* weakens its diagnostic value.

Occurrence.—*Sudanomocarina* ranges throughout the Amga Stage on the Siberian platform and in the Sayan Altay region where it also ranges up into the lower Maya Stage (Bognibova & Shcheglov, 1971). Its only other occurrence recorded to date is that of the type species, *S. changi*, in the *Peronopsis opimus* Zone of northwestern Queensland.

SUDANOMOCARINA CHANGI Jell, n. sp.

Plate 4, figures 9-16

Holotype.—Cranidium UQF69375 from UQL 463 (Pl. 4, fig. 14).

Other material.—Two badly damaged cranidia and 1 damaged pygidium from UQL256, and 5 cranidia from UQL463.

Diagnosis.—*Sudanomocarina* characterized by very slightly tapered glabella with rounded anterolateral corners, blunt anterior, and extremely weak lateral glabellar furrows; frontal area with uniformly short, flat to slightly convex border,

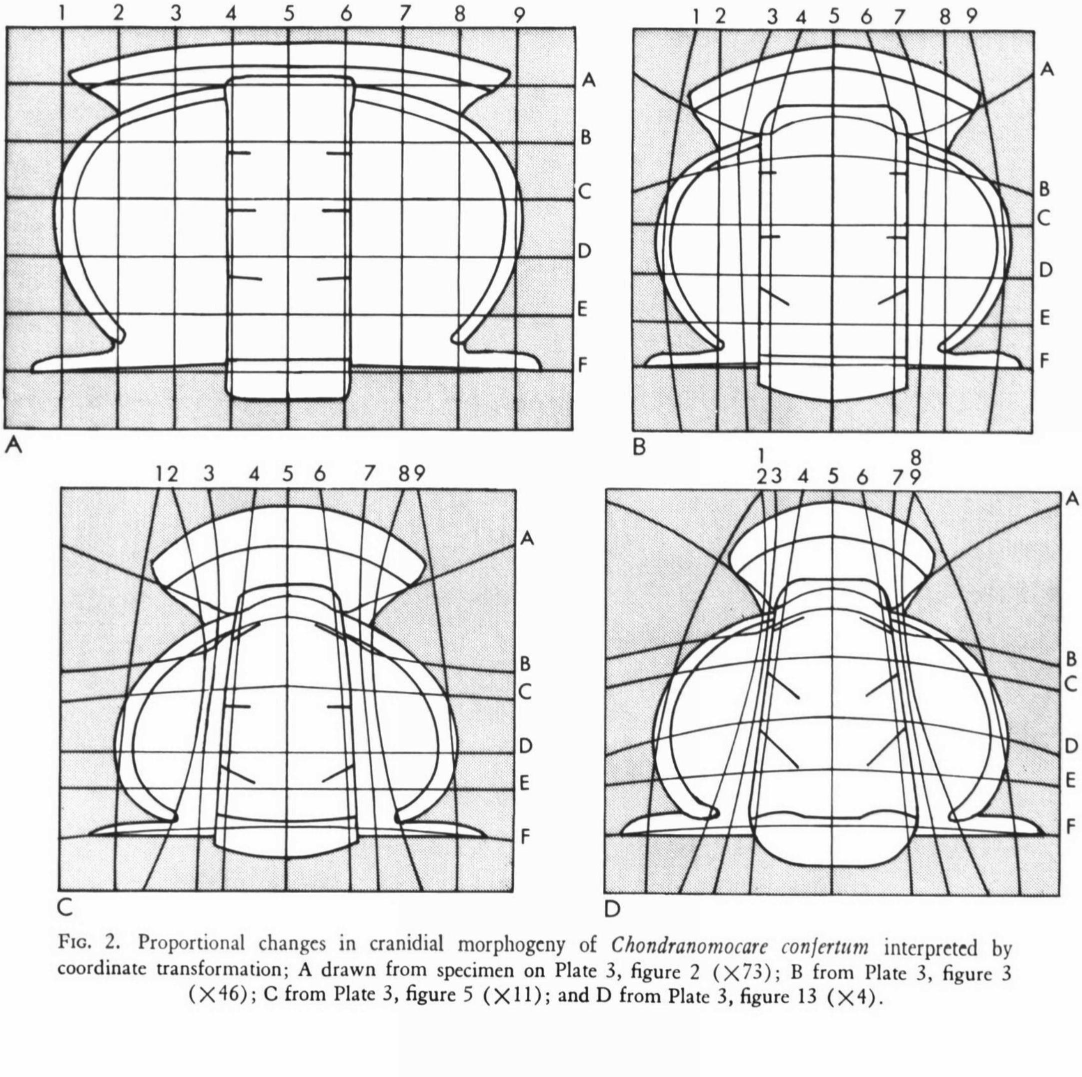

FIG. 2. Proportional changes in cranidial morphogeny of *Chondranomocare confertum* interpreted by coordinate transformation; A drawn from specimen on Plate 3, figure 2 (×73); B from Plate 3, figure 3 (×46); C from Plate 3, figure 5 (×11); and D from Plate 3, figure 13 (×4).

very short to absent preglabellar field; fixigenae narrow; palpebral lobes long and weakly convex with anterior ends close to glabella; anterior facial sutures moderately divergent. Pygidium about twice as wide as long, with rounded weakly lobate pleural margins, posteromedian marginal indentation, wide doublure.

Description.—Cranidium almost as wide as long, only slightly convex, but anterior glabella slopes moderately forward to border furrow. Glabella with straight, almost parallel sides, straight anterior margin across sagittal line, curved anterolateral corners, and three pairs of weak lateral glabellar furrows in some specimens (Pl. 4, figs. 10b, 12). Furrow 1P directed toward posterior and weakly bifurcate adaxially, 2P transverse, 3P almost imperceptible and directed anteriorly. Occipital furrow with steep anterior wall and slight apodemal pits just abaxial from midpoint between sagittal line and axial furrow. Occipital ring short, tapering laterally to half sagittal length, with small median node at midlength. Preglabellar field extremely short or absent. Anterior cranidium moderately downsloping, slope increasing anterolaterally. Border furrow poorly impressed but distinct, corresponding to marked change of slope, width constant (sag.), depth almost constant. Border weakly convex, narrowing slightly toward lateral ends, horizontal to gently arched in transverse profile. Palpebral area of fixigena very narrow (0.30 to 0.45 basal glabellar width), weakly convex, variable in shape, widest point at or behind midlength. Palpebral lobe 0.40 to 0.45 glabellar length, sloping down abaxially, narrowing slightly toward posterior. Eye ridge short but usually prominent. Palpebral furrow shallow but distinct, swinging abaxially behind eye, shallowest near midlength. Facial sutures diverging anteriorly at 15° from exsagittal lines, adaxial points (anterior and posterior to palpebral lobe) close to axial furrow and in the same exsagittal line in most specimens, but posterior adaxial point may be slightly more abaxial. Posterior area of fixigenae 0.15 to 0.20 (exsag.) glabellar length, extending further abaxially than palpebral lobe, steeply downsloping abaxially. Posterior border furrow well impressed behind midlength, with gentle forward arch.

Pygidium reniform, width 1.5 times length, with low posterior convexity, moderate lateral convexity, and a steep slope from axis to posterior margin. Lateral margin well rounded into lobes with marked posteromedian indentation. Axis 0.7 sagittal length, tapered slightly toward posterior; half ring very short; two straight, moderately deep ring furrows define relatively short rings; terminal piece large, posteriorly rounded, 0.6 sagittal length. Anterior axial ring marked by posteromedian excavation. Axial furrow indicated by change in slope from axis to pleural area. Pleural regions sloping gently to margin, with three pleural furrows decreasing in depth posteriorly and one faint interpleural furrow. Anterior border furrow (or first pleural furrow) well impressed parallel to anterior and lateral margins, exsagittal in distal portion. Doublure wide posterolaterally (0.5 width of pleural area), tapering anteriorly and adaxially.

Dorsal surface of exoskeleton finely papillose.

Remarks.—This new species closely resembles most specimens figured by Chernysheva (1961, pl. 22, figs. 3-8) as *Pseudanomocarina plana,* especially her figure 8. In fact, it is impossible to distinguish most cranidia from the Soviet Union and Queensland. The holotype of *P. plana,* however, can be differentiated by its larger frontal area, longer anterior border, more rounded glabellar anterior, and slightly shorter eyes, and is here transferred to *Chondranomocare bidjensis.* Two pygidia figured by Chernysheva (1961, pl. 22, figs. 9, 10) are also distinct from the Queensland specimens. Other material figured by her in 1961 is probably conspecific with *S. changi* from Queensland, but is not formally designated as such in the absence of adequate figures or access to Soviet material. *S. aojiformis* has a parallel-sided and proportionally larger glabella, more gently sloping glabellar anterior, and more triangular pygidium. Other species (e.g., *S. parva* and *S. eldachica*) are distinguished by a longer preglabellar field, straight- to parallel-sided glabella, and deeper lateral glabellar furrows.

The two specimens from UQL256 are immature and the species description is based largely on the material from UQL463.

Family DAMESELLIDAE Kobayashi, 1935

Genus PRODAMESELLA Chang

Prodamesella CHANG, 1959, p. 196, 218; KOBAYASHI, 1960, p. 352; LU and others, 1965, p. 397 [*nom. nud.,* CHANG, 1957, pl. 1, fig. 5].

Type species.—Prodamesella convexa Chang, 1959, p. 196, by original designation.

Diagnosis.—Chang's diagnosis (1959, p. 196; p. 218 for English translation) is followed here.

Discussion.—The two species, *Damesella quadrata* Resser and Endo (in Endo & Resser, 1937) and *Olenoides manchuriensis* Endo, 1944, tentatively referred to *Prodamesella* by Chang (1959, p. 219) are here excluded from that genus, although their correct generic placement is uncertain. *D. quadrata* has a more quadrate glabella, much longer palpebral lobes, and wider posterior fixigenae than *P. convexa*. Short eyes are characteristic of the Damesellidae and *D. quadrata* can be excluded on that feature alone. *O. manchuriensis* is distinguished by its more quadrate glabella with poorly impressed lateral glabellar furrows, convex anterior border, wider fixigenae, and more quadrate cranidium. Nature of the anterior border and glabella are of generic significance.

Prodamesella is here restricted to *P. convexa* and *P. biserrata,* and is defined by the truncato-conical glabella with deeply incised lateral glabellar furrows, concave border, short palpebral lobes, punctate ornament, and lack of a preglabellar field.

Occurrence.—Prodamesella is known only from the *Mapania* Zone in central Shantung, China, and from the *Peronopsis opimus* Zone in northwestern Queensland.

PRODAMESELLA BISERRATA Jell, n. sp.

Plate 1, figure 9; Plate 4, figures 1-6

Holotype.—Cranidium UQF69363 from UQL 256 (Pl. 4, fig. 2).

Other material.—Eleven cranidia, including the figured specimens UQF3196, 69362-69367, are known from the type locality. One other specimen is known from Queensland Museum locality 122 (lat. 19°32′ S., long. 138°54′ E.) and was listed as "*Ptychopariidae* sp." by Jell (1975, p. 6).

Diagnosis.—Prodamesella with short anterior border; indented (bilobed) anterior glabella, three pairs of prominent lateral glabellar furrows, long occipital ring with four posteromedial pits, and narrow and weakly punctate fixigenae.

Description.—Cranidium of small size (maximum length 2 mm), length to width ratio 2:3; moderately convex with steep slope near border furrow; axial furrow deep laterally, but shallower anteriorly and adjacent to occipital ring. Glabella about one-third cranidial width, reaching anterior border furrow, tapering slightly forward to 3P, slightly expanded in frontal lobe that has slight anteromedian indentation and bilobed appearance. Three pairs of lateral glabellar furrows laterally deep and quite narrow; 1P and 2P extending adaxially and slightly to posterior from axial furrow, 3P almost transverse. Occipital furrow well impressed with slight lateral pits; directed slightly posterior from axial furrow to pits, then anterior in gentle arch. Occipital ring 0.2 glabellar length, with strongly convex posterior margin, strong lateral taper; four tiny pits surrounding a small posteromedian tubercle on a faintly raised circular area extending full length of ring, anterior pair of pits more widely separated (tr.) than posterior pair. Anterior border furrow U-shaped in section, slightly expanded in front of glabella where posterior wall is convex. Anterior border flat but strongly upturned, slightly expanded posteromedially, tapered laterally. Fixigenae convex and narrower toward anterior, crossed by high prominent eye ridge commencing near middle of anterior glabellar lobe, with fine dense punctae weakly evident on some specimens. Posterior border of fixigenae narrow (exsag.) and convex; posterior border furrow long and shallow with slight anterolateral curve.

Remarks.—This species is distinguished from *P. convexa* Chang by its shorter anterior border, medially indented and slightly expanded anterior glabella, more oblique 1P and 2P furrows, and less prominent genal ornament.

Damage to the occipital area of illustrated cranidia of *P. convexa* and lack of knowledge of other exoskeletal parts for either species limits understanding of the species as well as the genus.

Four pits surrounding a small tubercle is an occipital feature apparently unknown in other Cambrian trilobites except rare olenids (Palmer, 1968, p. B68); however, it is more common in later trilobites, especially the Odontopleuridae and Scutelluidae. Its function is unknown.

Family NEPEIDAE Whitehouse, 1939

Genus PENAROSA Öpik, 1970

PENAROSA RETIFERA Öpik

Plate 4, figures 17-19

Penarosa retifera Öpik, 1970, p. 25-29, pl. 8, figs. 1, 2; pl. 9, figs. 1-4; pl. 17, figs. 7-9.

Material.—Three badly damaged specimens including a cranidium, fixigena, and part of a thorax.

Discussion.—This material is assigned to *Penarosa* because of its characteristic long frontal area, central boss, upturned border, tubercular ornamentation, eye ridges, and other features. It belongs to Öpik's (1970, p. 45) informal group 4(b) because of its rimless border, and is tentatively assigned to *P. retifera* rather than *P. vittata* of that group because of its wider (exsag.) flap on the posterior area of its fixigenae, narrower (tr.) palpebral area of its fixigenae, and lack of a ridge on the frontal part of the preglabellar field.

Family DORYPYGIDAE? Kobayashi, 1935

Gen. and sp. undet.

Plate 4, figure 7

Material.—One cranidium UQF69368 from UQL256.

Description.—The cranidium is subquadrate and quite convex. Glabella broad (0.43 cranidial width through palpebral area), subrectangular with weak lateral glabellar furrows; reaching anterior border furrow. Occipital furrow well impressed, but occipital ring broken. Anterior border short, convex, of uniform width (sag. and exsag.). Fixigenae convex, of moderate width, tapering slightly forward, crossed by distinct eye ridge running obliquely to anterior palpebral lobe opposite midlength of glabella. Palpebral lobe short but quite wide (0.3 fixigenal width), convex, well defined by palpebral furrow. Ornamentation granulose.

Remarks.—This specimen is almost certainly immature and generic and specific assignment is unwarranted at this time. It is questionably assigned to the Dorypygidae because of its large glabella reaching to the anterior border furrow, convex border, deep axial furrow, and granulose ornamentation.

REFERENCES

Angelin, N. P., 1851, *Palaeontologica Scandinavica, Pars I. Crustacea formationis transitionis:* Acad. Regiae Sci. Suec., p. 1-24, pl. 1-24.

———, 1854, *Palaeontologica Scandinavica, Pars II. Crustacea formationis transitionis:* Acad. Regiae Sci. Suec., p. 25-92, pl. 25-41.

Beyrich, Ernst, 1845, *Über einige böhmische Trilobiten:* p. 1-48, pl. 1-4, Reimer (Berlin).

Bognibova, R. T., & Shcheglov, A. P., 1971, *Regionalnaya skhema stratigrafiya i korrelyatsiya otlozheniy amginskogo veka Altaé-Sayanshoy oblasti:* Sibirskiy Nauchno-Issled. Inst. Geol. Geofiz. Miner. Syrya (SNIIGGIMS), Trudy, v. 111, p. 56-71. [*Regional scheme of stratigraphy and correlation of deposits of Amginsk age in the Altai-Sayan region.*]

———, Koptev, I. I., Mikhailova, L. M., Poletaeva, O. K., Romanenko, E. V., Romanenko, M. F., Semashko, A. K., Tomashpolskaya, V. D., Fedyanina, E. S., & Chernysheva, N. E., 1971, *Trilobity amginskogo veka Altae-Sayanskoy oblasti:* Sibirskiy Nauchno-Issled. Inst. Geol. Geofiz. Miner. Syrya (SNIIGGIMS), Trudy, v. 111, p. 82-263, pl. 1-25. [*Trilobites of Amginsk age in the Altai-Sayan region.*]

Chang, W. T., 1957, *Preliminary note on the Lower and Middle Cambrian stratigraphy of Poshan, central Shantung:* Acta Palaeontol. Sin., v. 5, p. 13-31, pl. 1-2. [*In Chinese with English summary.*]

———, 1959, *New trilobites from the Middle Cambrian of north China:* Acta Palaeontol. Sin., v. 7, p. 193-236, pl. 1-4. [*In Chinese with English summary.*]

Chernysheva, N. E., 1961, *Stratigrafiya kembriya Aldanskoy anteklizy i paleontologicheskoie obosnovanie vydeleniya Amginskogo yarusa:* Vses. Nauchno-Issled. Geol. Inst. (VSEGEI), Trudy, n. ser., v. 49, p. 1-347, pl. 1-30. [*Cambrian stratigraphy of the Aldan anticline and the paleontological basis for separation of the Amginsk Stage.*]

———, Egorova, L. I., Ogienko, L. V., Poletaeva, O. K., & Repina, L. N., 1956, *Klass trilobita:* Material po paleontologii, Vses. Nauchno-Issled. Geol. Inst. (VSEGEI), Trudy, n. ser., v. 12, p. 145-182, pl. 28-33. [*Class Trilobita.*]

deKeyser, F., & Cook, P. J., 1972, *Geology of the Middle Cambrian phosphorites and associated sediments of northwestern Queensland:* Bur. Miner. Resour. Aust., Bull. 138, 79 p.

Egorova, L. I., & Savitsky, V. E., 1969, *Stratigrafiya i biofatsii kembriva Sibirskoy platformy, Zapadnoe Prianabarye:* Sibirskiy Nauchno-Issled. Inst. Geol. Geofiz. Miner. Syrya (SNIIGGIMS), Trudy, v. 43, p. 1-408, pl. 1-61. [*Stratigraphy and biofacies of the Cambrian of the Siberian platform, western Anabar.*]

Endo, Ruiji, 1944, *Restudies on the Cambrian formations and fossils in southern Manchoukuo:* Bull. Cent. Natl. Mus. Manchoukuo, v. 7, p. 1-100, pl. 1-10.

———, & Resser, C. E., 1937, *The Sinian and Cambrian formations and fossils of southern Manchoukuo:* Manchurian Sci. Mus., Bull. 1, 474 p., 73 pl.

Harrington, H. J., Moore, R. C., & Stubblefield, C. J., 1959, *Morphological terms applied to Trilobita:* in Treatise on invertebrate paleontology, R. C. Moore (ed.), Part O, Arthropoda 1, p. O117-O126, Geol. Soc. Am. and Univ. Kansas Press (New York; Lawrence).

Hawle, Ignaz, & Corda, A. J. C., 1847, *Prodrom* *einer Monographie der böhmischen Trilobiten:* K. Böhmischen Ges. Wiss. (Prague), Abh., v. 5, 176 p., 7 pl.

Hill, Dorothy, Playford, Geoffrey, & Woods, J. T. (eds.), 1971, *Cambrian fossils of Queensland:* Queensland Palaeontogr. Soc., 32 p., 15 pl.

Howell, B. F., 1959, *Agnostina:* in Treatise on invertebrate paleontology, R. C. Moore (ed.), Part O, Arthropoda 1, p. O172-O186, Geol. Soc. Am. and Univ. Kansas Press (New York; Lawrence).

Ivshin, N. K., 1953, *Srednekembriiskie trilobity Kazakhstana; chast I:* Akad. Nauk Kazakhstan S.S.R., Inst. Geol. Nauk (Alma-Ata), 226 p., 11 pl. [*Middle Cambrian trilobites from Kazakhstan; Part I.*]

Jago, J. B., 1976, *Late Middle Cambrian agnostid trilobites from north-western Tasmania:* Palaeontology, v. 19, p. 133-172, pl. 21-26.

Jell, P. A., 1975, *Australian Middle Cambrian eodiscoids with a review of the superfamily:* Palaeontographica, Abt. A, v. 150, 97 p., 29 pl.

Khalfin, L. L. (ed.), 1955, *Atlas rukovodyashchikh form iskopaemykh fauny i flory zapadnoy sibiri:* Gosgeoltexizdat, Moskva, 502 p., 85 pl. [*Atlas of leading fossil fauna and flora of western Siberia.*]

———, 1960, *Biostratigrafiya Paleozoya Sayano-Altayskoy gornoy oblasti; tom 1, Nizhniy Paleozoy:* Sibirskiy Nauchno-Issled. Inst. Geol. Geofiz. Miner. Syrya (SNIIGGIMS), Trudy, v. 19, p. 1-498, pl. 152-253. [*Biostratigraphy of the Paleozoic of the Sayan-Altai mountain region; Volume 1, Lower Paleozoic.*]

Kobayashi, Teiichi, 1935, *The Cambro-Ordovician formations and faunas of South Chosen. Palaeontology. Part III:* J. Fac. Sci. Tokyo Univ., sec. 2, v. 4, p. 49-344, pl. 1-24.

———, 1939, *On the agnostids (Part I):* J. Fac. Sci. Tokyo Univ., sec. 2, v. 5, p. 69-198.

———, 1960, *The Cambro-Ordovician formations and faunas of South Korea, Part VII, Palaeontology VI:* J. Fac. Sci. Tokyo Univ., sec. 2, v. 12, p. 329-420, pl. 19-21.

———, 1962, *The Cambro-Ordovician formations and faunas of South Korea, Part IX, Palaeontology VIII:* J. Fac. Sci. Tokyo Univ., sec. 2, v. 14, p. 1-152, pl. 1-8.

Lazarenko, N. P., 1965, *Nekotorye novye srednekembriyskie trilobity severa sredney sibiri:* Nauchno-Issled. Inst. Geol. Arktiki (NIIGA), Uch. Zap., v. 7, p. 14-36, pl. 1-3. [*Some new Middle Cambrian trilobites from the north of Central Siberia.*]

———, & Datsenko, V. A., 1967, *Biostratigrafia verkhnego kembriya severo-zapada Sibirskoy platformy:* Nauchno-Issled. Inst. Geol. Arktiki (NIIGA), Uch. Zap., v. 20, p. 13-32. [*Upper Cambrian biostratigraphy of the northwest Siberian platform.*]

———, & Nikiforov, N. I., 1968, *Komplekṣy trilobitov iz otlozheniy verkhnego kembriya reki Kulyumbe (severozapad Sibirskoy platformy):* Nauchno-Issled. Inst. Geol. Arktiki (NIIGA), Uch. Zap., v. 23, p. 20-71, pl. 1-15. [*Trilobite assemblages from Upper Cambrian deposits of the Kulyumbe River region (northwestern Siberian platform).*]

Lochman, Christina, & Duncan, Donald, 1944, *Early Upper Cambrian faunas of central Montana:* Geol. Soc. Am. Spec. Pap. 54, 181 p., 19 pl.

Lu Yen-hao, 1960, *Kembriyskie otlozheniya Kitaya:* Sci. Rec., n. ser., v. 4, p. 199-216. [*Cambrian deposits of China.*]

———, Chang Wen-tang, Chu Chao-ling, Chien Yi-yuan, & Hsiang Lee-wen, 1965, *Zhonggo Gemenlei Huashi: Zhongguod Sanyechong:* v. 1, p. 1-362, pl. 1-66; v. 2, p. 363-766, pl. 67-135, Kexue Chubanshe [Science Publication Co.] (Peking). [*Fossils of each group of China: Chinese trilobites.*]

Öpik, A. A., 1967, *The Mindyallan fauna of northwestern Queensland:* Bur. Miner. Resour. Aust., Bull. 74, v. 1, 404 p.; v. 2, 165 p., 67 pl.

———, 1970, *Nepeid trilobites of the Middle Cambrian of northern Australia:* Bur. Miner. Resour. Aust., Bull. 113, 48 p., 17 pl.

Palmer, A. R., 1955, *The faunas of the Riley Formation in central Texas:* J. Paleontol., v. 28, p. 709-786, pl. 76-92. [Dated November 1954; mailed January 15, 1955.]

———, 1968, *Cambrian trilobites of east-central Alaska:* U.S. Geol. Surv., Prof. Pap. 559-B, p. 1-115, pl. 1-15.

———, & Gatehouse, C. G., 1972, *Early and Middle Cambrian trilobites from Antarctica:* U.S. Geol. Surv., Prof. Pap. 456-D, p. 1-37, pl. 1-6.

Pek, Ilja, & Vanek, Jiří, 1971, *Revision of the genera* Peronopsis *Hawle et Corda, 1847, and* Diplorrhina *Hawle et Corda, 1847 (Trilobita) from the Middle Cambrian of Bohemia:* Věstn. Ústřed. Úst. Geol., v. 46, p. 269-276, pl. 1, 2.

Poulsen, Christian, 1927, *The Cambrian, Ozarkian and Canadian faunas of northwest Greenland:* Medd. om Grønland, v. 70, no. 2, p. 233-343, pl. 14-21.

———, 1960, *Fossils from the late Middle Cambrian* Bolaspidella *Zone of Mendoza, Argentina:* Mat.-fys. Medd. dan. Vidensk. Selsk., v. 32, p. 1-42, pl. 1-3.

Rasetti, Franco, 1948, *Middle Cambrian trilobites from the conglomerates of Quebec:* J. Paleontol., v. 22, p. 315-339, pl. 45-52.

Raymond, P. E., 1913, *On the genera of the Eodiscidae:* Ottawa Nat., v. 27, p. 101-106.

Repina, L. N., Petrunina, Z. E., & Hajrullina, T. I., 1975, *Trilobity:* Inst. Geol. Geofiz. Sibirskiy Otd. (IGIG), Trudy, v. 278, p. 100-248, pl. 7-48. [*Trilobites, in Stratigraphy and fauna of lower Paleozoic, the northern submontane belt of Turkestan and Alai ridges.*]

Resser, C. E., 1938, *Cambrian System (restricted) of the southern Appalachians:* Geol. Soc. Am., Spec. Pap. 15, 140 p., 16 pl.

Richter, Rudolf, & Richter, Emma, 1940, *Studien im Paläozoikum der Mittelmeer-Länder, 5, Die Saukianda-Stufe von Andalusien, eine fremde Fauna im europäischen Ober-Kambrium:* Senckenb. naturforsch. Ges., Abh. 450, p. 1-81, pl. 1-5.

Robison, R. A., 1964, *Late Middle Cambrian faunas from western Utah:* J. Paleontol., v. 38, p. 510-566, pl. 79-92.

———, 1976, *Middle Cambrian biostratigraphy of the Great Basin:* in Paleontology and depositional environments, Cambrian of western North America, R. A. Robison & A. J. Rowell (eds.), Brigham Young Univ. Geol. Studies, v. 23, pt. 2, p. 93-109.

———, 1978, *Origin, taxonomy, and homeomorphs of*

Doryagnostus *(Cambrian Trilobita):* Univ. Kansas Paleontol. Contrib., Pap. 91, p. 1-10, pl. 1-2.

Rozova, A. V., 1964, *Biostratigrafiya i opisanie trilobitov srednego i verkhnego kembriya severo-zapada Sibirskoy platformy:* Inst. Geol. Geofiz. Sibirsk Otd. Akad. Nauk SSSR (Moscow), 148 p., 19 pl. [*Biostratigraphy and description of trilobites of the Middle and Upper Cambrian of the north-west Siberian platform.*]

Shergold, J. H., Druce, E. C., Radke, B. M., & Draper, J. J., 1976, *Cambrian and Ordovician stratigraphy of the eastern portion of the Georgina basin, Queensland and eastern Northern Territory:* 25th Int. Geol. Congr., Field Excursion Guideb. 4C, 54 p.

Westergård, A. H., 1946, *Agnostidea of the Middle Cambrian of Sweden:* Sver. Geol. Unders., ser. C, no. 477, 140 p., 16 pl.

———, 1949, Opsidiscus, *a new name replacing* Aulacodiscus *Westergård, 1946:* Geol. Fören. Stockholm Förh., v. 71, p. 606.

Whitehouse, F. W., 1936, *The Cambrian faunas of north-eastern Australia, Parts 1 and 2:* Queensland Mus., Mem., v. 11, p. 59-112, pl. 8-10.

———, 1939, *The Cambrian faunas of north-eastern Australia, Part 3:* Queensland Mus., Mem., (n. ser.) v. 1, p. 179-282, pl. 19-25.

———, 1945, *The Cambrian faunas of north-eastern Australia, Part 5:* Queensland Mus., Mem., v. 12, p. 117-123, pl. 11.

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EXPLANATION OF PLATES

Unless indicated otherwise, specimens on all plates are from locality UQL256 of the Currant Bush Limestone (late Middle Cambrian), northwestern Queensland.

PLATE 1

FIGURE

1,2,4,8. *Baltagnostus damesi* (Resser & Endo), Mapan Formation, Middle Cambrian, Manchuria (all ×8 and all numbered USNM 57829.—*1a,b.* Dorsal and lateral views of cephalon with incomplete preglabellar median furrow (cf. with retouched illustration by Endo & Resser, 1937, pl. 30, fig. 1).—*2a,b.* Stereogram of cephalon with incomplete preglabellar median furrow (cf. with retouched illustration by Endo & Resser, 1937, pl. 30, fig. 2).—*4a-c.* Lateral view *(a)* and stereogram *(b, c)* of lectotype pygidium (figured by Endo & Resser, 1937, pl. 30, fig. 4).—*8.* Pygidium with broken border spines (figured by Endo & Resser, 1937, pl. 30, fig. 3).

3,5-7, 9-11. *Baltagnostus australis* Robison, n. sp., all ×8.—*3,11.* Representative cephala, UQF69627, 69628. —*5a-c.* Lateral view *(a)* and stereogram *(b, c)* of holotype cephalon, UQF69629.—*6a-c.* Lateral view *(a)* and stereogram *(b, c)* of slightly exfoliated pygidium, UQF69630.—*7,10.* Medium and small holaspid pygidia, UQF69631, 69632.—*9a,b.* Stereogram of pygidium (figured as paratype of *Euagnostus opimus* by Whitehouse, 1936, pl. 8, fig. 12) associated with cranidium of *Prodamesella biserrata,* n. sp., UQF3196.

PLATE 2

FIGURE

1-6. *Peronopsis opimus* (Whitehouse).—*1a-c.* Stereogram *(a, b)* and lateral view *(c)* of well-preserved cephalon, ×6, UQF69633.—*2,3,6.* Holaspid cephala of various sizes, all ×6, UQF69634-69636.—*4a-c.* Stereogram *(a, b)* and lateral view *(c)* of latex cast of holotype, partially exfoliated (figured by Whitehouse, 1936, pl. 8, fig. 11), ×6, UQF3195.—*5.* Small holaspid pygidium, ×8, UQF69637.

7-9,12. *Doryagnostus deltoides* Robison, n. sp.—*7a,b.* Dorsal and lateral views of latex cast of cephalon (figured as paratype of *Euagnostus opimus* by Whitehouse, 1936, pl. 8, fig. 10), ×6, UQF3194. —*8a-c.* Lateral view and stereogram of partly exfoliated pygidium, ×7, UQF69625.—*9a,b.* Stereogram of holotype cephalon, ×6, UQF69624. —*12.* Pygidium, ×5, UQF69626.

10. *Hypagnostus?* sp. Damaged and partly exfoliated cephalon, ×9, UQF69638.

11. *Hypagnostus* cf. *H. clipeus* Whitehouse, V Creek Limestone, Middle Cambrian, Queensland. Pygidium, ×6.5, UQF69639.

PLATE 3

Chondranomocare confertum (Whitehouse)

FIGURE

1. Left pleura and part of axis of damaged thoracic segment, ×8, UQF69350.

2-5. Growth series of small cranidia showing development and lengthening of preglabellar field and decrease in relative size of the eyes; ×24, ×15, ×6, and ×6, UQF69351-69354, respectively. Figure 3 is a damaged complete specimen from UQL463, Currant Bush Limestone.

6. Posterior oblique view of posterior pygidial fragment (figured by Whitehouse, 1939, pl. 23, fig. 25), ×5, UQF3357.

7,8,12. Pygidia showing posterolateral angularity, wide doublure, steep posterior slope, and postaxial keel.

FIGURE

—*7b*. Left lateral view.—*8b*. Posterior oblique view. ×2.5, ×6, ×5; UQF69355-69357, respectively.

9. Latex cast of damaged pygidium (figured by Whitehouse, 1939, pl. 23, fig. 27), ×6, UQF3359.

10. Damaged pygidium (figured by Whitehouse, 1939, pl. 23, fig. 26), ×5, UQF3358.

11. Holotype cranidium (figured by Whitehouse, 1939, pl. 23, fig. 22), UQF3354; *a*, posterior view showing posterior fixigenae well below palpebral lobes, ×2.5; *b*, anterolateral oblique view, ×3; *c*, dorsal view, ×3.

13. Cranidium, ×3, UQF69358; *a*, oblique lateral view; *b*, dorsal view.

14. Cranidium (figured by Whitehouse, 1939, pl. 23, fig. 23), ×3, UQF3355.

15. Hypostoma, ×6, UQF69359.

16. Librigena, ×3, UQF69360.

17. Cranidium (figured by Whitehouse, 1939, pl. 23, fig. 24), ×3, UQF3356; *a*, latex cast; *b*, damaged original.

18. Latex cast of cranidium, ×3, UQF69361.

19. Latex cast of librigena (figured by Whitehouse, 1939, pl. 23, fig. 28), ×4, UQF3360.

PLATE 4

FIGURE

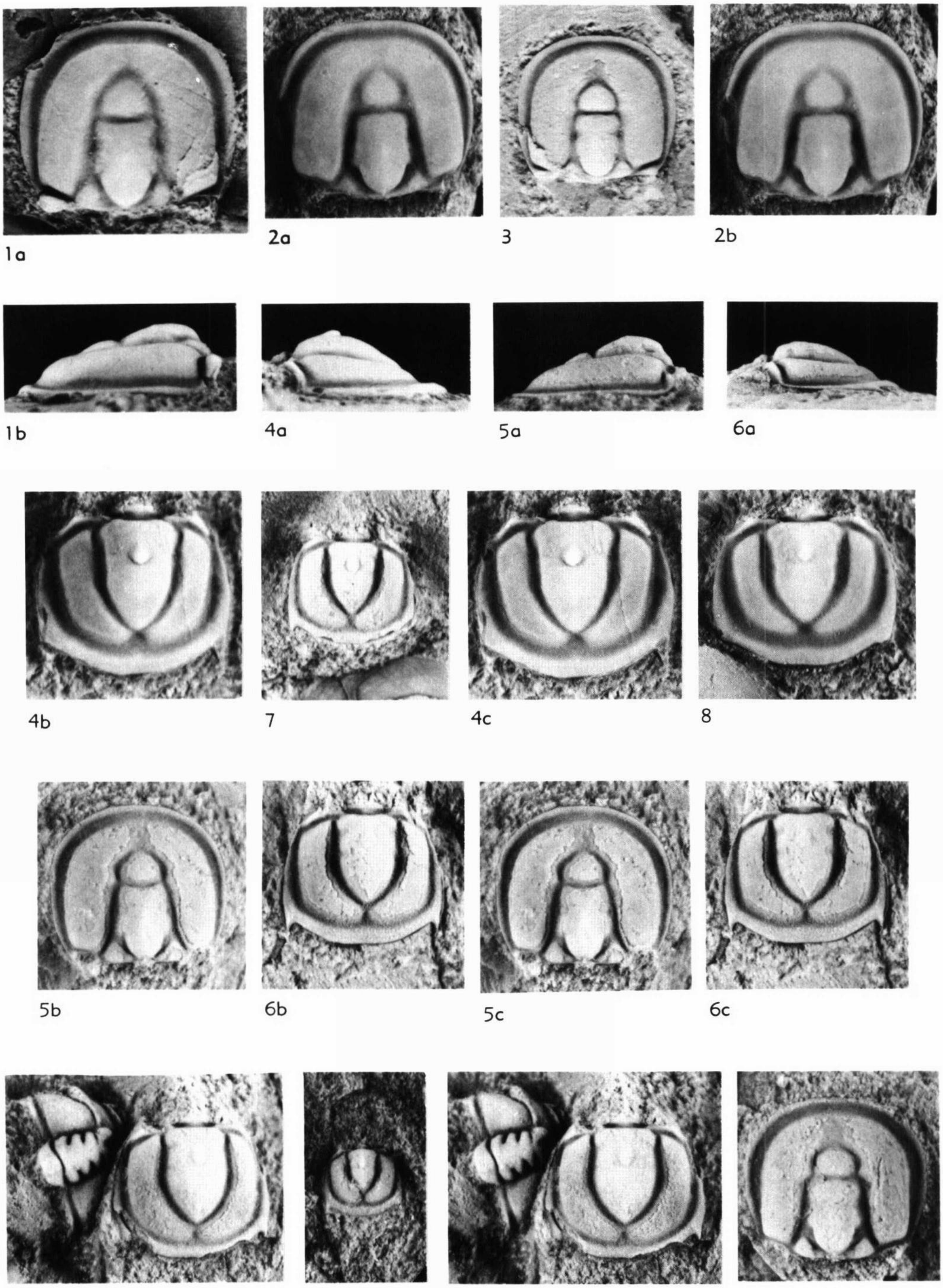
1-6. *Prodamesella biserrata* Jell, n. sp. Cranidia; all ×12, except *2b*, which is ×10; UQF69362-69367, respectively.—*2a,b*. Dorsal and anterolateral oblique views of holotype (UQF69363).—*1,3-6*. Paratypes.

7. Gen. and sp. undet. Cranidium, ×12, UQF69368.

8. *Opsidiscus microspinus* Jell. Cranidium, ×22, UQF69369; *a*, dorsal, and *b*, anterolateral oblique views.

9-16. *Sudanomocarina changi* Jell, n. gen. & sp.—*9,10,12,14,16*. ×8, ×4 (*10a*, ×5), ×4, ×6, ×6; UQF69370, 69371, 69373, 69375, 69377, respectively.—*11*. Pygidium, ×7, UQF69372.—*13,15*. Damaged juvenile cranidia, ×8 and ×10, UQF69374 and 69376, respectively. Figure *14* (UQF69375) is the holotype. Specimens in *9,10, 12,14,16* are from UQL463, Currant Bush Limestone.

17-19. *Penarosa retifera* Öpik.—*17*. Damaged cranidium, ×4, UQF69378.—*18*. Fragment of right fixigena, ×5, UQF69379.—*19*. Thoracic fragment, ×5, UQF69380.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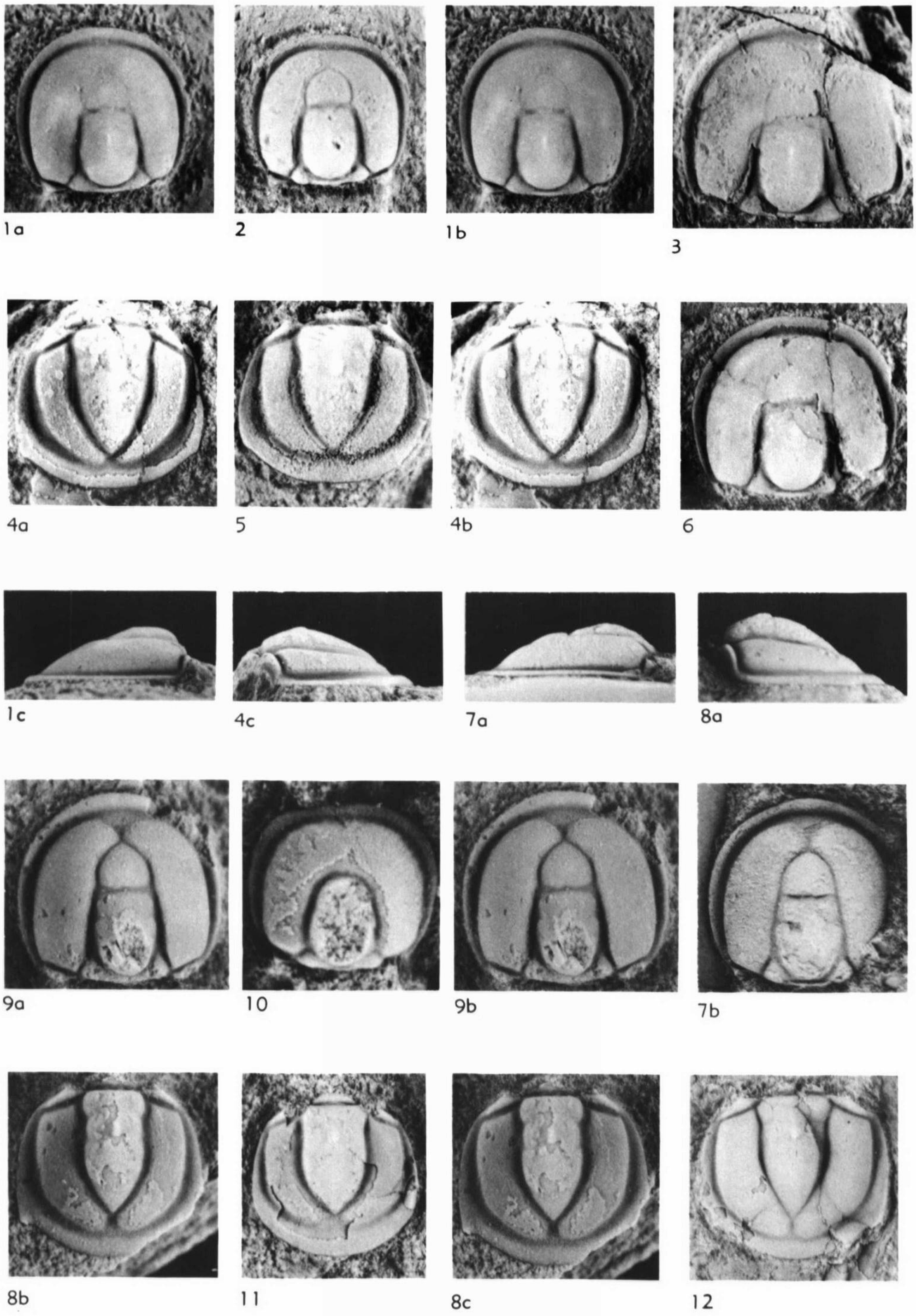
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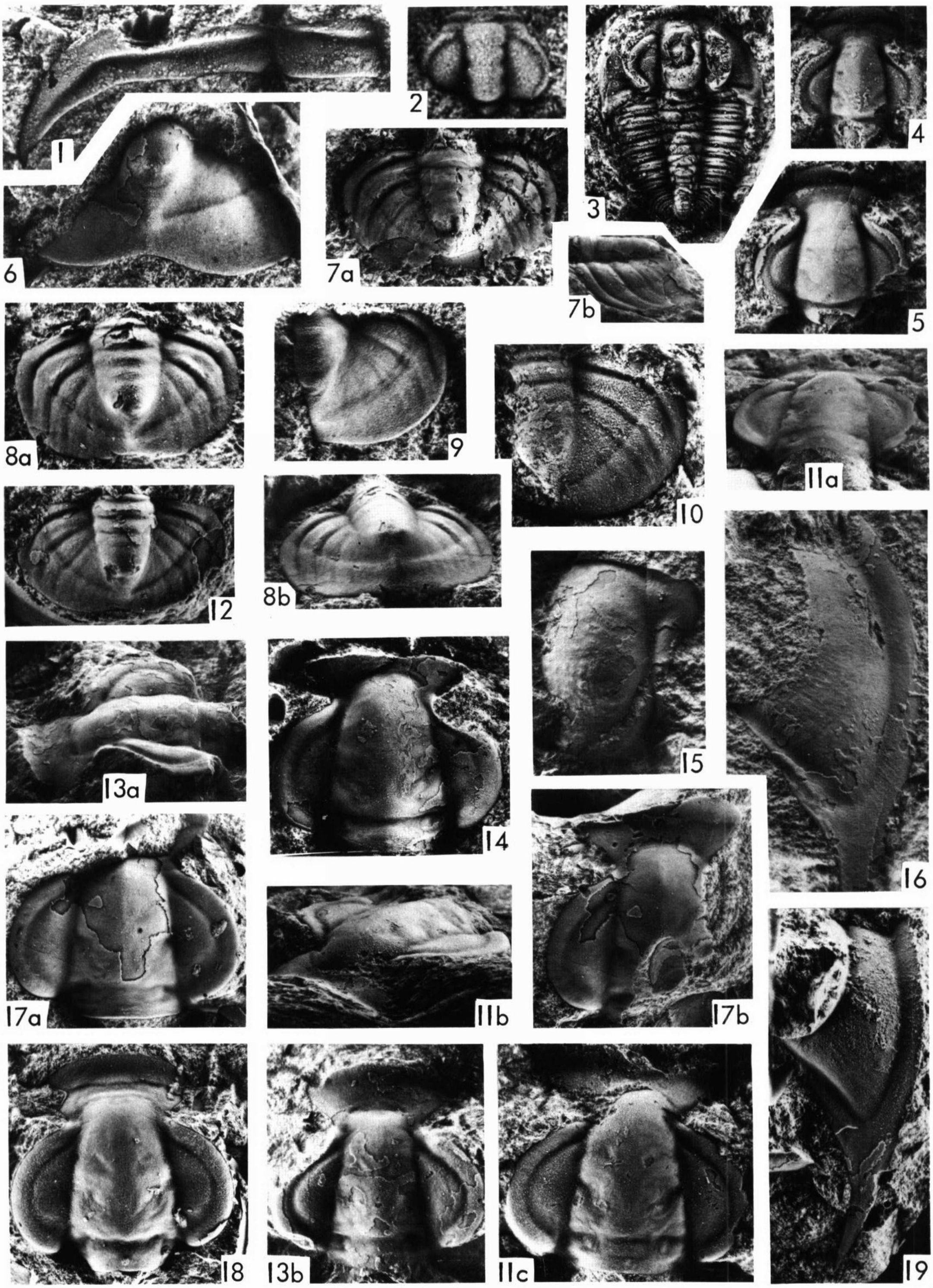
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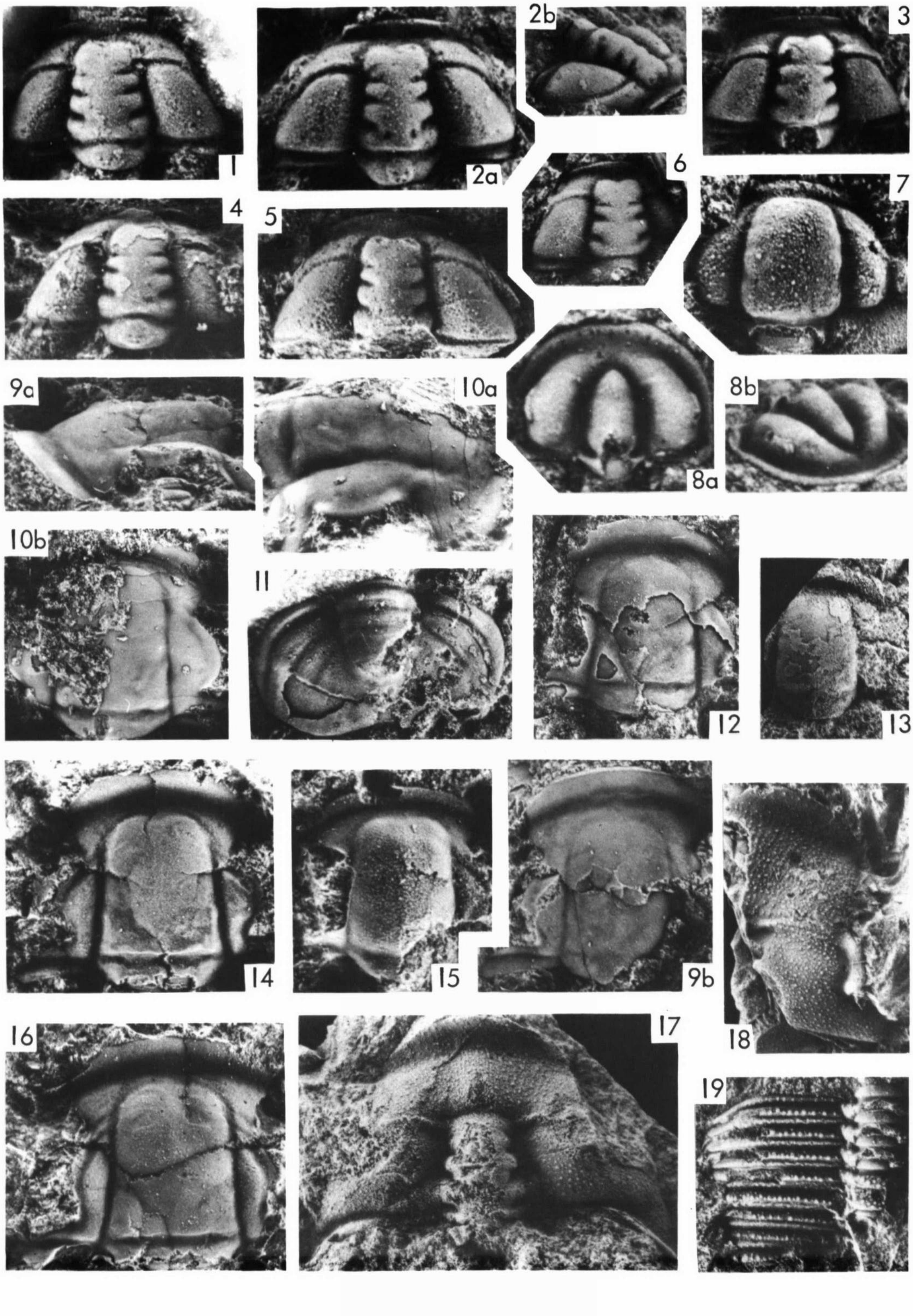
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