



New and revised species of the aulacopleurid trilobite *Maurotarion* from the Lower Devonian (Pragian) of Nevada

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Abstract

Deep water silicified trilobite faunas occur in argillaceous limestones of the Lower Devonian (Pragian) Wenban Limestone in the Cortez Mountains, Eureka County, central Nevada, USA. Trilobites occur as a stratigraphic series of three low diversity assemblages, including the odontopleurids *Nevadaprusia* Adrain, Chatterton, and Kloc, 2008, and *Kettneraspis* Prantl and Přibyl, 1949, the phacopids *Paciphacops* Maksimova, 1972, and an unnamed new genus, undetermined dalmanitids, a tropidocoryphid, and the brachymetopid *Mystrocephala* Whittington, 1960. Aulacopleurids are common elements of all three assemblages and, unusually, are represented by multiple articulated silicified specimens, permitting a complete assessment of the holaspid morphology of some of the species. All belong to the genus *Maurotarion* Alberti, 1969, and new species are *M. chryson*, *M. fooi*, and *M. wenbanense*. *Maurotarion periergum* (Haas, 1969) was described on the basis of a few fragmentary sclerites but is now represented by multiple articulated dorsal exoskeletons.

Key words: Trilobita, silicified, Aulacopleuridae, *Maurotarion*, Devonian

Introduction

The Great Basin of the western United States contains abundant outcrop of Devonian marine rocks rich in fossils. Many systematic works have been published on, for example, the brachiopods (e.g., Johnson, 1990, and references therein), corals (e.g., Pedder and Murphy, 2003, 2004), and other groups. Trilobites, however, have received only sporadic systematic attention despite their common occurrence in faunas. One of the few taxonomic works to appear is that of Haas (1969), who described several species based on silicified samples from the Pragian Wenban Limestone of the Cortez Mountains, central Nevada. Haas's (1969) paper featured good photographs, but the paucity of material for most taxa along with the number of species reported in open nomenclature suggest a relatively small sample size was available.

Although most of the species have yet to be adequately documented, the Wenban Limestone faunas are important, as they represent a very poorly known Early Devonian deep subtidal trilobite habitat. Hence, new field work was carried out in an attempt to make more extensive collections and expand the documentation of the faunas. This work was successful: in addition to locating the most prolific fauna studied by Haas, two distinct stratigraphically higher faunas were recovered, each of which was composed entirely of new species. Description of these faunas was begun by Adrain et al. (2008) who described species belonging to their new koneprusiine odontopleurid genus *Nevadaprusia* Adrain, Chatterton, and Kloc, 2008.

The goal of the present work is to document species of Aulacopleuridae Angelin, 1854, one of the most common groups occurring in the faunas. Four species (three new) were recovered in the course of new sampling, all of which are assigned to the genus *Maurotarion* Alberti, 1969. Remarkably, three of the four species are represented by articulated dorsal exoskeletons which, given the silicified preservation, can be studied in both dorsal and ventral aspect.

Localities and stratigraphy

The Wenban Limestone was named by Gilluly and Masursky (1965) for a series of shaly and occasionally bioclastic limestones overlying the Rabbit Hill Limestone in the Cortez Mountains, Eureka County, central Nevada. Faunas from the formation are of Pragian age, and are assigned to Johnson's (1977) "Lower *Spinoplasia* Subzone." More extensive remarks on the history of study were given by Adrain et al. (2008, p. 657) and need not be repeated.

The formation is exposed along the crest of a ridge trending southeast from Mount Tenabo in the Cortez Mountains (Fig. 1), just above the haul road of Cortez Gold Mine. Although silicified fossils are abundant and easily collected, the ridge is a wooded dip slope and continuous exposed outcrop is difficult to find and nearly impossible to measure. For this reason, faunas, which occur in restricted stratigraphic intervals, were collected as a series of lettered localities. The grouping of localities along strike and the relative stratigraphic order of the different faunas is clear, but the absolute stratigraphic distance between them is difficult to accurately assess. The entire sampled interval, however, is only on the order of a few tens of metres. The distinct trilobite faunas and the localities containing them are discussed in ascending stratigraphic order:

1) *Maurotarion periergum* Fauna. This assemblage occurs at localities CR-H and CR-B. The rocks are very thin bedded, slabby weathering, dark grey argillaceous limestones. Bedding surfaces tend to be covered with silicified trilobites. Many of these surfaces, however, have the trilobites flattened, coarsely silicified, and somewhat tectonically deformed. Some slightly thicker beds contain silicified fossils throughout their thickness, with their original dimensions preserved, and these yielded most of the material of *Maurotarion periergum* (Haas, 1969) illustrated herein. This assemblage was the source of the sample described by Haas (1969). The fauna includes *Maurotarion periergum* (Haas, 1969), "*Viaphacops*" *claviger* (Haas, 1969), *Kettneraspis favonia* Haas, 1969, *Nevadaprusia insolita* (Haas, 1969), "*Decoroproetus*" n. sp., and an indeterminate dalmanitid with a tripartite anterior cephalic process.

2) *Nevadaprusia cortezensis* Fauna. This assemblage occurs at localities CR-G and CR-C. The rocks yielding trilobites at this stratigraphic level are thicker bedded than those containing the lower *M. periergum* Fauna. Most of the trilobites were found in a black, approximately 15 cm thick, argillaceous limestone bed. Preservation is very good, with no compaction of the fossils evident. The assemblage contains *Nevadaprusia cortezensis* Adrain, Chatterton, and Kloc, 2008, *Kettneraspis* n. sp. 1, *Maurotarion chrysion* n. sp., *M. wenbanense* n. sp., and "*Viaphacops*" n. sp. aff. *claviger* (Haas, 1969).

3) *Maurotarion fooi* Fauna. This assemblage occurs at locality CR-D. Rocks at this locality are buff coloured heavily argillaceous limestones with a high insoluble quartz residue content. Non-trilobite fossils are more common than at the lower horizons, including articulate brachiopods, solitary rugosan corals, and lepidocoleid machaeridians. Trilobites include *Maurotarion fooi* n. sp., *Kettneraspis* n. sp. 2, *Kettneraspis* n. sp. 3, *Paciphacops* n. sp., *Mystrocephala* n. sp., and an indeterminate dalmanitid.

Systematics

Repositories. All new type and figured material is housed in the Paleontology Repository, Department of Geoscience, University of Iowa, with specimen number prefix SUI. Reference is made to type material in the United States National Museum of Natural History (Smithsonian Institution), with specimen number prefix USNM.

Terminology and measurements. Ratios are expressed as a mean followed by the observed range. The specimens used for measurements are listed at the beginning of each descriptive section. "sag." = sagittally; "exsag." = exsagittally. The term "fine raised lines" is preferred to the more commonly used "terrace lines" as the cross-sectional shape of many such lines in trilobites, and in the species described herein, is not terraced.

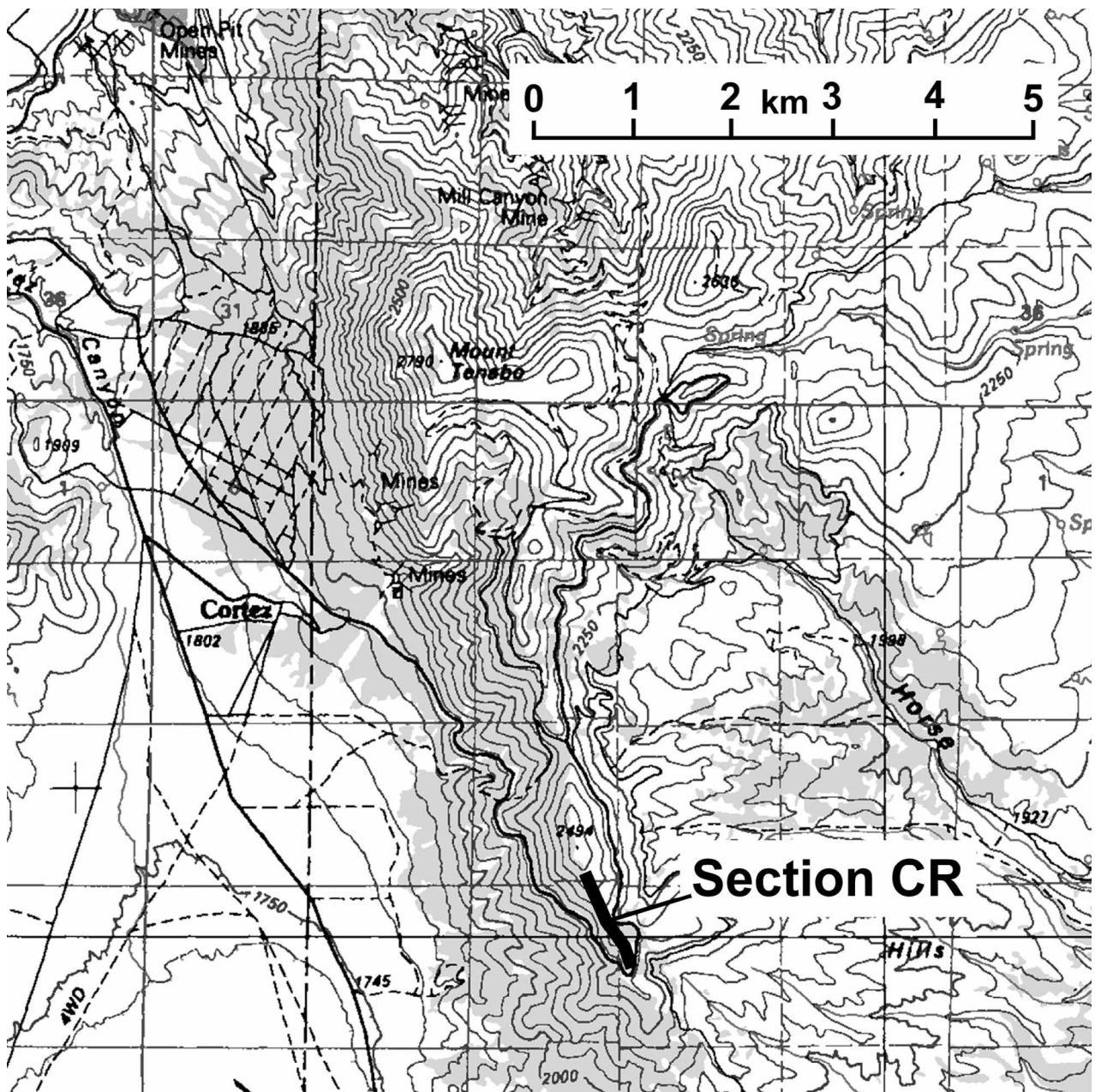


FIGURE 1. Position of section CR on ridge trending southeast from Mount Tenabo, Cortez Mountains, Eureka County, central Nevada. Base map from USGS Crescent Valley 30 x 60 minute quadrangle.

Family Aulacopleuridae Angelin, 1854

Subfamily Otarioninae Richter and Richter, 1926

Maurotarion Alberti, 1969

=*Goniopleura* Hawle and Corda, 1847 (preoccupied, not replaced)

=*Tricornotarion* Chatterton, 1971

=*Branisella* Přibyl and Vaněk, 1981 (preoccupied, not replaced)

Type species. *Harpidella maura*, Alberti, 1967.

Other species. See Adrain and Chatterton (1995a, p. 318), with the following additions and amendments: *Maurotarion chryson* n. sp., Pragian, Wenban Limestone, Nevada, USA; *Otarion dongujumqinensis* Nan,

1976, Lower Devonian of Inner Mongolia, China; *Forbesia euryceps* M'Coy, 1876, Yan Yean Formation, Ludlow, Australia (see Sandford [2000]; =*Cyphaspis spryi* Gregory, 1901, fide Sandford [2000, p. 164]); *M. fooi* n. sp., Pragian, Wenban Limestone, Nevada, USA; *Harpidella* (*Harpidella*) *hecate* Vaněk, Vokáč, and Hörbinger, 1992, Koněprusy Limestone, Pragian, Czech Republic; *M. isaacsoni* Adrain and Edgecombe, 1996, Belén Formation, Eifelian, Bolivia; *M. legrandi* Adrain and Edgecombe, 1996, Belén Formation, Eifelian, Bolivia; *Phillipsia minuscula* Hall, 1876, Schoharie Grit, Emsian, New York State, USA; *M. racheboeufi* Adrain and Edgecombe, 1996, Icla Formation, Emsian, Bolivia; *M. richardsoni* Chatterton and Ludvigsen, 2004, Jupiter Formation, Aeronian, Anticosti Island, Quebec, Canada; *M. wenbanense* n. sp., Pragian, Wenban Limestone, Nevada, USA.

Otarion pusillus Liu, 1982, is known from an internal mold of a single incomplete and distorted pygidium. It could possibly represent a species of *Maurotarion*.

Harpidella (s.l.) *occidentalis* Owen, 1981, was assigned to *Maurotarion* by Adrain and Chatterton (1995a, p. 318), but should be reassigned to *Harpidella*.

Cyphaspis australis Ohern and Maynard, 1913, from the Lower Devonian of Maryland, USA, may possibly represent a species of *Maurotarion*, but is known only from the original line drawing of a cranidium.

Harpidella (*Harpidella*) *thomasi* Clarkson and Howells, 1981, was assigned to *Maurotarion* by Adrain and Chatterton (1995a), but its affinities are uncertain. The species is known from a single articulated specimen represented by counterpart molds (Clarkson and Howells, 1981 pl. 79, figs. 1, 2). Clarkson and Howells (1981) also assigned an isolated pygidium, but expressed doubt as to whether it belonged. The pygidium is very long, with at least five axial rings, a morphology unknown in *Maurotarion* and unusual for an otarionine in general, aside from younger derived species of *Otarion* Zenker, 1833. The pygidium possibly represents a proetid, though given the uncertainty of the affinities of *thomasi*, assignment to that species cannot be ruled out on present evidence. *Harpidella* (*H.*) *thomasi* resembles species of *Maurotarion* in its apparently weakly inflated cranidium lacking dorsal sculpture and in its large eye and narrow librigenal field. However, it possesses a thoracic axial spine on the sixth segment, a feature definitively absent in every species of *Maurotarion* for which there is available evidence. Ordovician aulacopleurids typically have a thoracic axial spine (e.g., Adrain, 2005; unpublished data). If loss of this spine is synapomorphic within *Maurotarion*, it is conceivable that some basal species could retain it. *Harpidella* (*H.*) *thomasi* is Aeronian in age, and the only older species of *Maurotarion* is the Rhuddanian *M. messieri* Adrain and Chatterton, 1995a. Whether or not *M. messieri* possessed a spine is uncertain - Adrain and Chatterton (1995a, fig. 9.16–9.18, 9.24, 9.25) illustrated segments with long axial spines, but *M. messieri* occurs along with *H. tikkaneni* Adrain and Chatterton, 1995a. All species of *Harpidella* s.s. (sensu Adrain and Chatterton, 1995a) for which information is available possess such a spine, and the segments likely belong to *H. tikkaneni*.

Diagnosis: See Adrain and Chatterton (1995a, p. 318).

Discussion: Adrain and Chatterton's (1995a) revised concept of *Maurotarion* has been followed in most subsequent studies (e.g., Curtis and Lane, 1997; Edgecombe and Fortey, 2000; Sandford, 2000; Chatterton and Ludvigsen, 2004; Rustán, 2008).

With the taxa added herein, the Pragian becomes the stratigraphic stage with the highest *Maurotarion* species diversity, at nine. Four of these species, however, are very poorly known. *Harpidella neptis* Alberti, 1967, from the “*princeps*” Limestone at Ghtira-Tal, northwest Morocco, is known from only two cranidia. It was assigned to *Otarion* (*Maurotarion*) by Alberti (1969, pl. 36, figs. 9, 10). With so little information, it is not clear that the species is actually a representative of *Maurotarion*. In particular, it has very narrow interocular fixigenae, with the palpebral lobes nearly abutting the glabella. The palpebral lobes are also much smaller and narrower than in typical species of the genus, and do not protrude laterally to the widest point of divergence of the anterior facial sutures. In other respects it does resemble species of *Maurotarion*, such as in the possession of small L1 which do not significantly protrude from the lateral outline of the glabella, and a long, flat, anterior border. More material, particularly of sclerites in addition to the cranidium, would be required to adequately assess the affinity of the species.

Harpidella (Harpidella) distincta Přibyl and Vaněk, 1981, from the Vinariče Limestone, and *H. (H.) tantula* Přibyl and Vaněk, 1981, from the Dvorce-Prokop Limestone, both Pragian of the Prague Basin, Bohemia, Czech Republic, were assigned to *Maurotarion* by Adrain and Chatterton (1995a). The former is known from a single incomplete internal mold of a cranidium (Přibyl and Vaněk, 1981, pl. 7, fig. 10), and the latter from five incomplete cranidia (Přibyl and Vaněk, 1981, pl. 7, figs. 1–5). Přibyl and Vaněk compared the species only with each other and with their new *H. (H.) kobayashii* (Emsian, Czech Republic), which is known from three fragmentary cranidia (Přibyl and Vaněk, 1981, pl. 7, figs. 11, 12, pl. 9, fig. 8). These species are essentially uninterpretable beyond their probable status as ingroup *Maurotarion*.

Of the five non-Nevada species, only the late Lochkovian or earliest Pragian Bolivian *M. dereimsi* (Kozłowski, 1923) is reasonably well understood (see Adrain and Edgecombe, 1996, p. 424, pl. 52, figs. 1–3, 5–9). Adrain and Edgecombe (1996) argued that *M. dereimsi* formed a predominantly Malvinokaffric clade with their new species *M. racheboeufi* (Emsian, Bolivia) and *M. legrandi* (Eifelian, Bolivia), and probably also with *M. isaacsoni* Adrain and Edgecombe, 1996 (Early Devonian, Bolivia), and *Maurotarion* nov. sp. A of Adrain and Edgecombe (1996, p. 426; late Emsian or younger, South Africa). They also (Adrain and Edgecombe, 1996, pp. 420–421) considered that *M. periergum* was related to the *M. dereimsi* group. This opinion was based on the presence of inflated genal spine bases, termination of the lateral border furrow in front of the genal angle and continuation of the posterior border furrow along the genal spine, and an anterior border than is only slightly longer medially than laterally. Adrain and Edgecombe (1996, p. 422) tentatively interpreted the entire Malvinokaffric *Maurotarion* species group as monophyletic, and sister to *M. periergum*, implying an episode of Pragian invasion from lower latitudes. This scenario was challenged by the description (Edgecombe and Fortey, 2000) of a Silurian Malvinokaffric species of *Maurotarion* from Bolivia. Though not well known, this species is potentially a member of the *M. dereimsi* group. Before further biogeographic speculation is engaged in, a formal phylogenetic analysis of the entire genus is required. Such an analysis is beyond the scope of the present paper, but the species described herein provide some of the best known morphological data available for eventual cladistic analysis.

***Maurotarion periergum* (Haas, 1969)**

(Figs 2–4)

1969	<i>Otarion (Otarion) periergum</i> Haas, p. 645, pl. 81, figs 4–10, [non fig. 11].
?1969	<i>Otarion (Otarion)</i> sp.; Haas, p. 646, pl. 81, fig. 12.
1977	<i>Otarion periergum</i> Haas; Campbell, p. 17.
1979	<i>Otarion (Otarion) periergum</i> Haas; Chatterton et al., p. 811.
1981	<i>Harpidella (Harpidella) perierga</i> (Haas); Přibyl and Vaněk, p. 170.
1995a	<i>Maurotarion periergum</i> (Haas); Adrain and Chatterton, p. 318.
1996	<i>Maurotarion periergum</i> (Haas); Adrain and Edgecombe, p. 420.
2008	<i>Maurotarion periergum</i> (Haas); Adrain et al., p. 657.
2008	<i>Maurotarion periergum</i> (Haas); Rustán, p. 348.

Type material. Holotype, cranidium, USNM 161165, and specimens USNM 161166–161171, all illustrated by Haas (1969, pl. 81, figs. 4–10), from USNM locality 17233.

Additional material. Illustrated specimens SUI 109012–109016, 109018–109029, 109031–109035 from locality CR-H, and SUI 109017, 109030 from locality CR-B.

Diagnosis. Cranidium with coarse tubercles on rear of glabella; genal spine inflated at base, with posterior border furrow continued along length and row of moderate sized tubercles adaxial to furrow; 13 thoracic segments, pleural regions lacking sculpture, rings with a very subdued transverse tubercle row; pygidium with four axial rings and transverse terminal piece, subdued transverse tubercle rows on posterior pleural bands and axial rings of first two segments, otherwise granulose dorsal sculpture.

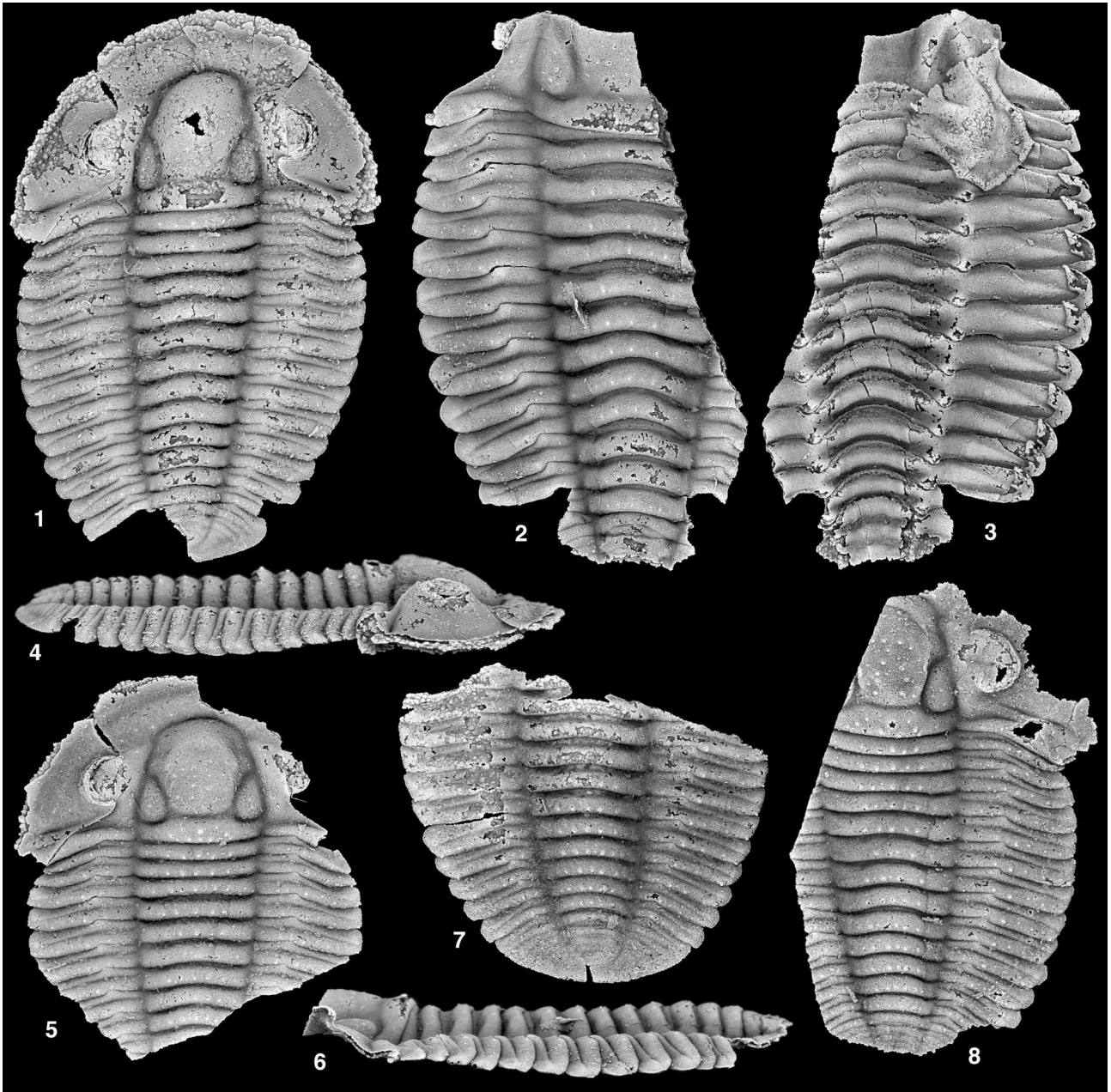


FIGURE 2. *Maurotarion periergum* (Haas, 1969), from the Wenban Limestone (Pragian), Cortez Gold Mine haul road, southern Cortez Mountains, Eureka County, Nevada, USA. All specimens are from locality CR-H. 1, 4. Dorsal exoskeleton, SUI 109012, dorsal and right lateral views, x5. 2, 3, 6. Dorsal exoskeleton, SUI 109013, dorsal, ventral, and left lateral views, x4. 5. Dorsal exoskeleton, SUI 109014, dorsal view, x5. 7. Posterior part of thorax and pygidium, SUI 109015, dorsal view, x5. 8. Dorsal exoskeleton, SUI 109016, dorsal view, x6.

Description. Except where a range is indicated, cranidial measurements are based on the undistorted specimen of Figure 3.1. Cranidium with sagittal length 91% width across midlength of palpebral lobes; width across maximum divergence of anterior sections of facial sutures 91.7% (87.3–96.0) width across midlength of palpebral lobes; width across midlength of palpebral lobes 74.4% width across posterior fixigenae; cranidium with substantial dorsal convexity in sagittal profile; glabella independently inflated and describing sagittal arc distinct from that of LO or preglabellar field; preglabellar field with more sharply inflated area immediately in front of preglabellar furrow, anterior part descending steeply to anterior border furrow; SO with strong dorsal convexity in sagittal profile; anterior border with sagittal length 17.8% (16.7–18.8) cranidial sagittal length, long and dorsally flat on posterior $\frac{3}{4}$ of area; anterior aspect abruptly curved to form rounded forward-pointing rim with sculpture of fine, closely spaced raised lines, larger and more distinct near

anterior/ventral margin; dorsal aspect of anterior border lacking sculpture; anterior margin of anterior border with nearly even and moderate anterior curvature in dorsal view; anterior border longest sagittally, slightly shortened exsagittally; anterior border furrow shallow and long (sag.; exsag.); with even anterior curvature in dorsal view, but less arcuate than anterior margin of anterior border, hence producing differential length of border sagittally vs exsagittally; anterior border furrow expressed not as a recessed area in the plane of the anterior border (in sagittal view) but set rearward and following the steeply declined slope of the preglabellar field; anterior border furrow of about the same length and depth along course, except distally near facial suture, where it is abruptly shallowed and much less distinct; preglabellar field with sagittal length in dorsal view 13.1% (12.8–13.4) that of cranidium, with background sculpture of very fine and faint caecal pitting; preglabellar field and frontal area with sparsely but evenly distributed small to medium tubercles; anterior sections of facial suture strongly anteriorly divergent immediately in front of β , curved more adaxially opposite anterior part of frontal area so as to be only moderately anteriorly divergent opposite anterior border; interocular fixigena quite broad, sloping downward in transverse profile from palpebral lobe toward axial furrow, with some dorsal inflation, sculpture smooth except for a very sparse smattering of very small tubercles in some specimens; anterior edge of interocular fixigena bounded by prominent eye ridge running obliquely from S3 slightly posteriorly to leading edge of palpebral lobe; eye ridge subquadrate in section, set off from frontal area by narrow, incised furrow and from interocular fixigena by much less prominent change in slope; palpebral lobe large, semilunate, adaxial $\frac{3}{4}$ of area sloped strongly downward toward interocular fixigena, abaxial $\frac{1}{4}$ of area sloped down toward lateral margin; sculpture of very fine granules, and faint pit set more or less centrally, and one or two small tubercles; glabella with sagittal length (excluding LO) 86.7% maximum width across rear of L1; axial furrows broad, relatively shallow, deflected in course laterally around L1 and wider opposite anterior half of L1 than opposite posterior half, deflected again around bulging L2, more anteriorly convergent in front of L2, and turned out once more at anterior edge of eye ridge near position of ventral fossulae, curving sharply into much narrower and more incised preglabellar furrow; preglabellar furrow describes flattened anterior arc, only moderately bowed anteriorly; SO about same breadth and depth as anterior part of axial furrow, deflected posteriorly around posterior bulge of L1, with slight posterior bow in median part; L1 teardrop shaped, anterior tip turned slightly abaxially, anterior edge set just posterior to midlength of palpebral lobe; L1 with dorsal inflation similar to that of main glabellar lobe, with sculpture of several small to moderate scattered tubercles; S1 deep along course, fully isolating L1, slightly deeper and wider distally near contact with axial furrow, of similar depth posteriorly to median part of SO; L2 developed as a small but distinct lateral bulge in front of S1; S2 discernible as a small notch or lateral depression set posterior to rear edge of eye ridge; L3 not independently inflated from main lobe of glabella; main lobe of glabella with sculpture of scattered tubercles of small to moderately large size, largest tubercles concentrated on posterior part and median mid-part, tubercles very sparse around anterior and anterolateral surfaces in front of L2; LO with sagittal length 13.6% (13.3–13.9) that of cranidium, shorter exsagittally behind L1, with sculpture of sparsely scattered small tubercles, somewhat less developed on anterior part in larger specimens, and small median node set slightly posterior to half sagittal length and slightly larger than other tubercles on ring; axial furrow deflected posterolaterally around chevron-shaped lateral margin of LO, confluent with posterior border furrow which is narrower than axial furrow; posterior part of fixigena inflated posterolateral to L1, smooth; posterior projection transverse to fulcrum, turned sharply posteriorly distal to fulcrum; posterior border short (exsag.) proximally, about doubled in length distal to fulcrum; posterior border furrow with slightly sinuous course, not turned posteriorly at fulcrum as much as posterior margin of projection; doublure beneath LO not completely preserved in any available specimen, but clearly broad and slightly concave; articulating groove developed beneath proximal part of posterior border; small but prominent fossulae set just abaxial to axial furrow in front of palpebral lobes.

Librigena with moderately large eye (smaller than in many congeneric species), visual surface not preserved in any available specimen; bilobate eye socle faintly expressed, nearly merged with field, best seen ventrally (Fig. 4.4); field moderately narrow and long, lacking in sculpture except for very fine background granulation and barely discernible caecal trunks and pitting (again best seen on internal surface); a few very

small and very subdued tubercles developed on posterior part of field in some specimens near to posterior border furrow; lateral border furrow very shallow and broad, set subparallel to curve of lateral margin, mainly describing a change in slope from field to border rather than a depressed furrow; posterior border furrow narrow and incised; lateral and posterior border furrows meet at genal angle (lateral border furrow substantially shallower anterior to this junction) to run distally along dorsal aspect of genal spine; furrow on spine well expressed only proximally, very faint to indiscernible on distal parts of spine; lateral border broad and robustly inflated, of similar width anteriorly and posteriorly, lacking sculpture except fine subparallel raised lines on ventrolateral aspect; posterior border narrower than lateral border, but strongly inflated; genal notch oblique and arcuate; genal spine very broad at base and long, tapering evenly along length; row of moderately sized tubercles developed in most specimens on posterior border and along adaxial dorsal aspect of genal spine, in some specimens with a few very small accessory tubercles scattered proximally; anterior projection not markedly long; ventral aspect of lateral border with distinct rim developed along sharp break in slope to doublure, raised lines closely spaced along this rim; doublure forming a smooth and broad surface turned up to underlie inner half of border; inner margin of doublure running along adaxial edge of border furrow, forming sharp angle, but no Panderian notch, in front of base of genal spines; rim of lateral border grades into flattened base of genal spine; genal spine with broad, slightly flattened ventral aspect with sculpture of very fine granules.

Rostral plate (Fig. 3.9) very wide and short, connective sutures set almost transversely; anterior margin with anterior curvature matching that of anterior border, posterior margin with narrow curved median portion; ventral aspect with sculpture of raised lines similar to, but not confluent with, those on adjacent librigenal doublure; ridge developed at contact with doublure, matching that on adjacent librigena, inturned doublural area very small and subtriangular.

Hypostome with sagittal length 92.6% maximum width across anterior wings; width across shoulders 72.8% width across anterior wings; anterior margin nearly transverse medially with only slight posterior median bow, deflected posteriorly distally to run toward anterior wings; anterior wings turned slightly anteriorly at tips, large and subtriangular, with small ventral pit marking base of dorsal process; lateral margin straight immediately behind anterior wing, flared laterally to form shoulder, straight and obliquely set between shoulder and contact with posterior margin; posterior margin nearly straight, posterolateral corner with prominent short spine, lost in larger specimens; lateral border independently inflated, of similar width along length, with sculpture of fine raised lines set subparallel to margins; posterior border shorter (sag., exsag.) than lateral border is wide, with similar raised line sculpture in smaller specimens; posterior part of lateral border and all of posterior border effaced and nearly merged into broad shelf in larger specimens (Fig. 3.20); lateral border furrow deep and incised anteriorly, much shallower opposite posterior lobe of middle body, running very slightly adaxially anteriorly, turned out toward shoulder opposite posterior lobe of middle body; posterior part of lateral border furrow and posterior border furrow merged into broad depression occupying area behind middle body; depression shallowed in larger specimens; middle furrow describing deep, smooth U shape, running without interruption from lateral border furrow, deep laterally, shallower but sharply defined medially; anterior lobe of middle body with moderate to strong ventral inflation, lacking sculpture; posterior lobe of middle body much more weakly inflated than anterior lobe, describing shallow V shape with three independent subtle inflations, two laterally and one medially; doublure underlying lateral and posterior borders, lacking sculpture, forming small sharp obliquely set ridge beneath shoulder.

Thorax of 13 segments. Maximum thoracic width across fifth or sixth segment; axis occupying about 40% of segment width on first segment, about 32.5% on fifth, and about 30% on 13th; typical segment with very shallow W-shaped ring, longer (exsag.) near axial furrow than sagittally, with sculpture of a transverse row of very faint small tubercles; distinct but small median tubercle visible on anterior 4–5 segments, not discernible on posterior segments; ring set off from broad articulating half ring by short, transverse, and incised ring furrow; axial furrow shallow and set slightly obliquely so as to run very slightly posterolaterally; fulcrum set close to axis, proximal part of pleura narrower than distal part, accounting for about 35% of pleural width; pleural furrow deepest across fulcrum, set obliquely to run posterolaterally, with slight deflection in course

around fulcrum, shallowed almost completely immediately at contact with axial furrow, narrowing to fine lineation distally and running toward posterior part of pleural tip behind articulating facet; anterior pleural band slightly shorter (exsag.) than posterior band; anterior band lacking sculpture; posterior band of some segments and in some specimens with transverse row of very small tubercles similar to that developed on axial ring; both pleural bands offset at fulcrum by strong, subtriangular articulating process developed



FIGURE 3. *Maurotarion periergum* (Haas, 1969), from the Wenban Limestone (Pragian), Cortez Gold Mine haul road, southern Cortez Mountains, Eureka County, Nevada, USA. Specimens are from locality CR-H except where noted. 1, 4, 7, 10, 15. Cranidium, SUI 109017, dorsal, right lateral, oblique, anterior, and ventral views, x7.5 (CR-B). 2, 5, 8. Cranidium, SUI 109018, dorsal, left lateral, and anterior views, x7.5. 3, 6, 9. Cephalon lacking right librigena, SUI 109019, dorsal, left lateral, and ventral views, x10. 11. Hypostome, SUI 109020, ventral view, x10. 12–14. Cranidium, SUI 109021, anterior, left lateral, and dorsal views, x10. 16–19. Hypostome, SUI 109022, ventral, posterior, left lateral, and dorsal views, x10. 20. Hypostome, SUI 109023, ventral view, x10.

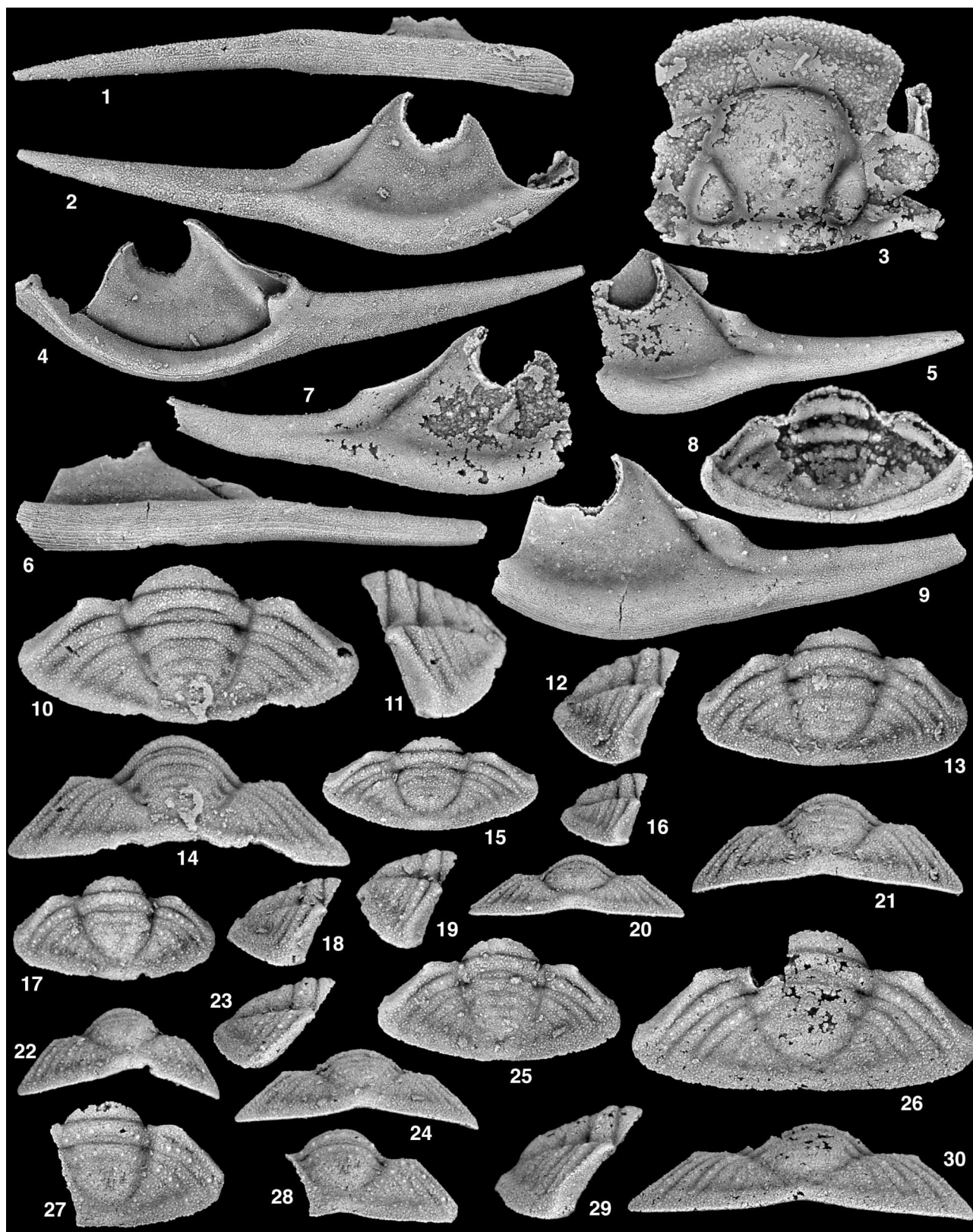


FIGURE 4. *Maurotarion periergum* (Haas, 1969), from the Wenban Limestone (Pragian), Cortez Gold Mine haul road, southern Cortez Mountains, Eureka County, Nevada, USA. Specimens are from locality CR-H except where noted. 1, 2, 4. Right librigena, SUI 109024, ventrolateral, external, and internal views, x7.5. 3. Cranidium, SUI 109025, dorsal view, x6. 5. Left librigena, SUI 109026, external view, x7.5. 6, 9. Left librigena, SUI 109027, ventrolateral and external views, x7.5. 7. Right librigena, SUI 109028, external view, x7.5. 8, 12, 13, 21. Pygidium, SUI 109029, ventral, right lateral, dorsal, and posterior views, x10. 10, 11, 14. Pygidium, SUI 109030, dorsal, left lateral, and posterior views, x10 (CR-B). 15, 16, 20. Pygidium, SUI 109031, dorsal, right lateral, and posterior views, x10. 17, 18, 22. Pygidium, SUI 109032, dorsal, right lateral, and posterior views, x10. 19, 24, 25. Pygidium, SUI 109033, right lateral, posterior, and dorsal views, x10. 23, 27, 28. Pygidium, SUI 109034, right lateral, dorsal, and posterior views, x10. 26, 29, 30. Pygidium, SUI 109035, dorsal, right lateral, and posterior views, x10.

forward from anterior band and received as notch in posterior band; pleural tips of first three segments short and developed into lateral point with small posterolaterally directed spine; pleural tips of segments 5–9 subquadrate; those of segments 10–13 more lobate and rounded; doublure underlying pleural tip with strong notch on posterior part for reception of leading edge of posterior segment during enrollment; doublure underlies posterior edge of posterior pleural band to fulcrum; proximal to fulcrum a transverse articulating groove is formed which receives a dorsal transverse ridge developed on the anterior edge of the anterior pleural band; strong knob-shaped apodeme projected ventrally and rear of axial furrow on each segment.

Pygidium with sagittal length 48.3% (43.7–51.4) maximum width; width across fulcrum 62.1% (59.4–64.9) maximum width; axis with maximum anterior width 36.8% (34.9–38.4) maximum pygidial width and 92.5% (73.1–99.1) sagittal length of axis; sagittal length of axis 82.6% (79.3–85.5) sagittal length of pygidium; all dorsal pygidial surfaces with subdued, close-set granular sculpture; small, low tubercles developed most prominently on first axial ring and posterior pleural band of first segment; in some specimens very faint tubercles visible on second axial ring (Fig. 4.17); tubercles developed on posterior pleural band of second segment in most specimens, but fewer and more subdued than on first; tubercles in general more prominent on smaller specimens; largest specimen (Figs. 2.1, 4.10) lacking tubercles altogether; articulating half ring large; axis composed of four rings and a terminal piece; ring furrow incised, very short (sag., exsag.), bowed slightly anteriorly; first axial ring shorter sagittally than exsagittally, bulging abaxially near axial furrow; pseudo-articulating half ring very prominent on second segment, faint but expressed on all specimens on third; not discernible on fourth; axis with moderate transverse dorsal convexity; prominent muscle scars developed on anterolateral part of rings on all four segments in some specimens (e.g., Fig. 4.10); axial furrows with somewhat uneven course, deflected laterally around rings, posteriorly convergent, meeting posterior to fully circumscribe axis, though median part distinctly shallow in some specimens; pleural bands of first three segments clearly expressed, fourth indistinct; anterior and posterior pleural bands of approximately similar length (exsag.) except anterior band of first segment constricted distally behind articulating facet; pleural bands with granulose sculpture similar to that of rings; posterior pleural band of first and sometimes second segment of some specimens with transverse row of very small, subdued tubercles; broad border with granulose sculpture, longer/wider abaxially than sagittally, pleural and interpleural furrows running onto border at first segment, terminating at inner edge of border on posterior segments; posterior margin describing nearly even posterior arc in dorsal view, with only slight median indentation; pygidium flexed medially in posterior view; doublure with faint sculpture of raised lines, exactly underlying dorsal expression of border.

Discussion. Members of the Malvinokaffric *Maurotarion dereimsi* group remain the closest morphological comparison for *M. periergum*, and Adrain and Edgecombe (1996, p. 422) contrasted the taxa at length. Of the other species present in the Wenban Limestone, *M. periergum* is most similar to *M. chrySION*, with which it is compared under discussion of that species below.

Small holaspide hypostomes have a conventional aulacopleurid morphology (Fig. 3.16) with two small posteriorly directed spines at the posterolateral corners. Larger specimens (Fig. 3.20) have the posterior portion substantially altered, with the posterior and lateral borders partly effaced to form a broad shelf and the posterolateral spines reduced or lost.

***Maurotarion chrySION* n. sp.**

(Figs 5, 6.1–6.7, 6.9, 6.11, 6.12)

Type material. Holotype, dorsal exoskeleton, SUI 109036 (Figure 5.1, 5.3, 5.4, 5.5., 5.8, 5.10), from locality CR-G(a), Wenban Limestone (Pragian), Cortez Gold Mine haul road, southern Cortez Mountains, Eureka County, Nevada, USA. Assigned specimens SUI 109037, 109039, 109044, 109045, from locality CR-G(a), SUI 109038, 109040–109042, from locality CR-G(b).

Etymology. Greek *chrySION*, gold, in reference to the Cortez Gold Mine.

Diagnosis. Dorsal sculpture mostly lacking, except for faint tubercle rows on thoracic axial rings; glabella relatively narrow and L1 small; genal spines of only moderate length; thorax of 12 segments; pygidium with only two clearly expressed rings and segments, though third likely present but effaced.

Description. Cranidial measurements were made only on the holotype specimen (Fig. 5.1), as the others are not completely enough preserved. Cranidium with sagittal length 80.8% width across midlength of palpebral lobes; width across anterior border 79.3% width across midlength of palpebral lobes; width across midlength of palpebral lobes 74.1% maximum cranidial width across posterior projections; anterior border with sagittal length 14.3% that of cranidium, lacking dorsal sculpture, flat over rear two thirds of area, evenly curved in sagittal section in anterior third, very faint sculpture of fine raised lines on anteroventral aspect near margin; anterior border furrow shallow and relatively short (sag., exsag.), similar in depth along course except slightly shallowed near facial suture; anterior margin and anterior border furrow with even anterior curvature, not V-shaped; preglabellar field long, sagittal length 19.8% that of cranidium, with moderate independent dorsal inflation in sagittal profile; preglabellar field and frontal area entirely lacking sculpture; anterior sections of facial suture strongly anteriorly divergent in front of palpebral lobes, maximum point of divergence opposite rear third of anterior border; eye ridge discernible only as a break in slope between frontal area and interocular fixigena; interocular fixigena relatively narrow, narrower than palpebral lobe, sloped strongly downward toward axial furrow, lacking sculpture; palpebral furrow present only as a slight break in slope anteriorly and posteriorly; palpebral lobe with exsagittal length 31.1% that of sagittal length of cranidium, lateral margin strongly laterally convex, lacking dorsal sculpture except for faint pit set at half length and slightly nearer to lateral margin than to adaxial edge of lobe, lobe held nearly horizontal; axial furrows moderately wide and deep, very slightly wider posteriorly, deflected weakly around L1, gently anteriorly convergent anterior to L1, running without interruption into strongly anteriorly bowed preglabellar furrow of similar depth; glabella with sagittal length 96.6% maximum width across rear of L1; L1 of moderate size, adaxial half teardrop shaped as in congeners but lateral margin slightly dimpled; S1 narrower than axial furrow, running uninterrupted from axial furrow to SO to fully isolate L1, junction with SO abrupt, not expanded into depressed area; SO slightly posteriorly bowed medially, deflected posteriorly behind L1 but not as strongly as many congeners, moderately deep and short (sag., exsag.); median glabellar lobe lacking sculpture; L2 with slight independent inflation, S2, L3, and S3 not discernible dorsally, but defined ventrally (Fig. 5.8); LO with sagittal length 13.2% that of cranidium, slightly longer exsagittally near junction of SO and S1, shorter behind L1, with faint median node at half length and very faint transverse row of small tubercles nearly posterior margin; posterior fixigena slightly inflated, sloped strongly posteriorly from rear of palpebral lobe, lacking dorsal sculpture, extended as moderately long (exsag.) strip along posterior projection; posterior border furrow short (exsag.) and incised, with nearly transversely straight course, only slightly posteriorly deflected at fulcrum; posterior border very short proximally, lengthened steadily distal to fulcrum, lacking sculpture, with weak dorsal inflation; doublure obscure due to articulation; S2 and S3 with obvious ventral expression as small ridges; fossula not obvious.

Librigenal field with width at half length of eye 27.2% exsagittal length; eye with exsagittal length 45.1% that of field; socle expressed only as very faint anterior lobe (Fig. 6.4) and narrow, very shallow furrow around base of visual surface; field completely lacking sculpture; lateral border furrow with gentle lateral curvature, very shallow, especially anteriorly and posteriorly, little more than a break in slope between field and border; lateral border moderately wide and inflated, slightly narrower anteriorly, lacking sculpture dorsally, but with many closely set fine raised lines laterally and ventrolaterally, with lateral margin slightly more strongly laterally bowed than lateral border furrow; posterior border furrow much deeper and more incised than lateral border furrow, with slightly sinuous oblique course; posterior border about as long as rear of lateral border is wide, lacking sculpture, forming shallow angle with genal spine; genal spine relatively short, sharply tapered, extending posteriorly to terminate opposite fourth thoracic segment, lacking dorsal sculpture; faint furrow running posteriorly from junction of lateral and posterior border furrows discernible on anterior two thirds of spine; anterior projection relatively short; doublure with larger and more widely spaced raised lines than ventrolateral aspect of lateral border, lines become effaced near base of genal spine, not

visible on ventral aspect of spine, doublure turned sharply upward and inward adaxially, forming unsculptured region terminated by inner margin aligned beneath lateral border furrow.

Rostral plate known only from articulated holotype (Fig. 5.8); broad, with wide anterior extent, posterior margin not reduced to a point but occupying narrow, anteriorly arced portion of adaxial doublural margin; connective sutures running obliquely, bowed slightly laterally; ventral surface with sculpture of closely spaced fine raised lines contiguous with those on librigenal doublure.

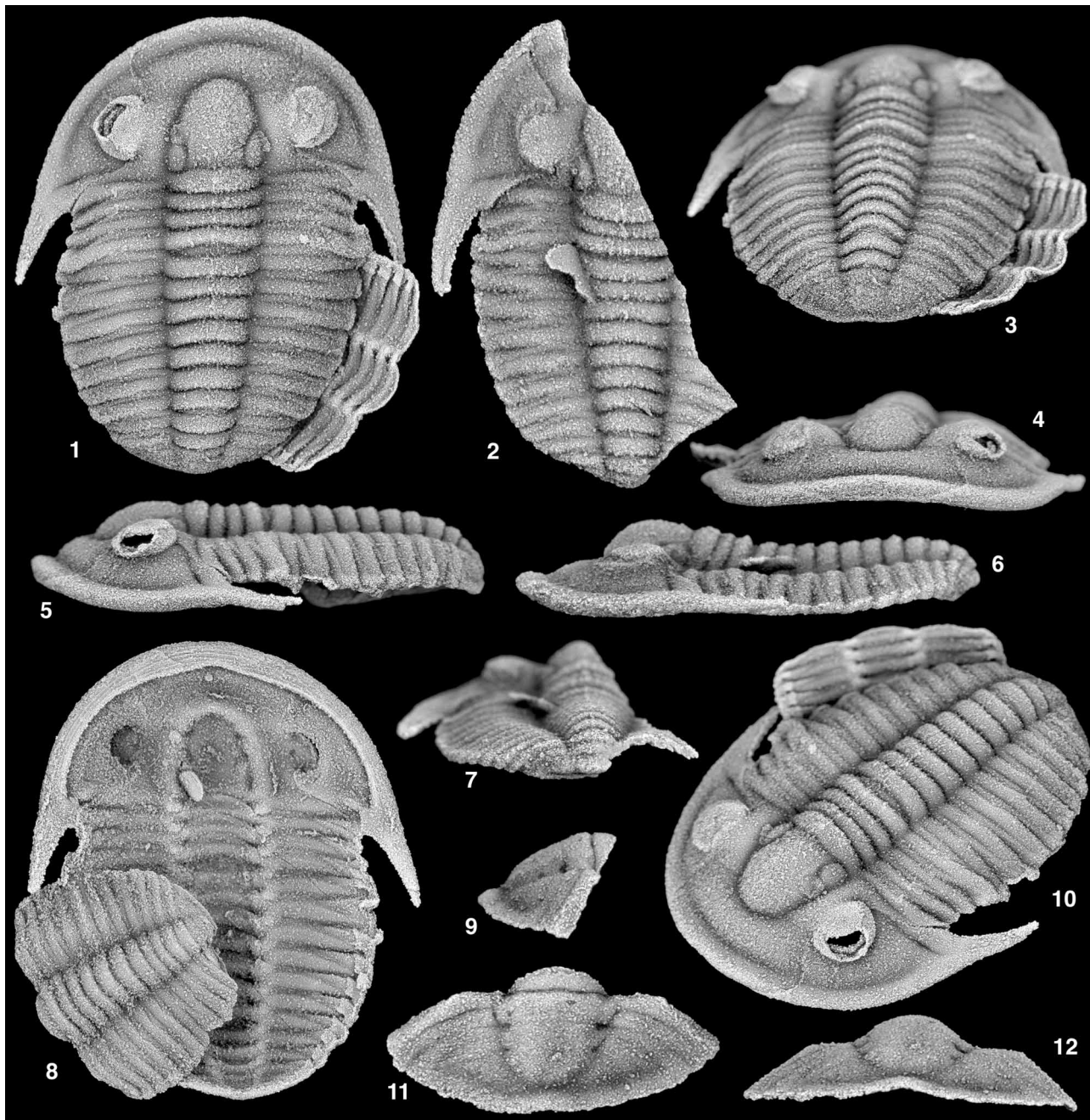


FIGURE 5. *Maurotarion chryson* n. sp., from the Wenban Limestone (Pragian), Cortez Gold Mine haul road, southern Cortez Mountains, Eureka County, Nevada, USA. 1, 3, 4, 5, 8, 10. Dorsal exoskeleton (with portion of thorax and pygidium of different individual attached), **holotype**, SUI 109036, dorsal, dorsal pygidial, anterior, left lateral, ventral, and oblique views, x5 (CR-G(a)). 2, 6, 7. Dorsal exoskeleton, SUI 109037, dorsal, left lateral, and posterior views, x7.5 (CR-G(a)). 9, 11, 12. Pygidium, SUI 109038, right lateral, dorsal, and posterior views, x10 (CR-G(b)).

Hypostome not recovered.

Thorax of 12 segments; widest across fifth segment; axis occupying 34% width of thorax across first segment, 30% across fifth segment, and 32% across 12th segment; fulcrum set at about half distance distally on pleurae of anterior and middle segments, closer to axis on posterior segments; axial ring of first three

segments short (sag.; exsag.) those of posterior nine segments longer, and of approximately similar length to each other; first four axial rings with faint transverse row of small tubercles aligned near posterior margin, tubercle row possibly poorly expressed on more posterior segments but difficult to discern; axial rings with very shallow W shape; ring furrow (seen on fourth segment of holotype, Fig. 5.1) short, shallow and finely incised; axial furrow shallow; anterior pleural band shorter (exsag.) than posterior band; both bands lacking dorsal sculpture; pleural tips bluntly terminated and subquadrate; pleural furrow deepest across fulcrum, very short (exsag.) and finely incised distally, running nearly to pleural tip, deflected slightly posteriorly behind facet.

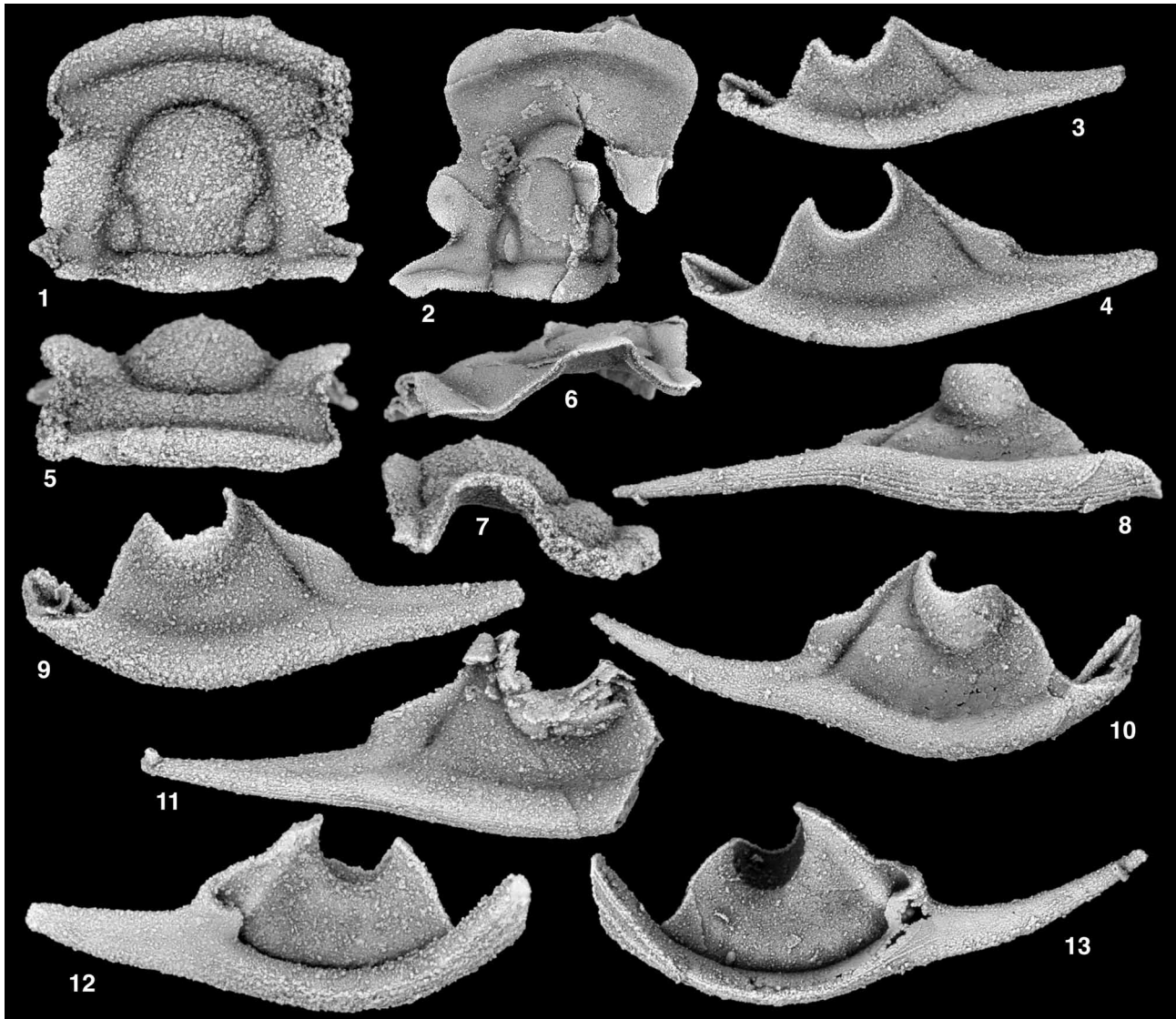


FIGURE 6. 1–7, 9, 11, 12, *Maurotarion chryson* n. sp., from the Wenban Limestone (Pragian), Cortez Gold Mine haul road, southern Cortez Mountains, Eureka County, Nevada, USA. 1, 5, 7. Cranidium, SUI 109039, dorsal, anterior, and right lateral views, x10 (CR-G(a)). 2, 6. Cranidium, SUI 109040, dorsal and left lateral views, x7.5 (CR-G(b)). 3. Left librigena, SUI 109041, external view, x7.5 (CR-G(b)). 4. Left librigena, SUI 109042, external view, x7.5 (CR-G(b)). 9, 12. Left librigena, SUI 109044, external and internal views, x10 (CR-G(a)). 11. Right librigena, SUI 109045, external view, x10 (CR-G(a)). 8, 10, 13. *Maurotarion* sp. indet. from the Wenban Limestone (Pragian), locality CR-C, Cortez Gold Mine haul road, southern Cortez Mountains, Eureka County, Nevada, USA, right librigena, SUI 109043, ventrolateral, external, and internal views, x10.

Pygidium with sagittal length 43.7% maximum width; axis with anterior width 36.2% maximum pygidial width; only two axial rings and pleural furrows clearly expressed, but a third is likely present though effaced and merged with a terminal piece; articulating half ring large and crescentic; dorsal sculpture of fine granules, nearly smooth on posteromedian surfaces, tuberculate sculpture completely absent; first and second ring furrows expressed only as distal notches, posterior ones not expressed; axial furrow shallow, strongly

deflected around first two segments, but meeting posterior to fully circumscribe axis; fulcrum set near to axis; anterior and posterior pleural bands expressed fully only on first segment, subequal in length; first pleural furrow well expressed and finely incised, turned posterolaterally at fulcrum to run subparallel to anterior pygidial margin; first interpleural furrow shallower than first pleural furrow, but complete from axial furrow across border to margin; second pleural furrow faint but discernible; second interpleural furrow very faint; broad, flattened border present, crossed only by first interpleural furrow; border with median inflection in dorsal view, bowed dorsally behind axis in posterior view; doublure broader anteriorly than posteriorly or medially, with sculpture of subparallel fine raised lines.

Discussion. *Maurotarion chrysion* occurs together with *M. wenbanense* at locality CR-G, but the species are very distinct and there is little chance of confusion or misassociation, particularly since each is represented by articulated specimens. The species share a relatively short median part of the anterior border and shallowing of the librigenal lateral border furrow in front of the genal spine with the posterior border furrow extended along the spine. However, there are many differences. *Maurotarion chrysion* lacks dorsal tuberculate sculpture in large specimens, its glabella is relatively smaller, its genal spine base is not inflated and the spine is smaller, its thorax has 12 versus 13 segments and has a relatively narrower axis, and its pygidium has three (only two well expressed) versus four axial rings.

Maurotarion chrysion differs from *M. fooi* **n. sp.** in the complete lack of cranial tuberculate sculpture in large specimens, versus presence on L1, a longer preglabellar field and broader frontal areas, and librigenae lacking expression of the socle, with a broader field, particularly posteriorly, narrower lateral border, and much shorter genal spine. The only other well known Laurentian Lower Devonian species is *M. axitiosum* (Campbell, 1977), from the Lochkovian Haragan Formation of Oklahoma (Campbell, 1977, pl. 3, figs. 2–6). *Maurotarion chrysion* differs from the slightly older *M. axitiosum* in the absence versus presence of tuberculate sculpture on the cranidium and librigenal field; the possession of larger L1; a much longer preglabellar field; a shallower anterior border and librigenal lateral border; a librigenal lateral border that is shallowed in front of the genal spine, versus merged with the posterior border in front of the spine; a much shorter genal spine; 12 versus 11 thoracic segments; and narrower thorax; very subdued tubercle rows on the axial rings of some segments only versus stronger tubercle rows on the axial ring and posterior pleural bands of most segments of most specimens; and a pygidium with only two versus three fully expressed rings.

***Maurotarion wenbanense* n. sp.**

(Fig. 7)

Type material. Holotype, dorsal exoskeleton, SUI 109047, (Figure 7.2, 7.3, 7.6, 7.8, 7.10, 7.13), from a talus block collected along the Cortez Gold Mine haul road, Wenban Limestone (Pragian), southern Cortez Mountains, Eureka County, Nevada, USA. Assigned specimen SUI 109046 from locality CR-G(a).

Etymology. From the Wenban Limestone.

Diagnosis. Cranidium with moderately dense tuberculate sculpture on glabella and scattered tubercles on the frontal areas; L1 large; librigena with very short genal spines, field lacking sculpture; thorax of 13 segments; prominent transverse tubercle row on rear of LO and thoracic axial rings; pygidium with three distinctly expressed axial rings, lacking dorsal sculpture.

Description. Cranial measurements were made only on the holotype specimen (Fig. 7.2) as the other specimen is somewhat distorted and crushed. Cranidium with sagittal length 83.8% width across midlength of palpebral lobes; width across anterior border 80.2% width across midlength of palpebral lobes; moderate dorsal inflation and convexity in sagittal profile, glabella and preglabellar field with independent inflations; anterior border with very slightly inverted V-shaped anterior margin, relatively short, sagittal length 12.5% that of cranidium, very slightly shorter exsagittally near facial suture, entirely lacking sculpture, rear part flat in profile, anterior part curved and subcylindrical in profile; anterior border furrow long (sag., exsag.) and shallow, with similar inverted V course to anterior margin, of similar length sagittally and exsagittally, slightly

shallowed near facial suture; preglabellar field long, 18.7% sagittal length of cranidium, field and frontal area with sparse sculpture of widely scattered moderate sized tubercles; eye ridge very faint, expressed most clearly immediately adjacent to axial furrow, with single tubercle set atop about 40% distance abaxially; interocular fixigena broad and lacking sculpture, separated from frontal area only by subtle break in slope due to subdued eye ridge, confluent with posterior fixigena; palpebral lobe with exsagittal length 30.5% that of sagittal length of cranidium, nearly flat, with only slight downward slope toward interocular fixigena, lacking in sculpture except for small pit set abaxial to center, lateral margin with strong, semilunate lateral convexity; palpebral furrow present only as a slight break in slope, most obvious anteriorly and posteriorly; glabella with sagittal length 98.3% maximum width across rear of L1; axial furrows wide and shallow, deflected strongly around L1, so outline of glabella is bell shaped in plan view, moderately anteriorly convergent in front of L1; preglabellar furrow shorter (sag., exsag.) than axial furrow is wide, slightly deeper, with weak anterior arc; L1 relatively large, teardrop shaped, with several small tubercles; S1 narrow and deep, nearly straight with oblique course, slightly wider and deeper near contact with axial furrow, fully isolating L1; S2 present as a slight indentation of lateral margin of glabella, L2 with extremely weak independent inflation; S3 and L3 not discernible dorsally, though S3 visible as very small lateral impression ventrally (Fig. 7.3); median glabellar lobe with sculpture of fairly densely scattered mixed small and medium sized tubercles; SO long (sag., exsag.) and shallow, anterior margin sharper than posterior margin, bowed posteriorly across median portion, shorter, deeper, and deflected posteriorly behind L1; LO with sagittal length 13.1% that of cranidium, somewhat shorter laterally behind L1, with prominent median node set at half length and sculpture of an aligned row of medium sized tubercles near posterior margin, with several smaller scattered tubercles; posterior fixigena moderately inflated, lacking dorsal sculpture, extending as broad triangular strip on posterior projection; posterior border furrow very short (exsag.), moderately deep, proximal part running transversely or very slightly anteriorly, turned slightly posteriorly at fulcrum; posterior border short and dorsally convex proximally, longer and turned posteriorly distal to fulcrum, lacking sculpture except for one small tubercle just abaxial to fulcrum in the holotype (a serial homologue of similar tubercles developed on the thoracic posterior pleural bands); ventral features largely obscured in available specimens, but fossula distinct.

Librigenal measurements were made on the right librigena of the holotype (Fig. 7.3), as it is almost perfectly preserved. Librigenal field with minimum width opposite half length of eye 26.1% exsagittal length; eye large, with exsagittal length 50.0% that of field; inflated socle not obvious, visual surface bounded by narrow depressed area on field; field completely lacking sculpture; lateral border furrow very shallow, mainly present as break in slope between field and border; border relatively narrow, of similar width everywhere along course, lacking sculpture dorsally with subdued fine subparallel lines ventrolaterally; posterior border furrow deeper and narrower than lateral border furrow, meeting lateral border furrow at acute angle; posterior border similar in exsagittal length to width of lateral border, lacking sculpture, forming oblique angle with base of genal spine; genal spine very short, with blunt tip, lacking dorsal sculpture, bisected dorsally by very faint furrow running distally from junction of lateral and posterior border furrows; anterior projection long, about twice length of genal spine; ventral morphology poorly known.

Rostral plate anteriorly very wide (Fig. 7.3, 7.11, 7.12), transversely bowed; posterior margin also with considerable transverse extent; connective sutures oblique but nearly transverse, very long; ventral sculpture of many subparallel raised lines contiguous with those on ventrolateral aspect of librigenal lateral borders.

Hypostome represented by one specimen on holotype (Fig. 7.3), but morphology obscured by underlying right librigena and rostral plate. Thorax of 13 segments. Axis occupying about 36% of width anteriorly, tapered gradually to about 26% posteriorly; maximum width achieved across third or fourth segment, roughly the same as sagittal length; fulcrum set about two thirds distance distally on pleurae on anterior segments, slightly less than half distance distally on posterior segments; axial rings shortest (sag., exsag.) anteriorly, progressively longer but narrower on posterior segments; axial furrow deeper than pleural furrow, deflected around bowed lateral margin of ring; rings describing subtle W shape, with dorsal sculpture of a transverse row of moderate sized tubercles, less well expressed posteriorly; anterior and posterior pleural bands of similar length (exsag.), posterior band with transverse row of very faint small tubercles (almost effaced in

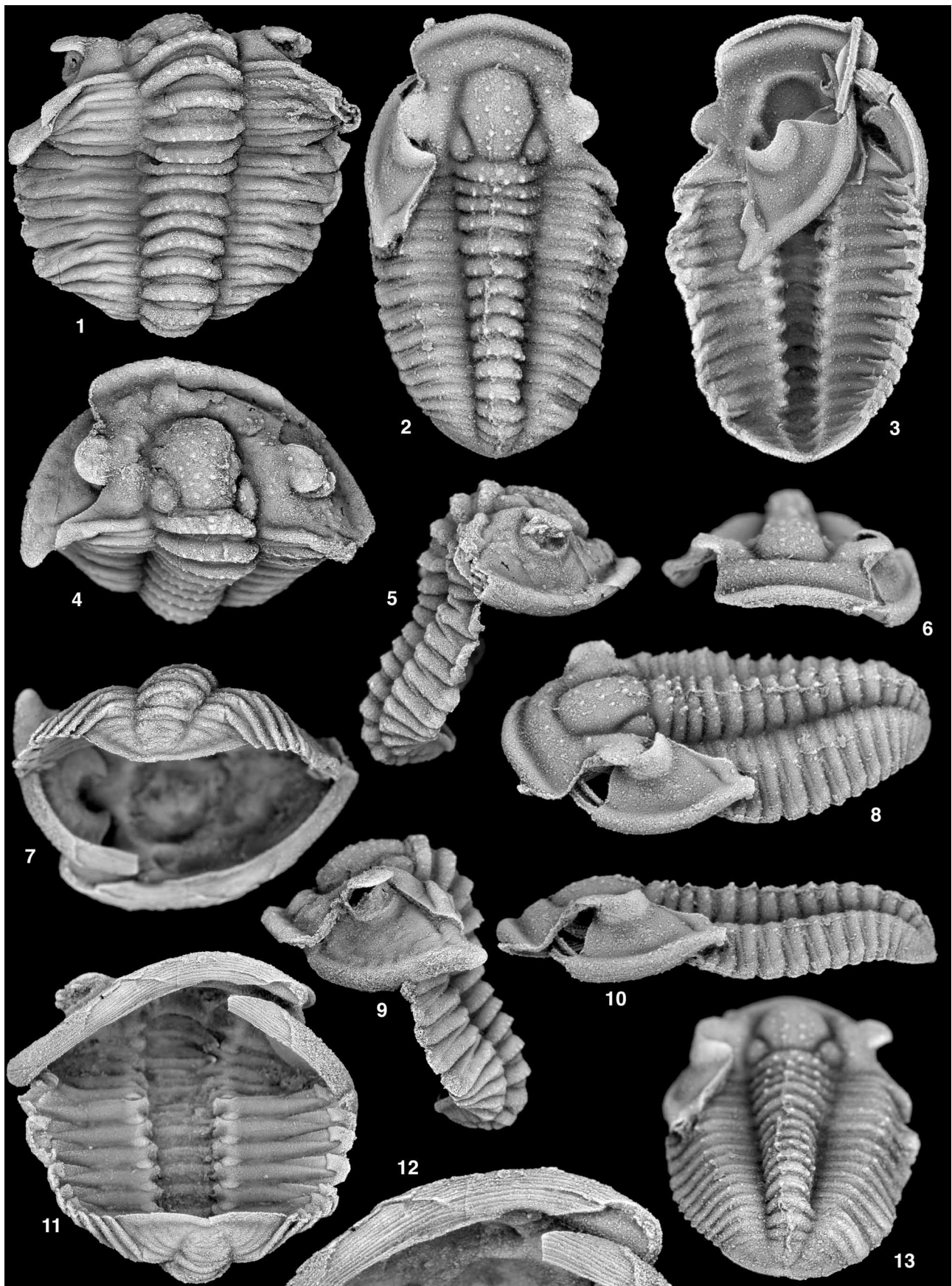


FIGURE 7. *Maurotarion wenbanense* n. sp., from the Wenban Limestone (Pragian), Cortez Gold Mine haul road, southern Cortez Mountains, Eureka County, Nevada, USA. 1, 4, 5, 7, 9, 11, 12. Dorsal exoskeleton, SUI 109046, dorsal thoracic, dorsal cephalic, right lateral, dorsal pygidial, left lateral, ventral views, and detail of rostral plate, x5 except 12, x7.5 (CR-G(a)). 2, 3, 6, 8, 10, 13. Dorsal exoskeleton, **holotype**, SUI 109047, dorsal, ventral, anterior, librigenal external, left lateral, and dorsal pygidial views, x7.5 (talus block along haul road).

larger specimen) and one more prominent tubercle just abaxial to fulcrum (again almost effaced in larger specimen); pleural furrow short (exsag.) proximally and distally, incised, slightly longer across fulcrum; anterior pleural band developed into wide (tr.) articulating facet distal to fulcrum; pleural tip blocky and subquadrate, with a few subdued tubercles along margin, and with pleural furrow continued to margin; double underlying pleural tip with articulatory notch; small apodemes present beneath rear of axial furrow.

Pygidial measurements were made only on the pygidium of the holotype (Fig. 7.13); because it is articulated, the sagittal length of the pygidium does not include the articulating half ring. Pygidium with sagittal length 39.4% maximum width; width across fulcrum 62.8% maximum width; axis with anterior width 31.6% maximum pygidial width and 104.3% sagittal length of axis; sagittal length of axis 76.9% that of pygidium; entire pygidium lacking dorsal sculpture; three axial rings distinct, with possibly a fourth expressed in front of transverse terminal piece (Fig. 7.7); rings slightly longer exsagittally than sagittally; second and third rings with prominent pseudo-articulating half rings; axial furrows moderately deep, meeting posteriorly to fully circumscribe axis; pleural furrows of first and second segments well expressed, that of third faintly expressed; anterior pleural band apparently shorter (exsag.) than posterior band, interpleural furrow between first and second segment impressed as very short (exsag.) firm lineation, those between posterior segments weakly expressed; prominent moderately wide border developed at which pleural bands and furrows terminate, border widest distally, short medially.

Discussion. There are some sculptural differences between the two available specimens, but these are likely ontogenetic as the specimen from locality CR-G (Fig. 7.1, 7.4, 7.5, 7.7, 7.9, 7.11, 7.12) is just over one and a half times larger than the holotype specimen. The larger specimen has a greater number of more densely scattered tubercles on its glabella, a greater number of smaller tubercles aligned transversely on LO and the thoracic axial rings; and has smaller and more subdued isolated tubercles distal to the fulcrum on the thoracic posterior pleural bands and the cranial posterior border. The region of the thoracic pleurae distal to the fulcrum appears wider in the larger specimen, but this is influenced by some distortion, with the right pleural folded at the fulcrum and the left side somewhat flattened. The specimens share all other features, including the highly distinctive short genal spine. A general reduction in tubercle prominence and increase in tubercle number is a common feature of aulacopleurid ontogenies (Adrain and Chatterton, 1994, 1995a, 1995b, 1996) and there is little reason to doubt that the specimens are conspecific.

As noted above, *M. wenbanense* is not easily confused with the cooccurring *M. chrysion*. *Maurotarion wenbanense* has prominent glabellar tubercles and tubercles on the fixigenae and frontal areas; *M. chrysion* completely lacks sculpture in these areas. *Maurotarion wenbanense* also has prominent transverse tubercle rows on LO and the thoracic axial rings; *M. wenbanense* has only extremely subdued and difficult to discern tiny tubercles in these positions. Other obvious differences include the occurrence in *M. wenbanense* of a larger and more prominent L1, a much smaller and shorter genal spine, 13 versus 12 thoracic segments, and a pygidium with three versus two fully expressed axial rings.

Maurotarion wenbanense is somewhat similar to *M. periergum* in the amount and distribution of tuberculate sculpture on the cranium and in the shared possession of 13 thoracic segments with transverse tubercle rows on the axial rings. The many differences include a relatively shorter anterior border in *M. wenbanense*, a narrower librigenal lateral border, a much shorter genal spine lacking a dorsal tubercle row on the adaxial part, and a pygidium with only three versus four well expressed axial rings.

Maurotarion wenbanense differs from *M. fooi* in the presence versus absence of tubercles on the main glabellar lobe and frontal areas, the possession of a larger L1, librigenae with a broader field lacking expression of the eye socle, a narrower librigenal lateral border, and a much shorter genal spine. The species differs from *M. axitiosum* (Campbell, 1977) in the presence of stronger tuberculate sculpture on the glabella, much shallower cephalic border furrows, a broader librigenal field, a much shorter genal spine, and the possession of 13 versus 11 thoracic segments.

***Maurotarion fooi* n. sp.**

(Fig. 8)

Type material. Holotype, cranidium, SUI 109048 (Figure 8.1, 8.5, 8.9, 8.13), and assigned specimens SUI 109049-109056, all from locality CR-D, Wenban Limestone (Pragian), Cortez Gold Mine haul road, southern Cortez Mountains, Eureka County, Nevada, USA.

Etymology. After Stan Foo, who was Chief Geologist at Cortez Gold Mine at the time the collections were made.

Diagnosis. Glabella with main lobe lacking sculpture; L1 small but with dense dorsal tubercles; frontal area lacking sculpture; librigenal field narrow, with very low, subdued tubercles; eye socle expressed as inflated anterior lobe; lateral border wide and flattened; librigenal lateral and posterior border furrows merged to run along dorsal aspect of genal spine; genal spine long, narrow.

Description. Measurements based on largest three nearly intact cranidia (Fig. 8.1–8.3). Cranidium with maximum width across posterior projections, but not fully preserved on any available specimen; width across anterior border 90.0% (87.3–93.5) width across midlength of palpebral lobes; sagittal length 96.1% (95.3–96.6) width across midlength of palpebral lobes; anterior border of similar length sagittally and exsagittally, rear half flat, anterior half with slight dorsal inflation, curved toward anterior margin; anterior border with sagittal length 15.6% (14.6–17.1) that of cranidium, lacking dorsal sculpture, with fine raised lines, more robust nearer margin, along anterior aspect; anterior margin of anterior border with gentle and nearly even anterior curvature; anterior border with slight dorsal flex in anterior view; anterior border furrow shallow and long, with distinct inverted V shape, posterior edge more sharply defined along preglabellar field than anterior edge, which grades into border; furrow set in same plane as anterior border; preglabellar field with sagittal length 14.8% (14.5–15.1) that of cranidium, with moderate dorsal inflation not strongly deviating in sagittal profile from curve of glabella, running downward from glabella to border at moderate angle, lacking sculpture; frontal area broad and subtriangular, with sculpture in some specimens of very subdued moderate sized tubercles laterally; anterior sections of facial sutures parentheses-shaped in front of palpebral lobes, turned more nearly anteriorly opposite anterior part of frontal area and anterior border; eye ridge visible but not strongly developed, nearly effaced in some specimens, most strongly defined by a faint furrow anteriorly near S3; interocular fixigena lacking dorsal sculpture, narrow, sloped down from palpebral lobe to axial furrow, with only slight independent dorsal inflation; palpebral furrow distinct as sharp break in slope anteriorly and posterior, partially or wholly effaced in middle part; palpebral lobes large, margins not describing even semi-circular arc, but maximum of curvature at mid-length or slightly posteriorly, lacking sculpture except for pit at midlength set slightly away from center toward lateral margin, lobes mostly held in horizontal plane, only slightly tilted toward glabella adaxially; axial furrows only slightly anteriorly convergent, mainly due to lateral bulge of L1, broad and moderately deep, of same width posteriorly and anteriorly, running without interruption into anteriorly arcuate preglabellar furrow of almost exactly same breadth and depth; main glabellar lobe with sagittal length 97.3% (94.7–98.8) maximum width across rear of L1; S1 deep, similar in width and depth to axial furrow, complete from axial furrow to SO and of similar depth and dimensions along entire course, fully isolating L1; S1 and SO form wider triangular depressions at junction; L1 relatively small, teardrop shaped, strongly inflated, with sculpture of fairly densely distributed medium-sized low and subdued tubercles; main glabellar lobe with only weak dorsal inflation, generally lacking dorsal sculpture but with subdued tubercles similar to those on L1 developed on anterolateral aspects in some specimens (e.g., Fig. 8.1); S2 visible as a faint notch, L2 small and with little independent inflation; S3 and L3 not distinct; SO with transversely straight course, short (sag., exsag.) and incised, longer at triangular junction with S1 and especially in posteriorly deflected course behind L1; LO with sagittal length 15.0% (14.5–15.4) that of cranidium, longest sagittally, only slightly shorter on portion behind main glabellar lobe, significantly shorter behind L1, mostly lacking dorsal sculpture, very subdued medium sized tubercles developed behind L1 and along posterior margin in some specimens, median node not discernible; posterior border furrow not fully preserved on any specimen, short (exsag.) and incised, with transverse course

proximal to fulcrum; posterior fixigena reduced to narrow strip, moderately inflated, with a few small subdued tubercles, extended along posterior projection as very narrow strip; posterior border not fully preserved on any specimen, about half as long as median part of LO proximally, apparently longer distal to

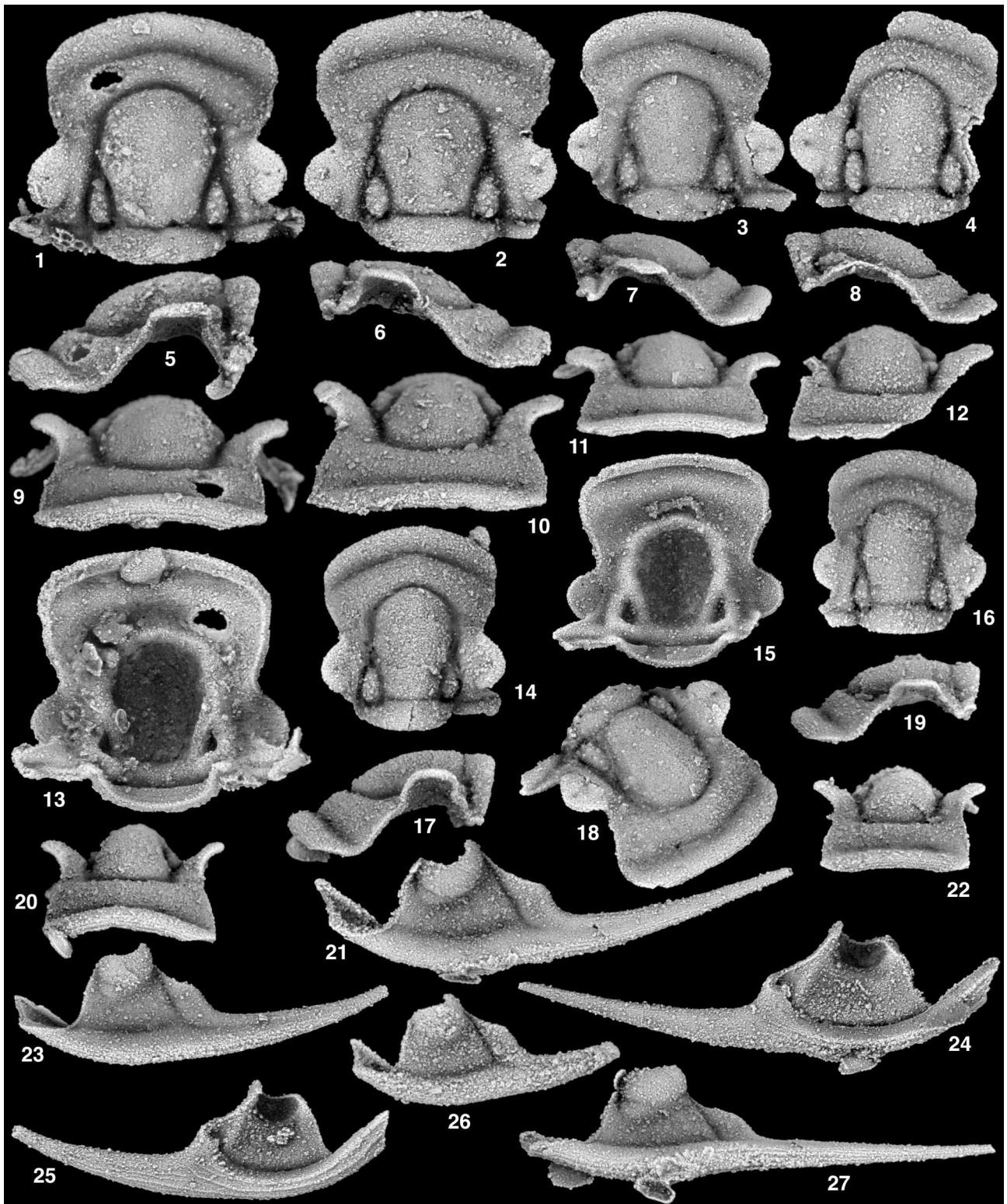


FIGURE 8. *Maurotarion fooi* n. sp., from the Wenban Limestone (Pragian), Cortez Gold Mine haul road, southern Cortez Mountains, Eureka County, Nevada, USA. All specimens are from locality CR-D and all magnifications are x12. 1, 5, 9, 13. Cranidium, **holotype**, SUI 109048, dorsal, left lateral, anterior, and ventral views. 2, 6, 10. Cranidium, SUI 109049, dorsal, right lateral, and anterior views. 3, 7, 11, 15, 18. Cranidium, SUI 109050, dorsal, right lateral, anterior, ventral, and oblique views. 4, 8, 12. Cranidium, SUI 109051, dorsal, right lateral, and anterior views. 14, 17, 20. Cranidium, SUI 109052, dorsal, left lateral, and anterior views. 16, 19, 22. Cranidium, SUI 109053, dorsal, left lateral, and anterior views. 21, 24, 27. Left librigena, SUI 109054, external, internal, and ventrolateral views. 23, 25. Left librigena, SUI 109055, external and internal views. 26. Left librigena, SUI 109056, external view.

fulcrum, moderately inflated and lacking dorsal sculpture; doublure beneath LO with faint raised lines; ventral aspect of posterior border with transverse articulating groove; fossulae weakly developed, position obscure.

Librigenal field with width at half length of eye 30.6% (27.2–34.0) exsagittal length; eye large, exsagittal length 54.6% (52.9–56.3) that of field, of similar width anteriorly and posteriorly (Fig. 8.27); eye socle not obvious posteriorly, but ellipsoid anterior lobe developed as a prominent swelling; visual surface set directly on field posteriorly; field with sculpture of only a few very subdued small to medium sized tubercles; lateral border furrow narrow, deepest opposite eye, notably shallower anteriorly and posteriorly just in front of contact with posterior border furrow; lateral border about same width as eye, slightly narrower anteriorly, moderately to strongly inflated, inner/dorsal aspect lacking sculpture, outer/ventrolateral aspect with sculpture of raised lines subparallel with margin, progressively more fully expressed abaxially; posterior border furrow narrower and slightly deeper than lateral border furrow, bowed slightly around rear of eye but otherwise with obliquely straight course to angular contact with lateral border furrow; posterior border about same length (exsag.) as lateral border is wide posteriorly, lacking sculpture, with very faint concave depression down center; posterior section of facial suture forming angular shoulder at contact with posterior margin; rear margin of posterior border set obliquely, forming slightly arcuate but still angular contact with genal spine; genal spine very long (not complete in any specimen, but at least 110% exsagittal length of remainder of librigena including anterior projection), slightly curved adaxially, broad at base (about half again as wide as posterior width of lateral border) and tapered evenly along length, flattened in section, with broader dorsal and ventral faces and narrower lateral faces; furrow running posterior from junction of lateral and posterior border furrows onto proximal part of dorsal face of genal spine, discernible over about proximal half of spine length; adaxial and abaxial edges of spine with raised lines similar to those on lateral aspect of lateral border, central aspect lacking sculpture; margin of lateral border with weak lateral convexity, subtle but definite break in slope opposite margin to separate lateral convexity of genal spine margin; anterior projection large, with long, oblique connective suture; ventral aspect of genal spine and doublure beneath lateral border with large raised lines, largest beneath border; inner edge of doublure beneath border turned up and inward, forming a sharp ridge at inner edge of lined portion; inner upturned part of doublure completely lacking sculpture, inner margin underlying adaxial margin of lateral border furrow; no Panderian notch evident.

Rostral plate, hypostome, thorax, and pygidium not recovered.

Discussion. The pygidium of *Maurotarion fooi* has not been recovered. Nevertheless the species is well represented by cephalic material and is clearly new and distinctive, so is judged well enough known to formally name. It was compared with *M. chrysion* and *M. wenbanense* under discussion of those species above. It differs from *M. periergum* in the possession of a basally narrower glabella with much smaller L1, the lack of tubercles on the main glabellar lobe and frontal area, inflated versus weakly expressed (mostly ventrally, Fig. 4.4) anterior eye socle lobe, a narrower librigenal field with subdued versus absent tubercles, librigenal lateral and posterior borders that unite in front of the genal spine base, and a much narrower genal spine. *Maurotarion fooi* differs from *M. axitiosum* (Campbell, 1977), which it most closely resembles, in the presence of more dense tuberculation on L1, slightly larger L1, and smooth versus tuberculate frontal areas. The species are similar in their general glabellar dimensions, deeply impressed cephalic borders, narrow librigenal field, posterior and lateral librigenal borders that unite in front of the genal spine, and long, narrow genal spine.

***Maurotarion* sp. indet.**

(Fig. 6.8, 6.10, 6.13)

Material. SUI 109043, from locality CR-C.

Discussion. A single librigena from Locality CR-C is obviously different from those of either *Maurotarion chrysion* or *M. wenbanense* from the same assemblage and probably represents a rare third species. The specimen differs from librigenae of *M. chrysion* in having a more laterally curved lateral border

and genal spine, a wider field, a better impressed lateral border furrow, a narrower lateral border, and narrower doublure. It is somewhat more similar to librigenae of *M. wenbanense*, but obviously has a much longer genal spine.

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