

Biostratigraphy and paleoecology of the trilobite faunas from the Mount Clark and Mount Cap formations (early and middle Cambrian), eastern Mackenzie Mountains, northwestern Canada

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Abstract.—Lower and middle Cambrian strata of the eastern Mackenzie Mountains, Northwest Territories, Canada, were deposited in a semi-enclosed basin along the eastern flank of the Mackenzie Arch. The Mount Clark Formation is predominantly composed of nearshore sandstone and is overlain by deeper water siltstone, mudstone, and carbonates of the Mount Cap Formation. The contact between these formations is interpreted as a flooding surface. Trilobite biostratigraphy indicates the presence of the traditional upper *Olenellus* through *Glossopleura* zones (Cambrian Series 2, Stage 4–Miaolingian, Wuliuan) and suggests the flooding surface is diachronous, spanning the Dyeran-Delamaran boundary. Above the *Olenellus* Zone, the *Amecephalus arjosensis-Eokochaspis nodosa* Zone, the new *Aitkenaspis keelensis* Zone, the new *Albertelloides mischi* Zone, and the *Glossopleura walcotti* Zone are recognized. Whereas the older zones are comparable to those in other areas of Laurentia, the trilobite faunas in the *Albertelloides mischi* and *Glossopleura walcotti* zones show a greater abundance of zacanthoidids and dolichometopids. They also have a lower diversity of ptychoparioids and oryctocephalids, and lack agnostoids, ediscoids, dorypygids, and ogygopsids. This suggests that zacanthoidids and dolichometopids were able to tolerate conditions that were unfavorable to the other groups, probably related to semi-restricted conditions in the basin. Four endemic species exhibit characteristics that are considered paedomorphic. This developmental process took place in three separate lineages, suggesting that heterochrony was also environmentally provoked.

New taxonomic names are authored by Handkamer and Pratt. New genera are *Eobathyuriscus*, *Sahtuia*, *Mexicaspidella Aitkenaspis*, *Dodoella*, and *Mackenzieaspis*. New species are *Bolbolenellus dodoensis*, *Eobathyuriscus mackenziensis*, *E. macqueeni*, *Glossopleura youngi*, *Sahtuia carcajouensis*, *Aitkenaspis keelensis*, *Albertelloides eliasi*, *Dodoella kobayashii*, *Mackenzieaspis parallelispinosa*, and *M. divergens*.

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Introduction

Cambrian trilobites of Laurentia have been studied extensively for over a century (Walcott, 1886, 1890, 1916a, b, 1917). However, there are many gaps in the geographic coverage, especially in northern Canada. Due to the remoteness of this region, with a few exceptions (Fritz, 1972, 1973, 1991; Pratt, 1992), most biostratigraphic information is at a reconnaissance level (e.g., Fritz, 1968, 1979; Dewing and Nowlan, 2012; Pyle, 2012) and organized using the traditional, Laurentian, genus-based biozonation. Now that more-refined, species-based zones are being erected in a number of localities (e.g., Sundberg, 1994; McColm and Sundberg, 2007), a higher resolution biostratigraphy is needed in support of local basin stratigraphy and long-distance correlation. The well-exposed, fossiliferous, lower and middle Cambrian formations of the eastern Mackenzie Mountains

provide an untapped opportunity to develop a biozonation in this region (MacNaughton et al., 2013).

The Mount Clark and Mount Cap formations of the northern Canadian Cordillera record sedimentation in a shallow, epicontinental sea—one of several that rimmed Laurentia during the early and middle Cambrian (Aitken et al., 1973; Pyle, 2012). This basin is thought to have been partially isolated from the open ocean by a series of uplifted, Precambrian-cored arches (Dixon and Stasiuk, 1998; MacLean, 2011). Regional stratigraphic studies suggest that the contact between the Mount Clark and Mount Cap formations is diachronous (MacNaughton et al., 2013; Serié et al., 2013). Early reports on reconnaissance collections of trilobites (Kobayashi, 1936; Fritz, 1969; Aitken et al., 1973) identified taxa indicating an age range from the *Bonnia-Olenellus* through *Glossopleura* zones (Cambrian Stage 4 and Wuliuan). Preliminary biostratigraphy by Pratt (in MacNaughton et al., 2013) documented that trilobites occurred sporadically in offshore facies that herein are assigned to the Mount Clark Formation, and more or less throughout the

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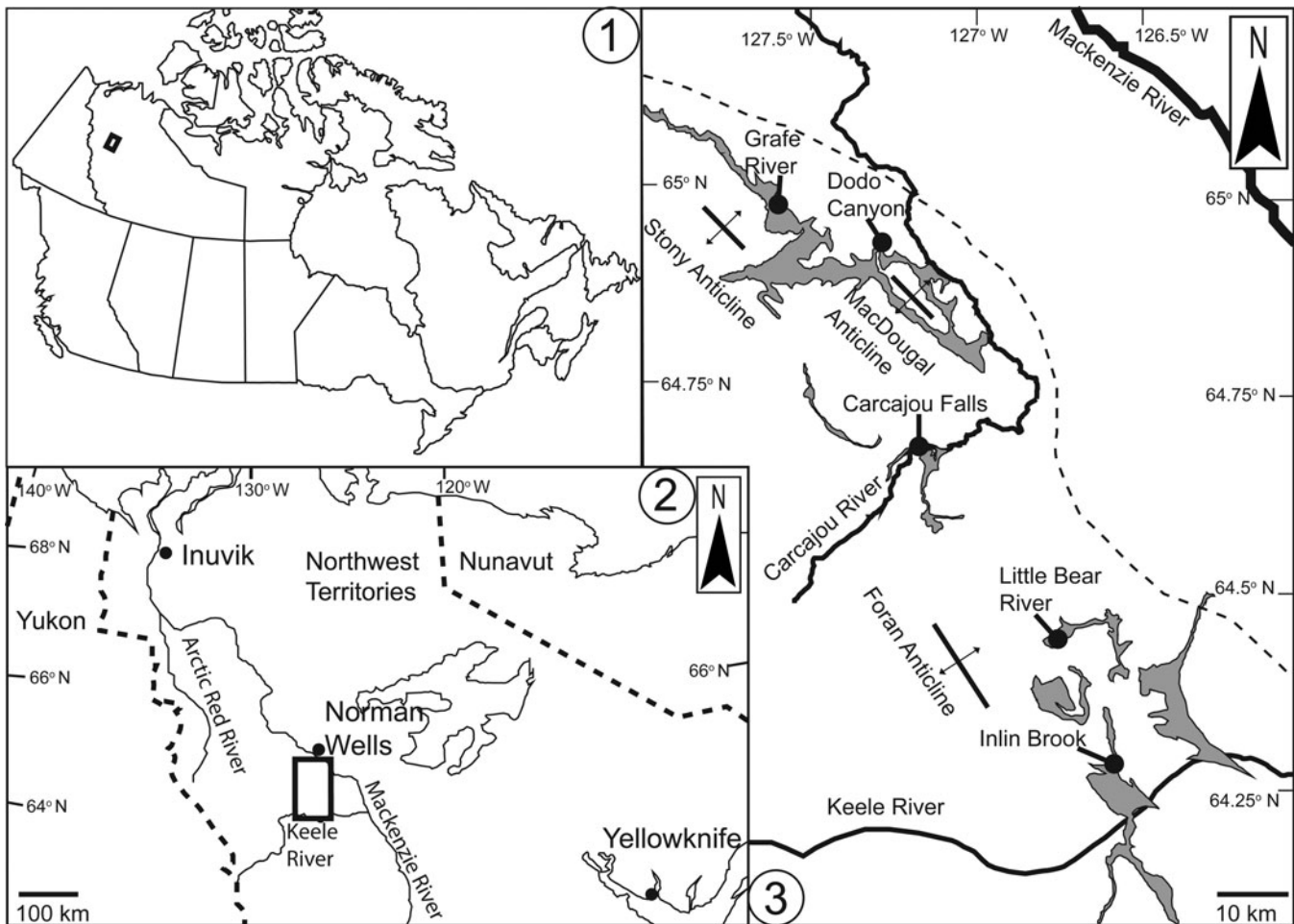


Figure 1. Locality of study area in the eastern Mackenzie Mountains, Northwest Territories. (1) National map; (2) location in the Northwest Territories; (3) location in the eastern Mackenzie Mountains. Outcrop belts of the Mount Clark, Mount Cap, and Saline River formations are shaded in gray. Localities studied are indicated by black dots, which include Dodo Canyon (64.937525°N, 127.265209°W), Little Bear River (64.479199°N, 126.794262°W), Inlin Brook (64.282846°N, 16543348°W), Carcajou Falls (64.670639°N, 127.161682°W), and Grafé River (64.988407°N, 127.649351°W). The dashed line in (3) roughly delineates the edge of the Mackenzie Arch. Major Laramide anticlines indicated by crosses with arrows.

Mount Cap Formation. The purpose of this study is to provide a detailed taxonomic, biostratigraphic, and paleoecological account of the trilobite faunas from a series of sections cropping out in the eastern Mackenzie Mountains (Fig. 1).

Geological setting

Strata of the lower and middle Cambrian basin are present in the subsurface of the Mackenzie Plain and northern Interior Plains (Dixon and Stasiuk, 1998; MacLean, 2011; Herbers et al., 2016; Sommers et al., 2020), and are uplifted and exposed in the Franklin Mountains and the Canyon Ranges of the eastern Mackenzie Mountains (Aitken et al., 1973; Aitken and Cook, 1974). The basin was flanked to the modern-day west by the Mackenzie, Redstone, and Peel arches, to the north by the Aklavik Arch Complex and Coppermine Arch, and to the east by the paleoshoreline on the Canadian Shield (Aitken et al., 1973; Dixon and Stasiuk, 1998) (Fig. 2). Convergent orientations of the Aklavik Arch Complex and Coppermine Arch indicate that they may have merged, which isolated the Cambrian basin to

the north (Dixon and Stasiuk, 1998), although similar stratigraphy on Victoria Island suggests a connection with basins in the Arctic Islands (Durbano et al., 2015; Sommers et al., 2020). The southern extent of the Cambrian basin is poorly understood (Aitken and Cook, 1974; Sommers et al., 2020). Subsurface data indicate that this basin was subdivided into depocenters by paleotopographic highs composed of Precambrian rocks (Dixon and Stasiuk, 1998; MacLean, 2011; Sommers et al., 2020) (Fig. 2).

Outcrops in the eastern Mackenzie Mountains represent the westernmost occurrences of the Mount Clark and Mount Cap formations. Strata onlap the eastern flank of the Mackenzie Arch, which is composed of deformed Neoproterozoic strata of the Mackenzie Mountains Supergroup (Aitken et al., 1973; Aitken and Cook, 1974; Turner and Long, 2012; MacNaughton et al., 2013; Long and Turner, 2014). The basal Cambrian formation in the basin is the Mount Clark Formation. At proximal sections in the Stony and Foran anticlines (Fig. 1.3), the Mount Clark Formation is composed of variably burrowed quartz arenite and argillaceous sandstone, whereas at distal sections in

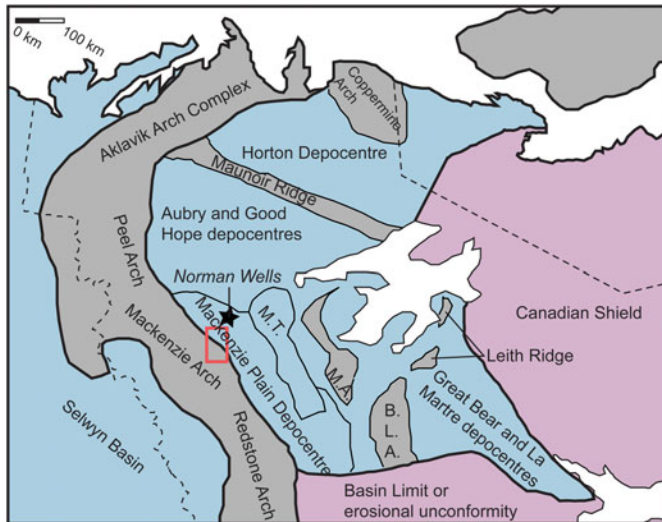


Figure 2. Depositional limit of the inland Cambrian basin and other adjacent basins. Blue shading indicates areas where deposition occurred during the early to middle Cambrian. Positive tectonic elements during the Cambrian are shaded in gray. Precambrian basement is shaded in pink. M.T. = Mackenzie Trough, B.L.A. = Bulmer Lake Arch, M.A. = Mahony Arch. Study area within the red box. Modified from Sommers et al., 2020.

the MacDougal Anticline (Fig. 1.3) the formation is composed of burrowed sandstone and siltstone, silty mudstone, and limestone (Williams, 1922, 1923; Aitken et al., 1973; Aitken and Cook, 1974; Fallas and MacNaughton, 2012; MacNaughton et al., 2013; Serié et al., 2013). These more distal strata have been treated by previous researchers as a basal, sandy unit of the Mount Cap Formation (e.g., Aitken et al., 1973; MacNaughton et al., 2013), but herein are assigned to the Mount Clark Formation on the basis of their stratigraphic position and overall sand-rich lithology. Although typical outcrop exposures of the Mount Clark Formation are dominated by sandstone (Aitken et al., 1973), strata assigned to the Mount Clark Formation in the subsurface also can contain a significant proportion of mudstone (Dixon and Stasiuk, 1998; Sommers et al., 2020).

The Mount Clark Formation is conformably overlain by the Mount Cap Formation, which consists of mudstone and lime mudstone with minor siltstone (Williams, 1923; Aitken et al., 1973; Aitken and Cook, 1974; MacNaughton et al., 2013). Reconnaissance biostratigraphy of the Mount Clark and Mount Cap formations identified the *Olenellus*, *Albertella*, and *Glossopleura* zones. The apparent absence of the *Plagiura-Poliella* Zone was regarded as evidence for an unconformity (Fritz, 1969; Aitken and Cook, 1974), although this interpretation has been disputed (MacNaughton et al., 2013). Unconformably overlying the Mount Cap Formation in outcrop is the Saline River Formation, which is composed of mudstone, dolostone, and gypsum (Aitken et al., 1973; Aitken and Cook, 1974; Dixon and Stasiuk, 1998; Serié et al., 2013; Bouchard and Turner, 2017). The westward truncation of the Mount Cap Formation beneath the Saline River Formation indicates that the Mackenzie Arch was variably tectonically active during this time (Aitken et al., 1973; Aitken and Cook, 1974).

In the Mackenzie Plain to the northeast, the Mount Clark and Mount Cap formations are thicker, and the contact between

the two formations is in the *Olenellus* Zone (Sommers et al., 2020) (Fig. 3). On the western flank of the Mackenzie Arch, lower and middle Cambrian formations of the Selwyn Basin record a carbonate platform to slope setting on the passive continental margin (Pratt, 1989; Dilliard et al., 2010; Kimmig and Pratt, 2016). Limestones of the Sekwi Formation contain trilobites belonging to the *Fallotaspis* through *Olenellus* zones (Cambrian stages 3 and 4; Fritz, 1972), suggesting that the initial Cambrian transgression had flooded the western continental margin prior to the inland Cambrian basin. Conformably overlying the Sekwi Formation is the Rockslide Formation, with trilobites indicative of the *Plagiura-Poliella* through *Bolaspidea* zones (Fritz, 1979).

Materials and methods

Fieldwork was carried out at five sites in the Canyon Ranges: Dodo Canyon, Little Bear River, Inlin Brook, Carcajou Falls, and Grafe River (Fig. 4; see Handkamer, 2020, for measured section data), ~50 km southwest of Norman Wells (NTS 96D) (Fig. 1.3). Material was also collected by Pratt in 2011 from Dodo Canyon and Carcajou Falls, and by MacNaughton in 2012 from three additional measured sections: MWB-12-s04 and MWB-12-s05 located northwest of Dodo Canyon, and 12-MWB-s06 located west of Little Bear River (see MacNaughton, 2021, for stratigraphic horizons of collections). All specimens were coated ammonium chloride sublimate and photographed, mainly with a macro lens, and in the case of small specimens, with a bellows attachment. Figures were assembled using Adobe Photoshop and Adobe Illustrator, and brightness and contrast were adjusted as needed to increase image quality. Simple rarefaction plots were generated in Past4.0 and modified visually using Illustrator, and population counts were tabulated in Microsoft Excel.

Repositories and institutional abbreviations.—All figured specimens are deposited in the type collection of the Geological Survey of Canada, Ottawa. Specimens not illustrated are housed at Geological Survey of Canada, Calgary. Institutional abbreviations are: GSC = Geological Survey of Canada; USNM = U.S. National Museum of Natural History, Smithsonian Institution, Washington DC; DMNH = Denver Museum of Natural History; and MGUH = Natural History Museum, Copenhagen, Denmark.

Sedimentology

Several reports have included measured sections through the Mount Clark and Mount Cap formations in the eastern Mackenzie Mountains (Aitken et al., 1973; Pyle and Gal, 2009; Serié et al., 2013; Bouchard and Turner, 2017; Handkamer, 2020; MacNaughton, 2021). Regionally, facies of the Mount Clark and Mount Cap formations record the evolution from a near-shore to deeper water environment (MacNaughton et al., 2013; Herbers et al., 2016; Handkamer, 2020; Sommers et al., 2020). In the present study area, low-angle cross-bedded, wavy bedded, and wave-rippled sandstone with minor glauconite of the Mount Clark Formation indicate a nearshore setting

Global chron.		Laurentian chronostratigraphy			Mackenzie Mountains	Victoria Island	Colville Hills	eastern Mackenzie Mountains	eastern Mackenzie Mountains biozones
Series	Stage	Series	Stage	Biozones					
Miaolingian	Wuliuan	Lincolnian	Delamaran	Glossopleura Zone/ Glossopleura walcotti Zone	Rockslide Formation	Mount Phayre formation	Mount Cap Formation	Glossopleura walcotti Zone	
				Albertella Zone/ Mexicella mexicana Zone				Albertelloides mischi Zone	
				Poliella Zone				?	
Series 2	Stage 4	Waucoban	Dyeran	Poliella denticulata Zone	Sekwi Formation	Uvayualuk formation	Mount Clark Formation	Aitkenaspis keelensis Zone	
				Amecephalus arjosensis Zone				Amecephalus arjosensis-Eokochaspis nodosa Zone	
				Eokochaspis nodosa Zone					
				Bonnia-Olenellus Zone				Olenellus Zone	

Figure 3. Lithostratigraphic correlation chart and biostratigraphic ages of Cambrian formations of the Mackenzie Mountains, Arctic Islands, Colville Hills, and eastern Mackenzie Mountains. Color of formations indicates the dominant lithology: yellow = dominantly sandstone, gray = dominantly mudstone, and blue = dominantly carbonate. Biostratigraphic and lithostratigraphic data from Fritz, 1972, 1979; Pratt, 1989; Palmer, 1998a; Durban et al., 2015; Kimmig and Pratt, 2016; Sundberg et al., 2016, 2020; and Sommers et al., 2020. Biostratigraphic framework of the eastern Mackenzie Mountains based on Fritz (1969), Aitken et al. (1973), and this work. Biostratigraphy of Victoria Island is currently under investigation by Pratt.

(Handkamer, 2020). The dominance of storm-induced features, with rare sand bars, suggest a relatively low-energy storm-dominated shoreline with weak tidal influence. In distal sections of the Mount Clark Formation, interbedded sandstone and siltstone with wave ripples, gutter casts, local hummocky cross-stratification, and minor unidirectional ripples (Handkamer, 2020) record fluctuating conditions produced by storms in the offshore setting. Interbedded, rippled sandy grainstone and argillaceous lime mudstone (Handkamer, 2020) represent similar conditions during episodes of localized carbonate production. Strata of the Mount Clark Formation are dominated by a deposit-feeding ichnofauna (Handkamer, 2020). The scarcity of burrows cast by tempestites in the offshore setting is attributed to scour during deposition. A vertical, suspension-feeding ichnofauna is dominant in strata representing upper-shoreface deposits (Handkamer, 2020), due to organic productivity in the water column.

The contact between the Mount Clark and Mount Cap formations is interpreted to be a flooding surface. Variably calcareous and fossiliferous silty mudstone, clay-rich mudstone, and minor siltstone of the Mount Cap Formation (Handkamer, 2020) are interpreted as deeper water hemipelagites. Carbonate strata are common especially at Dodo Canyon and Carcajou Falls. Carbonate lithologies include: (1) thin-bedded, rippled sandy grainstone; (2) wavy bedded and rippled, argillaceous or sandy dolostone; (3) thin- to medium-bedded, bioclastic and peloidal wackestone; (4) variably burrowed, wavy bedded

lime mudstone; and (5) interbedded, burrowed lime mudstone and siliciclastic mudstone with minor bioclastic grainstone lenses and bioclastic wackestone (Handkamer, 2020). The first two are interpreted to be higher energy, shallow-subtidal ramp sediments, the third and fourth lower energy, deeper subtidal ramp sediments, and the fifth intercalated, deeper subtidal lime mud and siliciclastic mud, punctuated by minor tempestites. The contrast between the thick carbonate accumulations at Dodo Canyon and Carcajou Falls versus the minor proportions at Little Bear River, Inlin Brook, and Grafe River, is considered to record localized carbonate production in a well-oxygenated setting. In the Mount Cap Formation, the greater proportion of carbonate strata in the eastern Mackenzie Mountains compared to the Colville Hills (Handkamer, 2020; Sommers et al., 2020) indicates that there was a more productive, but geographically localized, carbonate factory in this region. The Colville Hills were closer to the basin's eastern paleoshoreline and may have been supplied with a more continuous amount of siliciclastic mud compared to the intermittently tectonically active Mackenzie Arch. In outcrops studied for this report, horizontal, deposit-feeding burrows are rare, either preserved by pyrite or on the surfaces of carbonate concretions in silty mudstone. These surfaces indicate well-oxygenated surface sediments, whereas the apparent absence of burrows in mudstone is regarded as taphonomic. Variably numerous trilobites, hyoliths, and linguliformean brachiopods comprise the benthic, shelly biota (Handkamer, 2020) that developed during times of well-oxygenated conditions.

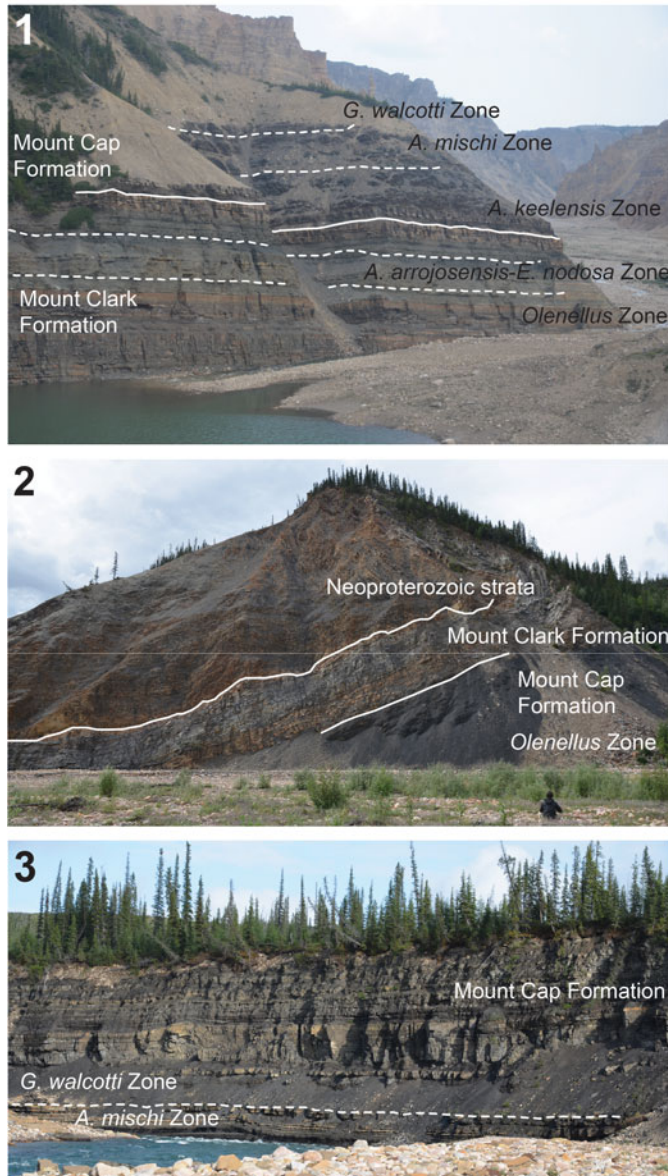


Figure 4. Outcrop views of the Mount Clark, Mount Cap, and Neoproterozoic formations of the Canyon Ranges, Northwest Territories. Solid lines indicate lithostratigraphic boundaries and dashed lines indicate biostratigraphic boundaries. (1) Section at Dodo Canyon. Stratal thickness = 73.9 m. The Mount Cap Formation-Saline River Formation contact is exposed farther downriver (in the distance). Central talus cone covers normal faults. (2) Section at Inlin Brook with the units exposed in an overturned anticline. Stratal thickness of Cambrian formations = 18.3 m. The top of the section is marked where debris covers the Mount Cap Formation. (3) Upper part of the section exposed at Carcajow Falls. Stratal thickness = 28.2 m. The section was measured upriver from this cliff (behind the observer).

Biostratigraphy

Trilobites from the Mount Clark and Mount Cap formations indicate an age spanning the Laurentian upper Dyeran and Delamaran stages of the upper Waucoban and Lincolnian series, respectively, and the global upper Stage 4 and Wuliuan stages of the upper Series 2 and lower Miaolingian series (Fig. 3). Some of the traditional Laurentian zones are recognized (Rasetti, 1951; Lochman-Balk and Wilson, 1958; Robison,

1976; Palmer and Halley, 1979; Palmer, 1998a, b; Sundberg and McCollum, 2000, 2003a, b; McCollum and Sundberg, 2007; Webster, 2011b; Pratt and Bordonaro, 2014; Sundberg et al., 2020). However, two new zones (the *Aitkenaspis keelensis* Zone and the *Albertelloides mischi* Zone) are established due to a lack of typical Laurentian taxa in part of the Mount Cap Formation. These zones are, in ascending order, the upper *Olenellus*, *Amecephalus arrojosisensis-Eokochaspis nodosa*, *Aitkenaspis keelensis*, *Albertelloides mischi*, and *Glossopleura walcotti* zones (Figs. 5, 6).

The base of the *Olenellus* Zone of the Dyeran (Palmer, 1998a) is recorded by the first appearance datum (FAD) of an olenellid, indicating the traditional marker for the uppermost early Cambrian of Laurentia. *Olenellus gilberti* Meek in White, 1874, and *O. terminatus* Palmer, 1998b, which occur in the Mount Clark and Mount Cap formations, span the two uppermost zones of the species-based biozonation in the Great Basin (Webster, 2011b), the *Bolbolenellus euryparia* Zone and overlying *Nephrolenellus multinodus* Zone. This prevents the assignment to either of these zones, but the lack of an unconformity above the fossil-bearing horizons possibly indicates the *N. multinodus* Zone.

The overlying zone is the undifferentiated *Amecephalus arrojosisensis-Eokochaspis nodosa* Zone. The *Eokochaspis nodosa* Zone and the younger *Amecephalus arrojosisensis* Zone were established as separate zones in the Pioche Formation (Sundberg and McCollum, 2000). However, in the La Laja Formation of the Precordillera of western Argentina, *A. arrojosisensis* and *E. nodosa* are present in reverse order, suggesting that these two taxa co-existed and are not temporally exclusive (Pratt and Bordonaro, 2014). Furthermore, *E. nodosa* and *Tonopahella walcotti* (Sundberg and McCollum, 2000), a species previously recorded from the *Amecephalus arrojosisensis* Zone, occur in the same bed at Little Bear River. The base of the *A. arrojosisensis-E. nodosa* Zone in the Mount Cap Formation is probably synchronous with the base of the *E. nodosa* Zone in the Pioche, Emigrant, and Monola formations (Sundberg and McCollum, 2000, 2003b), and the *Plagiura-Poliella* Zone elsewhere (Lochman-Balk and Wilson, 1958; Robison, 1976). It is at this time when simple ptychoparioids (referable as ‘kochaspids’) diversified (Sundberg and McCollum, 2000).

The succeeding zone in the Mount Clark and Mount Cap formations is the *Aitkenaspis keelensis* Zone, established herein. The base of this zone is inferred to be equivalent to the base of the *Poliella denticulata* Zone in restricted-shelf settings (Sundberg and McCollum, 2003a) and the *Oryctocephalus indicus* Zone in open-shelf settings in the Great Basin (Sundberg and McCollum, 2003b), due to its position above the *A. arrojosisensis-E. nodosa* Zone and lack of any erosional unconformity at the base. The temporal relationships of the *A. keelensis* Zone relative to the *Wenkchemnia-Stephenaspis* and *Plagiura-Kochaspis* zones of the Mount Whyte Formation of Alberta and British Columbia (Rasetti, 1951), or the upper *Amecephalus arrojosisensis-Eokochaspis nodosa* and lower *Mexicella mexicana* zones of La Laja Formation, are not well constrained. The *A. keelensis* and equivalent zones record when corynexochids became significant components of Laurentian faunas.

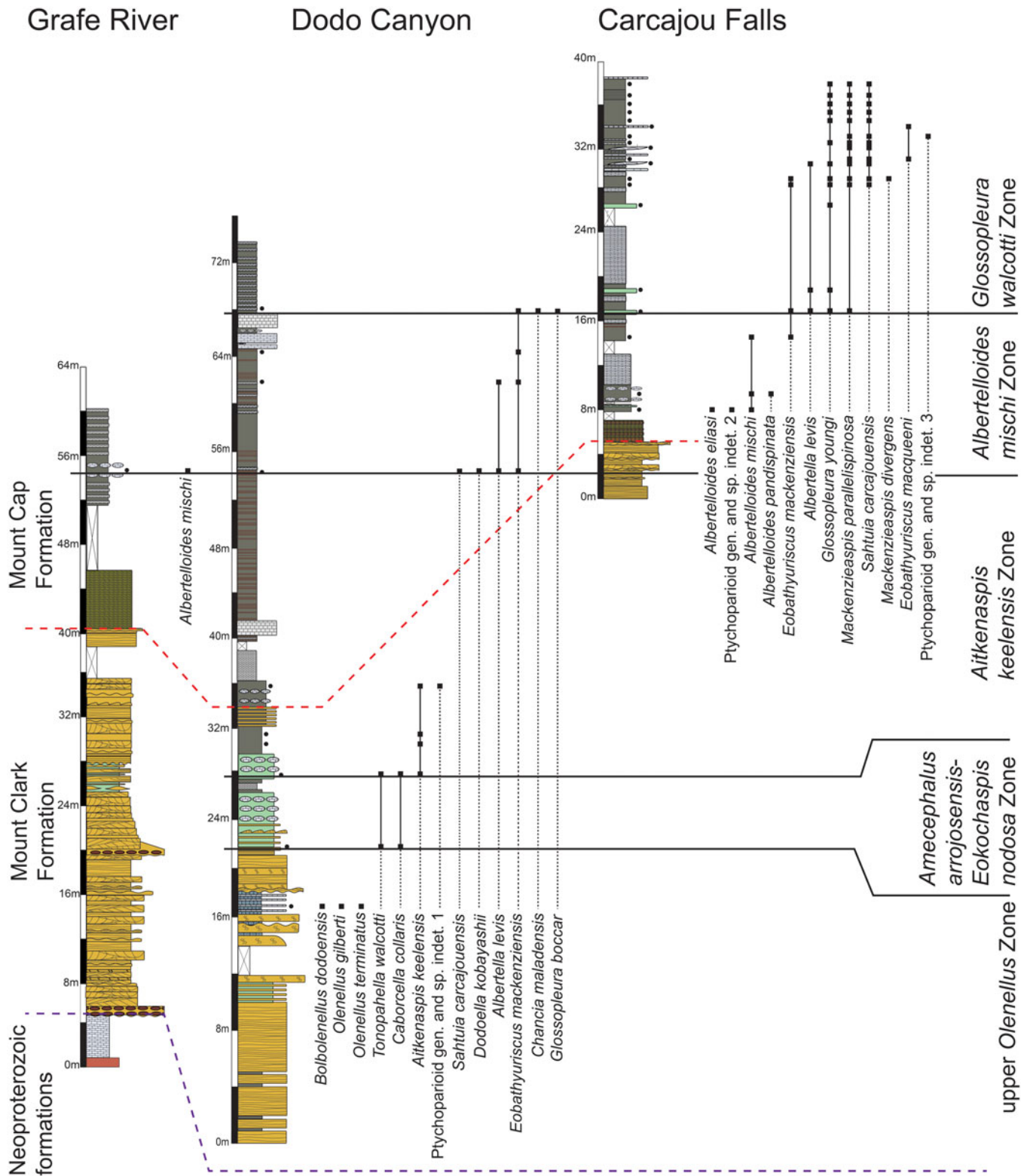


Figure 5. Measured sections of the Mount Clark and Mount Cap formations exposed at Dodo Canyon, Carcajou Falls, and Grafe River. Black dots beside stratigraphic sections denote sampling horizons. The legend for the stratigraphic columns is in Figure 6. The purple dashed line denotes the lithostratigraphic contact between the Mount Clark Formation and underlying Neoproterozoic formations (Handkamer, 2020). The red dashed line denotes the Mount Clark Formation-Mount Cap Formation contact.

The new *Albertelloides mischi* Zone overlies the *Aitkenaspis keelensis* Zone in the Mount Cap Formation. This zone is recognized by the FAD of *Albertelloides mischi* Fritz, 1968,

which appears to be synchronous with the FADs of *A. pandispinata* Fritz, 1968, and *A. eliasi* Handkamer and Pratt, n. sp. In the Great Basin, *A. pandispinata* is present close to the base

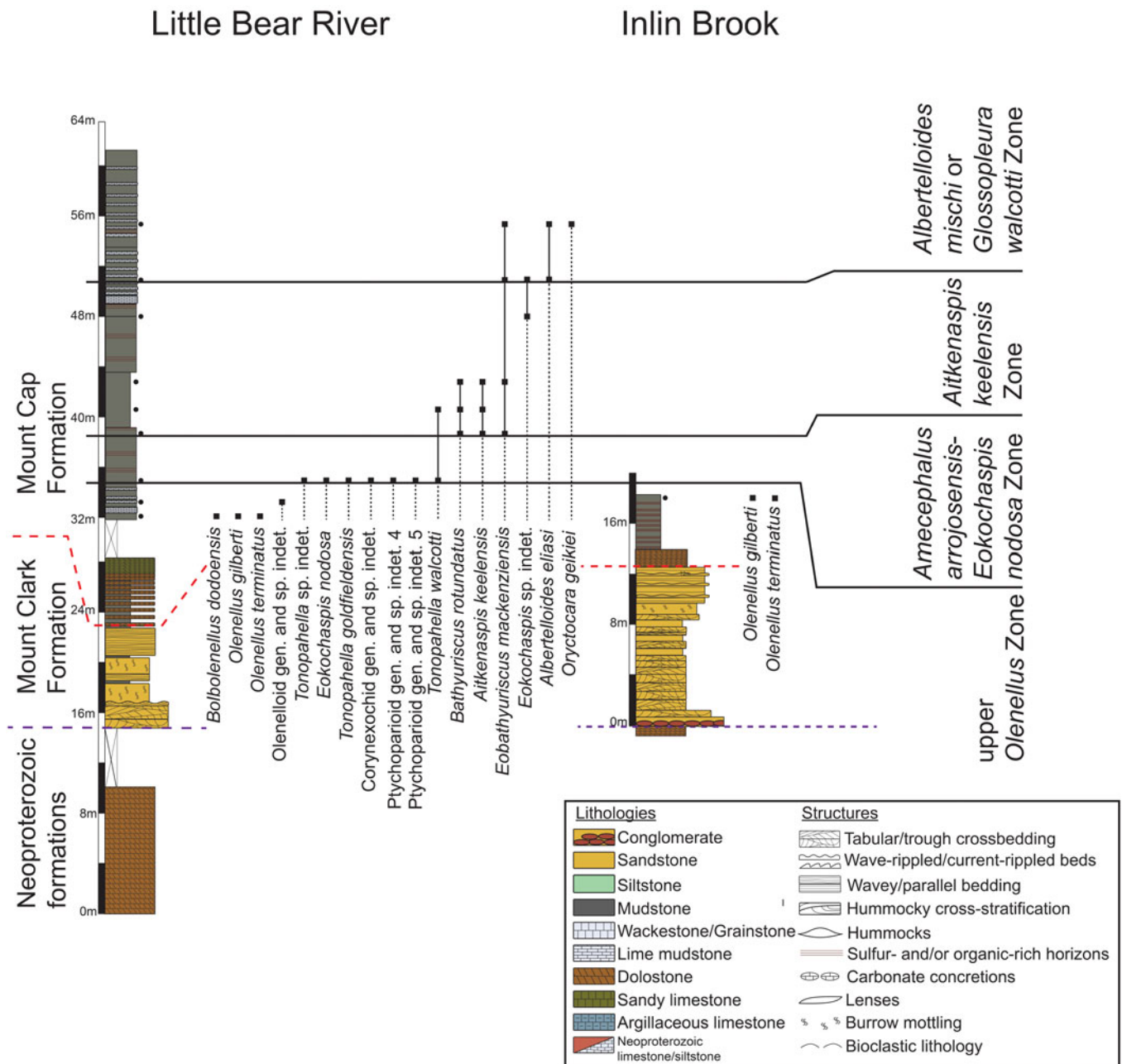


Figure 6. Measured sections of the Mount Clark and Mount Cap formations exposed at Little Bear River and Inlin Brook. Black dots beside stratigraphic sections denotes sampling horizons. The purple dashed line denotes the lithostratigraphic contact between the Mount Clark Formation and underlying Neoproterozoic formations (Handkamer, 2020). The red dashed line denotes the Mount Clark Formation-Mount Cap Formation contact.

of the *Albertellina aspinosa* Subzone of the *Mexicella mexicana* Zone, whereas *Albertelloides mischi* is likely present higher up in the *Albertella highlandensis* Subzone (Fritz, 1968; Eddy and McCollum, 1998; McCollum and Sundberg, 2007). These two species co-occur in the Mount Cap Formation, so the age relationship of the base of the *Albertelloides mischi* Zone with respect to that of the *Mexicella mexicana* Zone is uncertain. Alternatively, the co-occurrence of *Oryctocara geikiei* Walcott, 1908b, and *Albertelloides eliasi* Handkamer and Pratt, n. sp., within the uppermost strata at Little Bear River may suggest that part of this zone is equivalent to the lower *Glossopleura walcotti* and lower *Ptychagnostus*

praecurrens zones (Sundberg and McCollum, 1997, 2003a, b). Two biofacies are represented in the *Albertelloides mischi* Zone: the higher diversity and abundance *Albertelloides* biofacies is present at Carcajou Falls, Little Bear River, and Grafe River in variably calcareous, silty mudstone and lime mudstone, whereas the sparse biofacies is present at Dodo Canyon in organic-rich mudstone. The contrast between the two biofacies correlates with shoreline trajectory, in that diversity and abundance decrease farther offshore.

The youngest zone recognized in the Mount Cap Formation is the *Glossopleura walcotti* Zone, the base of which is indicated by the FADs of *G. boccar* (Walcott, 1916b) and *G. youngi*

Handkamer and Pratt, n. sp. In the southern Canadian Rocky Mountains, the oldest species of *Glossopleura* is *G. skokiensis* (? = *G. walcotti*; McCollum and Sundberg, 2007), indicating that the base of the *G. walcotti* Zone is near the top of the Cathedral Formation (Rasetti, 1951; McCollum and Sundberg, 2007). The basal beds of the overlying Stephen Formation contain *G. boccar*, suggesting that this species occurs slightly above the base of the *G. walcotti* Zone. Therefore, the base of the *G. walcotti* Zone in the Mount Cap Formation is considered slightly younger than that in the Carrara Formation, Lyndon Limestone, Chisholm Formation, upper Emigrant Formation, and possibly the Bright Angel Shale of the Great Basin (Palmer and Halley, 1979; Eddy and McCollum, 1998; Sundberg, 2005, 2018; Foster, 2011). It is also considered younger than the base of the *Glossopleura* Zone of the Cathedral Formation (Rasetti, 1951), although equivalent to the *Glossopleura* Zone of the Stephen and Snake Indian formations of the Canadian Rocky Mountains (Rasetti, 1951; Mountjoy and Aitken, 1978; Fletcher and Collins, 1998). The base of the *G. walcotti* Zone in the Mount Cap Formation is also probably younger than the *G. walcotti* Zone of the Cape Wood Formation of Greenland (Poulsen, 1927) and the *G. walcotti* Zone of the upper La Laja Formation of the Precordillera (Foglia and Vaccari, 2010).

Biostratigraphic zonation of the Mount Clark and Mount Cap formations indicates that: (1) the formations are partly time equivalent; (2) the contact between the Mount Clark Formation and the Mount Cap Formation, interpreted as a flooding surface, is diachronous; and (3) there is no biostratigraphic evidence for an unconformity within the Mount Cap Formation as was postulated by Fritz (1969, also in Aitken et al., 1973), which is consistent with the lack of any physical evidence of an unconformity. Flooding began during the upper *Olenellus* Zone in the southeastern part of the study area and continued into the *Albertelloides mischi* Zone in the northwestern part of the study area.

Paleoecology

Trilobites co-occur with linguliformean brachiopods in siltstone, limestone, and mudstone, and co-occur with hyoliths in mudstone. Soft-bodied faunal elements are present at Little Bear River, which include anomalocarids, bivalved arthropods, cancelloriids, and small carbonaceous fossils of planktonic acritarchs, crustaceans, and lophotrochozoans (Butterfield and Nicholas, 1996; Harvey and Butterfield, 2011). The rare occurrence of protaspids and meraspids of *Sahtuia carcajouensis* Handkamer and Pratt, n. gen. n. sp., and *Eobathyuriscus mackenziensis* Handkamer and Pratt, n. gen. n. sp., in mudstone and lime mudstone, respectively, indicates that these species were able to reproduce in the environments in which those facies were deposited.

Trilobite faunas.—In Laurentia, trilobite faunas of the inner detrital belt are composed of endemic taxa, while those of the outer detrital belt contain globally distributed genera (Robison, 1976; see also Pegel, 2000). In the Mount Cap Formation, the faunas are overall less diverse than those in other middle Cambrian formations of Laurentia, particularly at higher taxonomic levels in the *Albertelloides mischi* and

Glossopleura walcotti zones. Genera and species present are typical of a restricted-shelf setting (Robison, 1976; Palmer and Halley, 1979; Eddy and McCollum, 1998), and the closest faunal analogs are those present in the inner detrital belt facies of the Great Basin. Faunas of the *Albertella/Mexicella mexicana* and *Glossopleura walcotti* zones of the Pioche, Chisholm, and inner-shelf Carrara formations are comparable (Fritz, 1968; Palmer and Halley, 1979; Eddy and McCollum, 1998; Sundberg, 2005). Rarefaction of trilobite collection data from Mount Cap Formation and these three formations indicate that they represent a reasonable approximation of the original trilobite biotas (Fig. 7.1).

Dolichometopids and zecanthoidids are relatively abundant in the Mount Cap Formation, whereas ptychoparioids and oryctocephalids are rare, and agnostoids, eodiscoids, dorypygids and ogygopsidids are absent (Fig. 7.2). The dominance of dolichometopids and zecanthoidids increases in younger zones, and ptychoparioids virtually disappear. The absence of agnostoids and eodiscoids and paucity of oryctocephalids are to be expected within a semi-enclosed basin far from deep-water settings where these taxa tend to be common (Robison, 1976; Whittington, 1995; Sundberg and McCollum, 1997). The lack of dorypygids and ogygopsidids contrasts with other areas where these families are present, such as in the southern Canadian Rocky Mountains (Rasetti, 1951), eastern Alaska (Palmer, 1968), the Great Basin (Fritz, 1968; Robison, 1976; Palmer and Halley, 1979; Eddy and McCollum, 1998; Sundberg, 2005, 2018; Foster, 2011; Robison and Babcock, 2011), the Precordillera (Bordonaro et al., 2008), and Greenland (Poulsen, 1927; Babcock, 1994). Also, these two groups are present in both inner and outer detrital belt faunas. Environmental conditions in the Mount Cap Formation were favorable, or tolerable, to zecanthoidids and dolichometopids, but less so to ptychoparioids, and not so for dorypygids and ogygopsidids. Facies in the Pioche (Merriam and Palmer, 1964; Eddy and McCollum, 1998) and Chisholm formations (Sundberg, 2005), broadly similar to those in the Mount Cap Formation, suggest environmental preference was independent of substrate type or physical sedimentary processes, such as bottom turbulence. Three possible paleoecological stressors include variation in water temperature, salinity, or bottom-water oxygenation. Variations in any of these could be expected within a semi-enclosed basin, but to single them out specifically has not yet been achieved.

Paedomorphic trilobites.—Several taxa unique to the Mount Cap Formation of the eastern Mackenzie Mountains exhibit paedomorphic anatomical features, interpreted as arising due to heterochronic changes during ontogeny (McNamara, 1986a, b). These species are *Dodoella kobayashii* Handkamer and Pratt, n. gen. n. sp., and *Sahtuia carcajouensis* Handkamer and Pratt, n. gen. n. sp., in the *Albertelloides mischi* Zone at Dodo Canyon, and *S. carcajouensis* n. gen. n. sp., *Mackenzieaspis parallelispinosa* Handkamer and Pratt, n. gen., n. sp., and *M. divergens* Handkamer and Pratt, n. gen., n. sp., in the *Glossopleura walcotti* Zone at Carcajou Falls. Non-paedomorphic relatives of all four species were collected from the Mount Cap Formation as well: *Albertella levis*, *Eobathyuriscus mackenziensis* Handkamer and Pratt, n. gen., n. sp., and *Albertelloides eliasi*

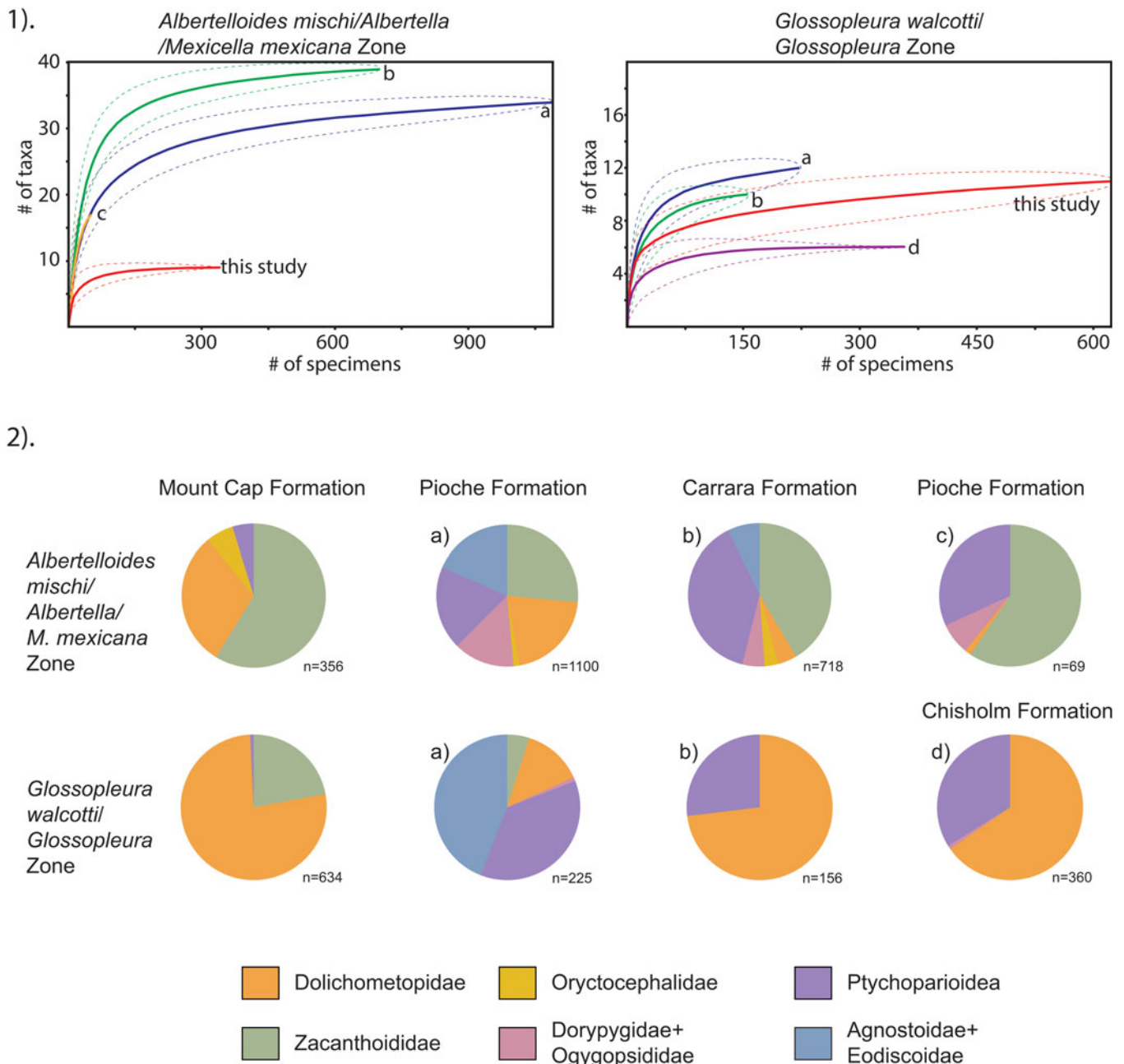


Figure 7. Quantitative paleoecology of the trilobite faunas from the *Albertelloides mischi/Albertella/Mexicella mexicana* and *Glossopleura walcottii/Glossopleura* zones of the Mount Cap, Pioche, Chisholm, and Carrara formations. (1) Simple rarefaction curves of collections. Dashed lines denote 95% confidence intervals. (2) Abundance of trilobite groups. Individual cranidia and pygidia, partially complete specimens, and complete specimens were all given equal value in the abundance count. Counts from the Great Basin are compiled from (a) Fritz, 1968; (b) Palmer and Halley, 1979; (c) Eddy and McCollum, 1998; and (d) Sundberg, 2005.

Handkamer and Pratt, n. sp., or *A. mischi*, respectively, which are regarded as ancestral due to their similarity to typical zacanthoidids and dolichometopids of Laurentia (see McNamara, 1982). These ancestor-descendant relationships are supported by many subtle morphological similarities (see remarks on new genera). Identification of the ancestral form is a criterion for recognizing the occurrence of paedomorphosis (McNamara, 1986a). Compared to the ancestral apaedomorphs, paedomorphic species have: (1) fewer thoracic segments; (2) a larger pygidium exhibiting more furrows; and (3) shorter thoracic spines. Exoskeletons of the holaspids of both paedomorphic and

apaedomorphic species are broadly similar in their sagittal length. Morphological differences indicate that only the development of the thorax was retarded, interpreted as arising from post-displacement. Paedomorphosis is demonstrated in three separate lineages in the Mount Cap Formation due to the presence of three separate paedomorph-apaedomorph pairs. This indicates that the development was likely environmentally provoked, rather than from random mutation or genetic drift. Almost all the paedomorphic specimens were collected from 20 meters of abundantly fossiliferous mudstone at Carcajou Falls, but the reason for this distribution is unclear.

Systematic paleontology

New taxonomic names are authored by Handkamer and Pratt. The descriptors “long” and “short” refer to sagittal and exsagittal measurements, while “wide” and “narrow” refer to transverse measurements. In the materials sections, a “nearly complete exoskeleton” refers to specimens lacking either sclerites of the cephalon, thorax, or pygidium.

Class Trilobita Walch, 1771
 Order Redlichiida Richter, 1932
 Suborder Olenellina Walcott, 1890
 Superfamily Olenelloidea Walcott, 1890
 Family Olenellidae Walcott, 1890
 Subfamily Olenellinae Walcott, 1890
 Genus *Olenellus* Hall, 1861

Type species.—*Olenus thompsoni* Hall, 1859, from the *Olenellus* Zone of the Parker Formation (Slate), Vermont.

Remarks.—Palmer and Repina’s (1993) and Palmer’s (1998b) generic classification is followed. Observations on the ontogeny and intraspecific variation of *Olenellus gilberti* Meek in White, 1874, have raised doubt about this classification (Webster, 2015). Because of this uncertainty, subgenera proposed by Palmer (1998b) are not adopted here.

Olenellus gilberti Meek in White, 1874
 Figure 8.1–8.4, 8.6, 8.10

- 1874 *Olenellus gilberti* Meek in White, p. 7.
 1877 *Olenellus gilberti*; White, p. 44, pl. 2, fig. 3a–c.
 ?1936 *Olenellus mackenziensis* Kobayashi, p. 162, pl. 21, fig. 32.
 2015 *Olenellus gilberti*; Webster, p. 11, figs. 6–14, 19–21, 25–29, 31–33, 36A–W. [see for synonymy]
 2021 *Olenellus* cf. *gilberti*; Boyce, p. 67, pl. 1.

Holotype.—Cephalon (USNM 15411a) from the *Olenellus* Zone of the Delamar Member, Pioche Formation, Nevada (White, 1877, pl. 2, fig. 3a; Walcott, 1910, pl. 36, fig. 3).

Occurrence.—Sandstone, Mount Clark Formation, measured section 12-MWB-05; carbonate, Mount Cap Formation, measured section 12-MWB-06; sandy limestone, Mount Clark Formation, Dodo Canyon; silty mudstone, Mount Cap Formation, Little Bear River and Inlin Brook, Northwest Territories, upper *Olenellus* Zone; Buelna Formation, Sonora, Mexico (Cooper et al., 1952); Carrara Formation, Nevada, *Olenellus* Zone (Palmer and Halley, 1979); Delamar Member, Pioche Formation, Utah and Nevada, *Bolbolenellus euryparia* and *Nephrolenellus multinodus* zones, upper *Olenellus* Zone (Palmer, 1998b; Webster, 2011b, c); Cadiz Formation, California, *Olenellus* Zone (Webster, 2015); middle shale, Forteau Formation, Newfoundland, *Bonnia-Olenellus* Zone (Boyce, 2021).

Material.—Twenty cephalata and one hypostome. Figured material: GSC 142281–142285.

Remarks.—*Olenellus gilberti* is characterized by a long cephalic border that is the same length or slightly shorter than the preglabellar field, a moderately long ocular lobe that has the posterior tip opposite the occipital furrow, and an advanced genal spine. Specimens from the Mount Cap Formation are nearly identical to the holotype from the Pioche Formation. One specimen (Fig. 8.10) from the Mount Clark Formation appears to have a shorter ocular ridge, although this is attributed to compaction.

Olenellus terminatus Palmer, 1998
 Figure 8.5, 8.7, 8.9

- 1979 *Olenellus clarki* (Resser); Palmer and Halley, p. 68, pl. 3, figs. 1, 2, 5.
 1998b *Olenellus terminatus* Palmer, p. 670, fig. 12.1–12.8.
 2011c *Olenellus terminatus*; Webster, fig. 4.2.

Holotype.—Cephalon (DMNH 16085) from the *Olenellus* Zone of the Delamar Member, Pioche Formation, Nevada (Palmer, 1998b, fig. 12.3).

Occurrence.—Sandy limestone, Mount Clark Formation, Dodo Canyon; silty mudstone, Mount Cap, Little Bear River, and Inlin Brook, Northwest Territories, upper *Olenellus* Zone; Carrara Formation, Nevada and California, *Olenellus* Zone (Palmer and Halley, 1979); Delamar Member, Pioche Formation, Nevada, *Bolbolenellus euryparia* and *Nephrolenellus multinodus* zones, upper *Olenellus* Zone (Palmer, 1998b; Webster, 2011c).

Material.—Twenty-seven cephalata, two thoracic segments, and one possible hypostome. Figured material: GSC 142286, 142287.

Remarks.—*Olenellus terminatus* differs from *O. gilberti* by the shorter cephalic border and less-advanced genal spine. *Olenellus terminatus* differs from *O. clarki* by having a longer ocular lobe with the posterior tip opposite the anterior half of the occipital ring.

Genus *Bolbolenellus* Palmer and Repina, 1993

Type species.—*Olenellus euryparia* Palmer in Palmer and Halley, 1979, from the *Olenellus* Zone of the Carrara Formation, Nevada.

Remarks.—This genus was originally classified in subfamily Bristolinae by Palmer and Repina (1993), but was later reclassified within Olenellinae due to the presence of a macropleural thoracic segment (Palmer, 1998b). The most distinctive feature is the absence of a preglabellar field, where the anterior glabellar lobe abuts or overlaps the cephalic border (Palmer and Repina, 1993).

Bolbolenellus dodoensis Handkamer and Pratt, new species
 Figure 9

Holotype.—Cephalon (GSC 142289) from the upper *Olenellus* Zone of the Mount Clark Formation, Dodo Canyon (17.3 m

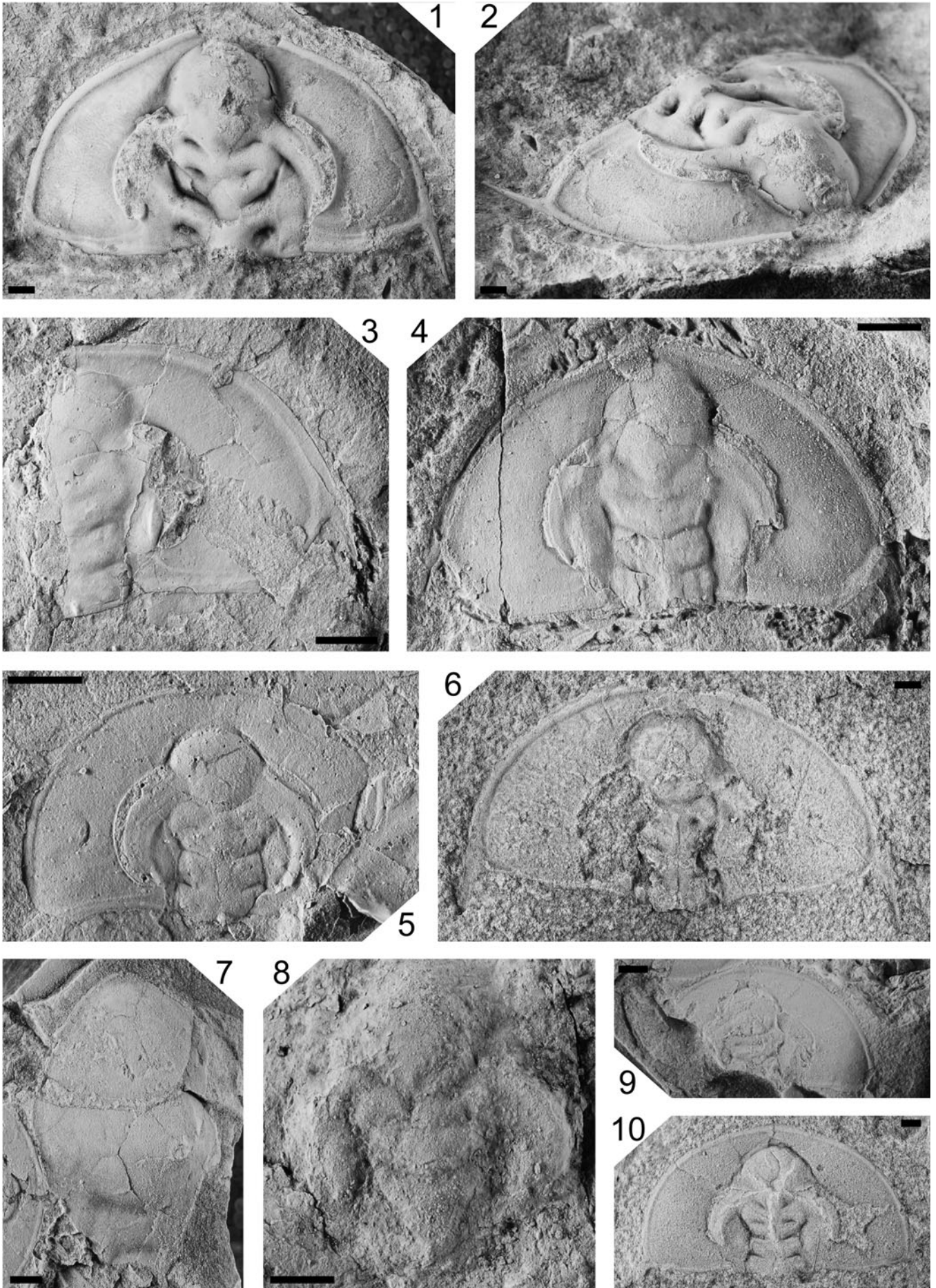


Figure 8. Species of *Olenellus* Hall, 1861, from the upper *Olenellus* Zone, Northwest Territories: (1–4, 6, 10) *Olenellus gilberti* Meek in White, 1874; (1, 2) cephalon (dorsal, oblique) GSC 142281, sandy limestone, Mount Clark Formation, Dodo Canyon; (3) partially complete cephalon (dorsal) GSC 142282, silty mudstone, Mount Cap Formation, Inlin Brook; (4) fractured cephalon (dorsal) GSC 142283, silty mudstone, Mount Cap Formation, Inlin Brook; (6) cephalon (dorsal) GSC 142284, sandstone, Mount Clark Formation, measured section 12-MWB-05; (10) cephalon (dorsal) GSC 142285, carbonate, Mount Clark Formation, measured section 12-MWB-06. (5, 7, 9) *Olenellus terminatus* Palmer, 1998b; (5) cephalon (dorsal, latex mold) GSC 142286, silty mudstone, Mount Cap Formation, Little Bear River; (7) possible fractured hypostome (dorsal) GSC 142287, silty mudstone, Mount Cap Formation, Inlin Brook; (9) partially complete cephalon (dorsal) GSC 142288, silty mudstone, Mount Cap Formation, Little Bear River. (8) *Olenellid* gen. and sp. indet., partially complete cephalon (dorsal) GSC 142288, lime mudstone, Mount Cap Formation, Little Bear River. All scale bars = 2 mm.

below the base of the Mount Cap Formation), Northwest Territories (Fig. 9.1, 9.2).

Diagnosis.—A species of *Bolbolenellus* with the anterior glabellar lobe intersecting or overlapping the anterior cephalic border furrow, ocular lobe long, posterior cephalic border nearly transverse, genal spine slightly advanced and moderately long.

Occurrence.—Sandy limestone, Mount Clark Formation, Dodo Canyon; silty mudstone, Mount Cap Formation, Little Bear River, Northwest Territories, upper *Olenellus* Zone.

Description.—Cephalon is semicircular in outline, the length equal to half the width. Anterior cephalic border ranges in length from half to slightly less than that of the occipital ring. Cephalic border furrow is moderately to well defined.

Preglabellar field is absent, with the anterior edge of the glabella either intersecting or overlapping the anterior border furrow. Strongly convex glabella with a well-defined axial furrow, narrowing from the occipital ring to L2, and expanding from L2 to the rounded anterior lobe. S1 and S2 are well defined and oriented obliquely backward, S2 does not intersect the axial furrow, and S3 is moderately defined and oriented transversely. L3 expands posterolaterally to envelope the lateral side of L2. Occipital ring and furrow are well defined, with a medial occipital tubercle. Strongly convex ocular lobe is crescent-shaped, narrows posteriorly, with the anterior tip intersecting the posterior part of the anterior glabellar lobe, and the posterior tip opposite the occipital furrow. Length of the ocular lobe is half that of the glabella. Interocular cheek at the widest point in width is one-third that of the occipital ring. Width of the moderately convex extraocular area at the widest point

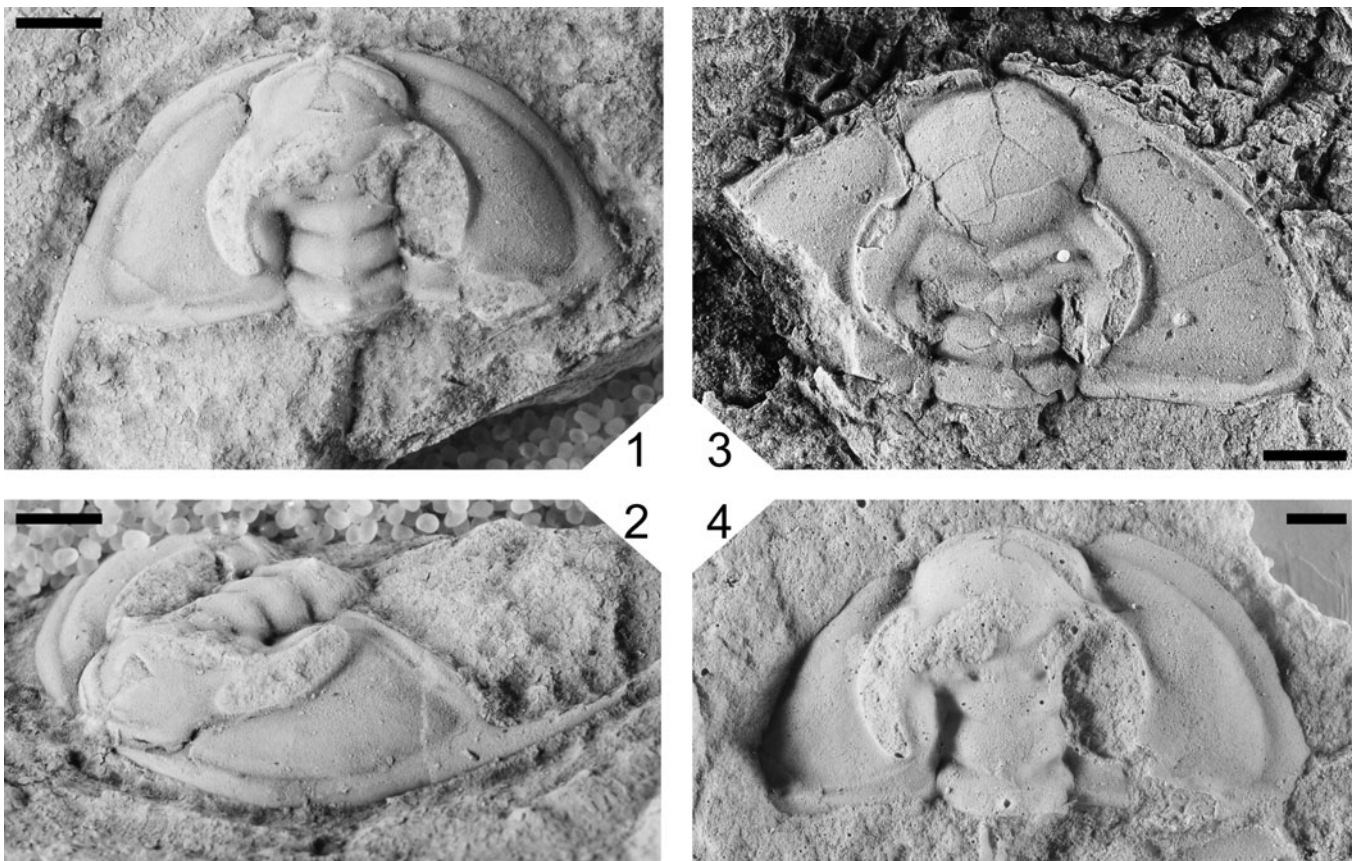


Figure 9. *Bolbolenellus dodoensis* Handkamer and Pratt, n. sp., from the upper *Olenellus* Zone, Northwest Territories. (1, 2) Holotype cephalon (dorsal, oblique) GSC 142289, sandy limestone, Mount Clark Formation, Dodo Canyon; (3) partially complete paratype cephalon (dorsal) GSC 142290, silty mudstone, Mount Cap Formation, Little Bear River; (4) paratype cephalon (dorsal, latex mold) GSC 142291, sandy limestone, Mount Clark Formation, Dodo Canyon. All scale bars = 2 mm.

one-and-one-third times that of the occipital ring. Posterior border oriented nearly transverse and in width is one-and-one-half times that of the occipital ring. Genal spine is slightly advanced, the length is five-sixths that of the glabella.

Hypostome, thorax, and pygidium are unknown.

Etymology.—Named after Dodo Canyon, Canyon Ranges, eastern Mackenzie Mountains.

Material.—Eleven cephalata. Type material: holotype, GSC 142289; paratypes, GSC 142290, GSC 142291.

Remarks.—Specimens of *Bolbolenellus dodoensis* Handkamer and Pratt, n. sp., from the Mount Cap Formation show variation in the length of the anterior cephalic border and position of the anterior lobe of the glabella with respect to the cephalic border. The border length and position of the anterior glabellar lobe with respect to the anterior cephalic border varies in *Olenellus gilberti* (Webster, 2015, figs. 4F, 5A). These features are considered to represent intraspecific variation in *B. dodoensis* n. sp. as well.

Olenellid genus and species indet.

Figure 8.8

Occurrence.—Dolomitic limestone of the Mount Cap Formation, Little Bear River, Northwest Territories, upper *Olenellus* Zone.

Material.—One partial cephalon. Figured material: GSC 142288.

Remarks.—The fragmentary cephalon shows the ocular lobe intersecting the posterior edge of L4, and L3 expanding posterolaterally to envelope the side of L2. This separates S2 from the axial furrow. Olenellid gen. and sp. indet. may be a poorly preserved specimen of *Olenellus gilberti* or *O. terminatus*. The presence of a possible preglabellar field suggests this specimen is not *Bolbolenellus dodoensis* Handkamer and Pratt, n. sp.

Order Corynexochida Kobayashi, 1935
Family Dolichometopidae Walcott, 1916
Genus *Bathyuriscus* Meek, 1873

Type species.—*Bathyurus* (?) *haydeni* Meek, 1873, from the Meagher Formation (Limestone), Montana (Diess, 1936).

Remarks.—The generic diagnosis by Robison (1964) is followed here. See Young and Ludvigsen (1989) for the history of the discussion on the generic name.

Bathyuriscus rotundatus (Rominger, 1887)

Figures 10, 11

1887 *Embolimus rotundata* Rominger, p. 16, pl. 1, figs. 4, 5.
1908a *Bathyuriscus rotundatus*; Walcott, pl. 4, fig. 2.

1916b *Bathyuriscus rotundatus*; Walcott, p. 346, pl. 47, figs. 2, 2a, b. [see for synonymy]

1951 *Bathyuriscus rotundatus*; Rasetti, p. 158, pl. 28, figs. 2, 3.

1985 *Bathyuriscus rotundatus*; Hu, pl. 6, figs. 18, 21, 25.

Holotype.—*Embolimus rotundata* (specimen appears to be lost) from the Stephen Formation, British Columbia (Rominger, 1887, pl. 1, fig. 4).

Diagnosis.—A species of *Bathyuriscus* with the anterior facial suture divergent, interocular area narrow, posterior border moderately wide; pygidium subisopygous, five to six axial rings, border spines absent.

Occurrence.—Mudstone, Mount Cap Formation, Little Bear River, Northwest Territories, *Aitkenaspis keelensis* Zone; Stephen Formation, British Columbia, *Bathyuriscus-Elrathina* Zone (Rominger, 1887; Walcott, 1908a, 1916b; Rasetti, 1951; Hu, 1985).

Material.—Six complete exoskeletons, 23 incomplete exoskeletons or nearly complete exoskeletons, two early holaspid exoskeletons, 10 cranidia, 15 free cheeks, three thoracic segments, and 27 pygidia. Figured material: GSC 142292–142300.

Remarks.—Pygidia from the Mount Cap Formation vary in the length to width ratio (Figs. 10.1, 11.4, 11.6), similar to Walcott's material (1916b, pl. 47, figs. 2, 2a) from the Stephen Formation. Because the ratio does not correlate to the overall size or number of pygidial segments, this is interpreted as intraspecific variation. The length of the terminal spines of the thoracic segments seems to vary slightly in *B. rotundatus*. Also, the free cheeks from the Mount Cap Formation appear to have a slightly longer genal spine than those in the Stephen Formation. This occurrence of *B. rotundatus* is older than previously reported collections.

Two early holaspids of *Bathyuriscus rotundatus* were collected (Fig. 11.1, 11.2). These differ from late holaspid exoskeletons by the narrower posterior cranial border; narrower thoracic pleura; smaller, triangular-shaped pygidium with an axis that is nearer the border furrow, which is composed of one less axial ring; and a faintly denticulated pygidial margin. Except for the denticulated margin, these differences are similar to those between early and late holaspids of *B. fimbriatus* Robison, 1964 (Robison, 1967).

Genus *Eobathyuriscus* Handkamer and Pratt, new genus

Type species.—*Eobathyuriscus mackenziensis* Handkamer and Pratt, n. sp. from the *Albertelloides mischi* and *Glossopleura walcotti* zones of the Mount Cap Formation, Northwest Territories.

Diagnosis.—Dolichometopid with glabella expanding anteriorly, anterior border short to absent, palpebral lobe short, interocular area wide to moderately wide; free cheek moderately wide, genal spine long; eight or nine thoracic segments; subisopygous, four or five axial rings, pleural field moderately narrow, pleural furrows poorly to moderately defined, border furrow well defined, border short.

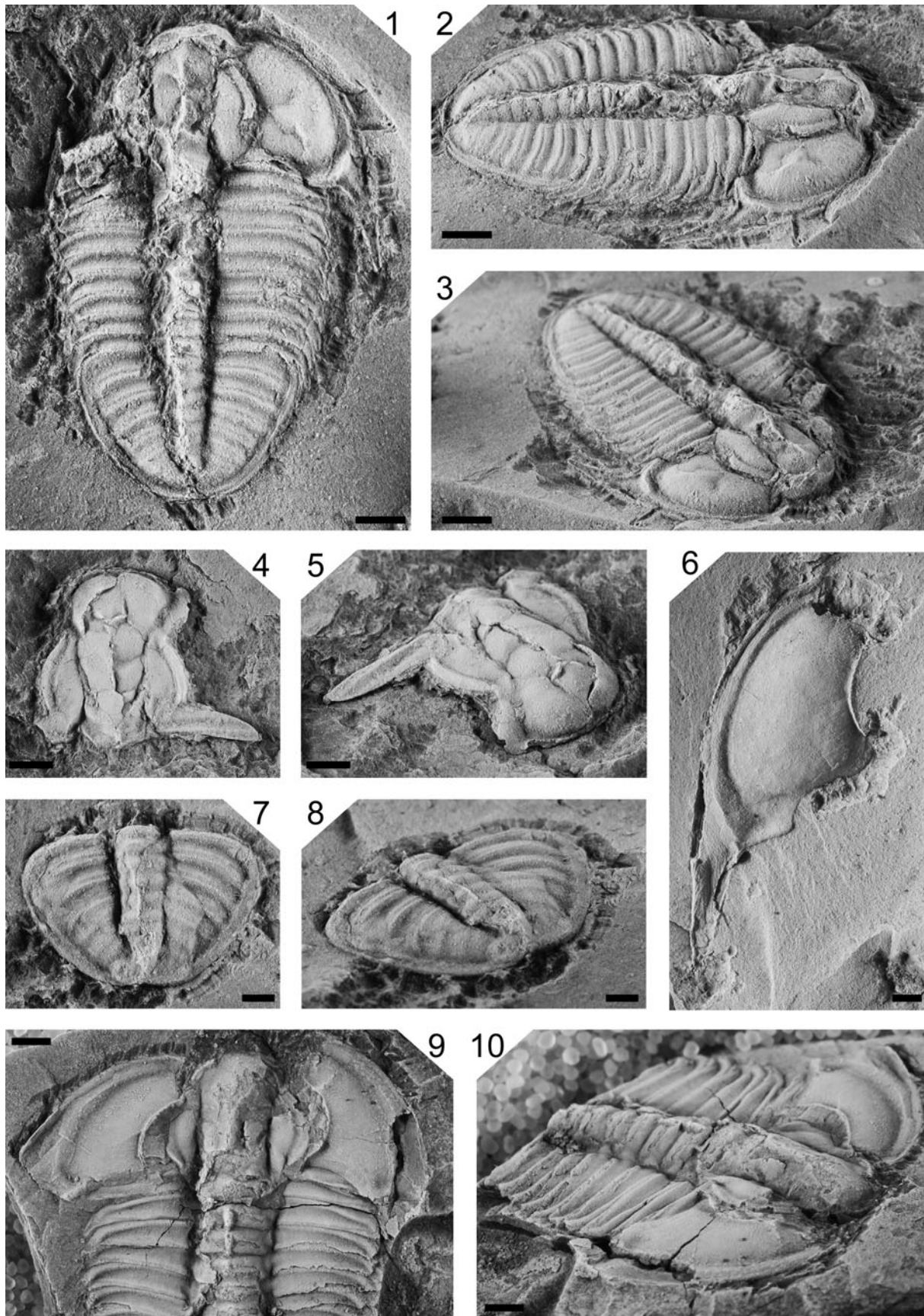


Figure 10. *Bathyriscus rotundatus* (Rominger, 1887) from the *Aitkenaspis keelensis* Zone, mudstone, Mount Cap Formation, Little Bear River, Northwest Territories. (1–3) Nearly complete exoskeleton (dorsal, lateral, oblique) GSC 142292; (4, 5) cranium (dorsal, oblique) GSC 142293; (6) free cheek, (dorsal) GSC 142294; (7, 8) pygidium (dorsal, oblique) GSC 142295; (9, 10) nearly complete exoskeleton, (dorsal, oblique) GSC 142296. All scale bars = 2 mm.

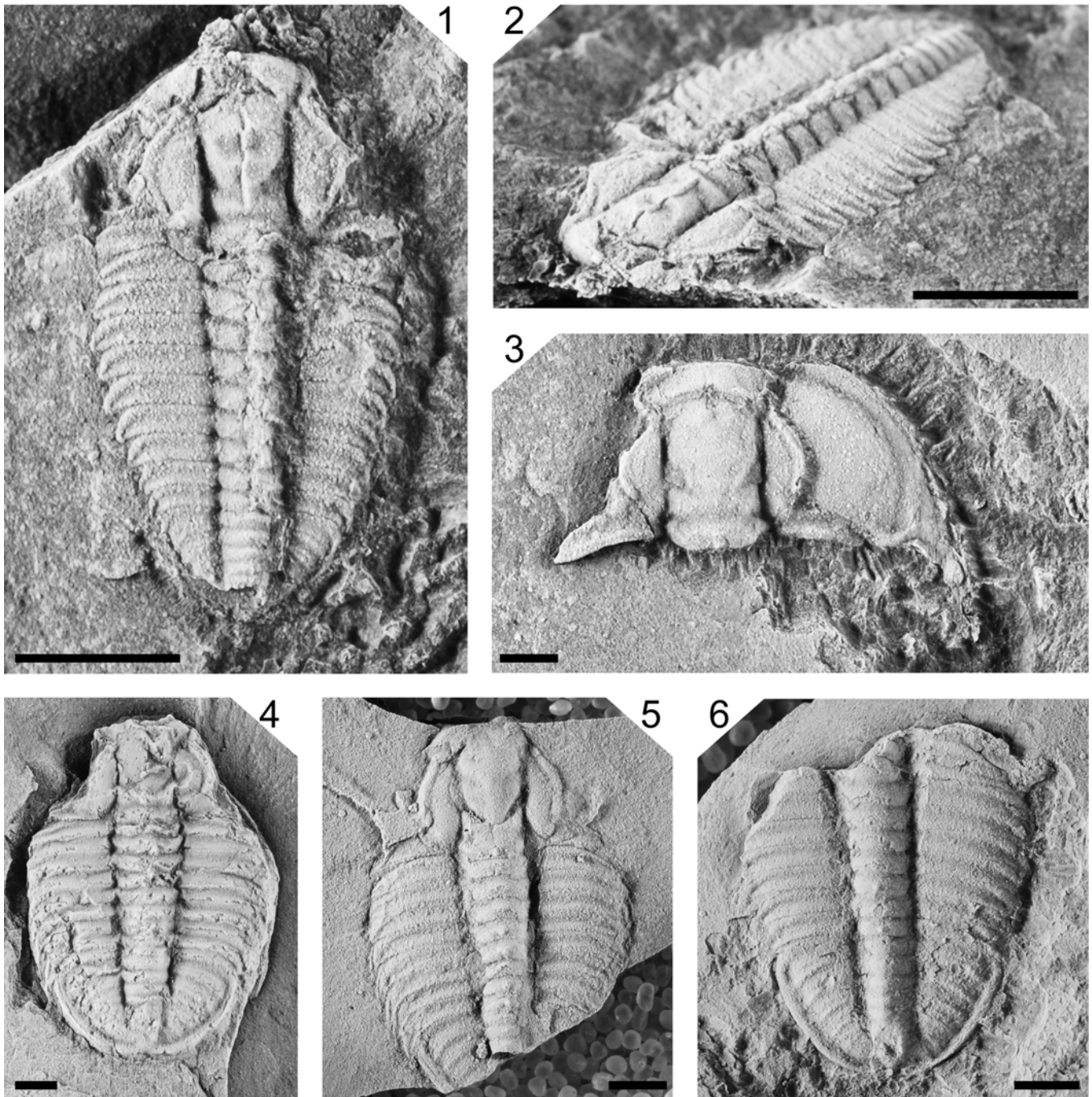


Figure 11. *Bathyriscus rotundatus* (Rominger, 1887) from the *Aitkenaspis keelensis* Zone, mudstone, Mount Cap Formation, Little Bear River, Northwest Territories. (1, 2) Early holaspid exoskeleton lacking free cheeks (dorsal, oblique) GSC 142297; (3) cranium with one free cheek (dorsal) GSC 142298; (4) exoskeleton lacking free cheeks (dorsal) GSC 142299; (5) exoskeleton lacking free cheeks (dorsal) GSC 142300; (6) articulated thorax and pygidium (dorsal) GSC 142294. All scale bars = 2 mm.

Etymology.—Occurs in strata older than those typically containing species of *Bathyriscus*.

Remarks.—*Eobathyriscus* Handkamer and Pratt, n. gen., is similar to *Bathyriscus*, *Poliella* Walcott, 1916b, and *Wenkchemnia* Rasetti, 1951. *Eobathyriscus* n. gen., differs from *Bathyriscus* by having a generally wider interocular area, smaller pygidium composed of fewer axial rings, and less well-defined pygidial pleural furrows. It differs from

Poliella in having a wider anterior glabellar lobe, generally shorter palpebral lobe, larger pygidium composed of more axial rings, and narrower pygidial border. *Eobathyriscus* n. gen., differs from *Wenkchemnia* in having a wider interocular area and larger pygidium with more axial rings.

Eobathyriscus Handkamer and Pratt, n. gen., is intermediate in form between *Wenkchemnia* and *Bathyriscus*. The length of the palpebral lobe (40–48% of the cranial length) is like that of *Wenkchemnia* (35–41% of the cranial length) and some

species of *Bathyriscus*, such as *B. terranovens* Young and Ludvigsen, 1989 (40–50% of the cranial length). The size of the pygidium in *Eobathyriscus* n. gen., (60–65% of the cranial length) and number of axial rings (four or five) is intermediate between *Wenkchemnia* (45–57% of the cranial length, two or three rings) and *Bathyriscus* (75–120% of the cranial length, five to eight axial rings). Some specimens of *B. rotundatus* have the same number of axial rings, although the pygidium is proportionally larger and has better defined pleural furrows than *Eobathyriscus* n. gen., (Fig. 11.6; Walcott, 1916b, pl. 47, figs. 2, 2a).

Eobathyriscus mackenziensis Handkamer and Pratt,
new species
Figures 12, 13

Holotype.—*Eobathyriscus mackenziensis* (GSC 142301) from the *Glossopleura walcotti* Zone of the Mount Cap Formation, Carcajou Falls (24.4 m above the base of the Mount Cap Formation), Northwest Territories (Fig. 12.1).

Diagnosis.—*Eobathyriscus* Handkamer and Pratt, n. gen., with interocular area wide, slightly variable, posterior border wide; free cheek narrow, genal spine short; eight or nine thoracic segments, thoracic spines short; four or five pygidial axial rings, pleural field narrow, border short, variably with shallow medial indentation and very short border spine.

Occurrence.—Mudstone, siltstone, lime mudstone, and wackestone, Mount Cap Formation, Little Bear River, Carcajou Falls, and Dodo Canyon, Northwest Territories, *Aitkenaspis keelensis*, *Albertelloides mischi*, and *Glossopleura walcotti* zones.

Description.—Exoskeleton is subelliptical in outline. Exoskeleton length 14–25 mm.

Cranidium is subtrapezoidal in outline. Axial furrow is well defined. Glabella extends to anterior border furrow or margin if anterior border is absent. Four pairs of lateral glabellar furrows are present. Glabella narrows gently from the occipital ring to S1 and widens from S1 to the anterior lobe. S1 is well defined and oriented obliquely backwards; S2 is moderately defined and oriented obliquely backwards; and S3 and S4 are poorly defined and oriented obliquely forward. Occipital furrow is well defined, the occipital ring variably bearing a median tubercle. Anterior course of the facial suture is slightly divergent. Interocular area at the widest point is two-thirds to half the width of the occipital ring. Palpebral lobe is strongly arched, with the anterior tip intersecting the axial furrow opposite S4, and the posterior tip opposite S1. Length of the palpebral lobe is half that of the glabella. Posterior course of the facial suture is oriented obliquely backwards. Posterior border is equal in width to the occipital ring, with a moderately defined border furrow.

Free cheek is equal in width to the occipital ring; flat lateral border comprises one-fifth the width. Genal spine is non-advanced and comprises one-third the length of the free cheek.

Hypostome is conterminant, widening anteriorly and narrowing posteriorly. Length of the posterior lobe is equal to one-fifth of the total length.

Thorax consists of eight, rarely nine segments. Axial furrow is well defined; each axial ring has a medial tubercle. Pleura is slightly wider than the axis, with well-defined pleural and interpleural furrows. Pleural spines moderately short to moderately long and narrow.

Pygidium subisopygous, semicircular in outline, and the length is equal to two-thirds the width. Pygidial axis tapers gently posteriorly; the posterior tip is slightly anterior of the border furrow, and is composed of four or five rings and a terminal piece. Pleural field is equal in width to the axis, with four or five pairs of pleural furrows. The two or three anterior furrows are moderately to poorly defined and intersect the border furrow, and the two posterior furrows are poorly defined or effaced and do not intersect the border furrow. The border comprises one-tenth or less the length of the pygidium. One pair of short border spines is variably present, opposite the anteriormost pleural furrow. The posterior edge of the border may have a medial indentation.

Etymology.—Named after the Mackenzie Mountains.

Material.—Twenty-nine complete and nearly complete exoskeletons, 93 exoskeletons lacking the free cheeks, 78 holaspid cranidia, three meraspid cranidia, four isolated thoracic segments, and 87 pygidia. Type material: holotype, GSC 142301; paratypes GSC 142302–142319.

Remarks.—Specimens of *Eobathyriscus mackenziensis* Handkamer and Pratt, n. gen. n. sp., show variation in the width of the interocular area, number of thoracic segments, length and width of the border of the free cheek and pygidium, number of pygidial axial rings and furrows, presence of a medial indentation in the pygidial margin, and presence of border spines. The width of the interocular area correlates to the size of the cranidium in that it is narrower in larger specimens (Figs. 12.1, 12.7, 13.8). Larger pygidia have five rather than four axial rings and pleural furrows, and border spines are present only on the smaller pygidia (Figs. 12.4–12.6, 13.2). These features are interpreted as growth related. Variation in border length, number of thoracic segments, and presence of a medial indentation do not correlate with exoskeleton size and are regarded as intraspecific variation.

Eobathyriscus macqueeni Handkamer and Pratt, new species
Figure 14

Holotype.—*Eobathyriscus macqueeni* (GSC 142320) from the *Glossopleura walcotti* Zone of the Mount Cap Formation, Carcajou Falls (27.2 m above the base of the Mount Cap Formation), Northwest Territories (Fig. 14.1–14.3).

Diagnosis.—*Eobathyriscus* Handkamer and Pratt, n. gen., with an interocular area narrow, posterior border narrow; free cheek wide, genal spine long; nine thoracic segments, thoracic spine long; five or six pygidial axial rings, pleural field wide, border long, medial indentation and border spines absent.

Occurrence.—Lime mudstone and rarely wackestone, Mount Cap Formation, Carcajou Falls, Northwest Territories, *Glossopleura walcotti* Zone.

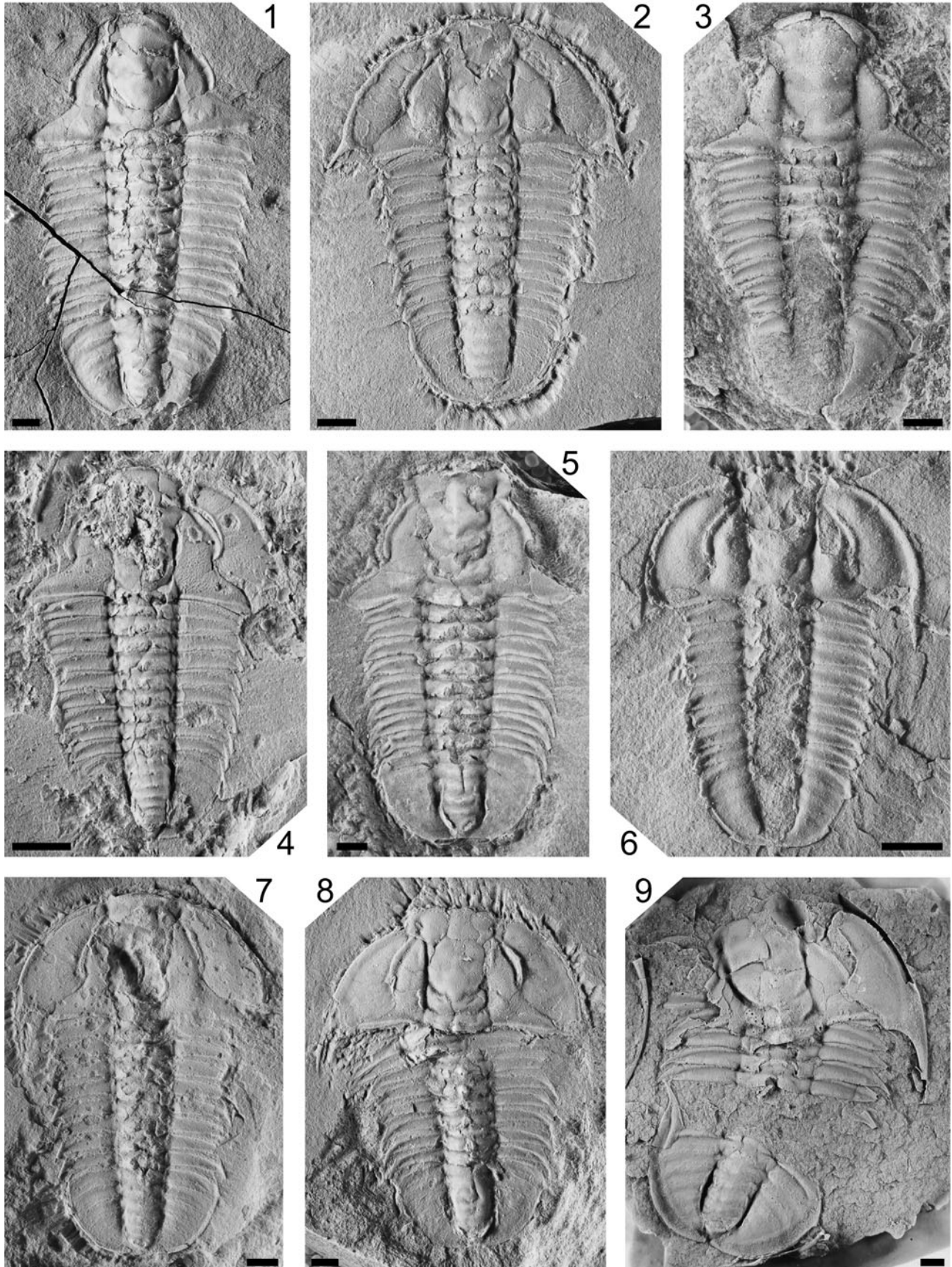


Figure 12. *Eobathyriscus mackenziensis* Handkamer and Pratt, n. gen., n. sp., from the Mount Cap Formation, Northwest Territories. (1) Holotype exoskeleton lacking free cheeks (dorsal) GSC 142301, lime mudstone, Carcajou Falls, *Glossopleura walcotti* Zone; (2) paratype complete exoskeleton (dorsal) GSC 142302, mudstone, Carcajou Falls, *Glossopleura walcotti* Zone; (3) paratype exoskeleton lacking free cheeks (dorsal) GSC 142303, wackestone, Carcajou Falls, *Glossopleura walcotti* Zone; (4) paratype exoskeleton lacking a free cheek (dorsal) GSC 142304, mudstone, Little Bear River, *Albertelloides mischi* or *Glossopleura walcotti* Zone; (5) paratype exoskeleton lacking free cheeks (dorsal) GSC 142305, lime mudstone, Carcajou Falls, *Glossopleura walcotti* Zone; (6) paratype exoskeleton (dorsal) GSC 142306, lime mudstone, Carcajou Falls, *Glossopleura walcotti* Zone; (7) paratype exoskeleton (dorsal) GSC 142307, lime mudstone, Carcajou Falls, *Glossopleura walcotti* Zone; (8) paratype exoskeleton (dorsal) GSC 142308, mudstone, Carcajou Falls, *Glossopleura walcotti* Zone; (9) disarticulated exoskeleton (dorsal, latex mold) GSC 142309, mudstone, Carcajou Falls, *Glossopleura walcotti* Zone. All scale bars = 2 mm.

Description.—Exoskeleton is subquadrate in outline. Exoskeleton length 40 mm.

Cranidium is subtrapezoidal in outline. Axial furrow is well defined. Glabella extends to anterior border furrow or margin if anterior border is absent. Four pairs of lateral glabellar furrows are present. Glabella narrows gently from the occipital ring to S1 and widens from S1 to the anterior lobe. S1 is well defined and oriented obliquely backwards; S2 is poorly defined or effaced and oriented obliquely backwards; and S3 and S4 are poorly defined or effaced and oriented obliquely forward. Occipital furrow is well defined, the occipital ring variably bearing a medial tubercle. Anterior course of the facial suture is divergent. Moderately convex interocular area at the widest point is equal to half the width of the occipital ring. Palpebral lobe is strongly arched, with the anterior tip intersecting the axial furrow opposite S4, and the posterior tip opposite the middle of L1. Length of the palpebral lobe is equal to half that of the glabella. Posterior course of the facial suture is oriented obliquely backwards. Weakly convex posterior border is slightly narrower than the occipital ring, with a well-defined border furrow.

Free cheek is slightly narrower than the occipital ring, moderately convex, and the border comprises one-third of the width. Genal spine is non-advanced and comprises one-third to two-thirds the length of the free cheek.

Hypostome is conterminant.

Thorax consists of nine segments. Moderately convex axis with a well-defined axial furrow; each axial ring has a medial tubercle. Gently convex pleura is slightly wider than the axis, with well-defined pleural and interpleural furrows. Pleural spines are moderately long and narrow.

Pygidium subsoppygous, semicircular in outline, and the length is equal to half to two-thirds the width. Moderately convex axis narrows posteriorly, the posterior tip is slightly anterior of the border furrow, and is composed of five or six rings and a terminal piece. Axial ring furrows are well defined. Gently convex pleural field is slightly wider than the axis, with five pairs of pleural furrows that intersect the border furrow. The three anterior furrows are well defined, and the two posterior furrows are poorly defined. The flat border comprises one-eighth the length of the pygidium. Border spines are absent.

Etymology.—Named after Roger W. Macqueen, who was the first GSC researcher to study the lower Paleozoic stratigraphy of the eastern Mackenzie Mountains in detail.

Material.—One complete exoskeleton, one nearly complete exoskeleton, six cranidia, and seven pygidia. Type material: holotype, GSC 142320; paratypes, GSC 14321–142324.

Remarks.—*Eobathyriscus macqueeni* Handkamer and Pratt, n. gen. n. sp. differs from *E. mackenziensis* n. gen. n. sp. in its larger size, narrower interocular area, wider free cheek, longer genal spine, slightly longer thoracic spines, occasional additional axial ring, wider pleural field, better defined pleural furrows, slightly longer border, and lack of short border spines. *Eobathyriscus macqueeni* n. gen. n. sp. was only collected in limestone, whereas *E. mackenziensis* n. gen. n. sp. was collected in mudstones as well.

Genus *Glossopleura* Poulsen, 1927

Type species.—*Dolichometopus boccar* Walcott, 1916b, from the *Glossopleura* Zone of the Stephen Formation, British Columbia.

Remarks.—*Glossopleura* Poulsen, 1927, has >50 species and is in need of review because most species are likely synonymous (Sundberg, 2005; Robison and Babcock, 2011) and features used to discern species of this genus can overlap significantly (Sundberg, 2005). Hitherto, *Glossopleura* species for which the thorax is known had seven or eight segments. *Glossopleura youngi* Handkamer and Pratt, n. sp., bears six thoracic segments, which is not regarded as taxonomically important at the generic level.

Glossopleura boccar (Walcott, 1916)

Figure 15.1–15.6

1916b *Dolichometopus boccar* Walcott, p. 363, pl. 52, fig. 1, 1a–f.

2005 *Glossopleura boccar*; Sundberg, p. 65, fig. 6.10–6.14. [see for synonymy]

2011 *Glossopleura boccar*; Foster, p. 105, fig. 4.1–4.3.

Holotype.—*Dolichometopus boccar* (USNM 62702) from the *Glossopleura* Zone of the Stephen Formation, British Columbia (Walcott, 1916b, pl. 52, fig. 1).

Diagnosis.—*Glossopleura* with anterior glabellar lobe moderately wide to wide, S1 well defined, S2, S3, and S4 poorly defined or effaced, palpebral lobe long and narrow; posterior border wide; thorax with seven segments; pygidial length two-thirds the width, axis long, intersecting the border furrow, ring furrows moderately defined, pleural furrows and border furrow moderately to poorly defined, border moderately long (modified from Sundberg, 2005).

Occurrence.—Mudstone, lime mudstone, and wackestone, Mount Cap Formation, Dodo Canyon and measured section 12-MWB-04, Northwest Territories, *Glossopleura walcotti*

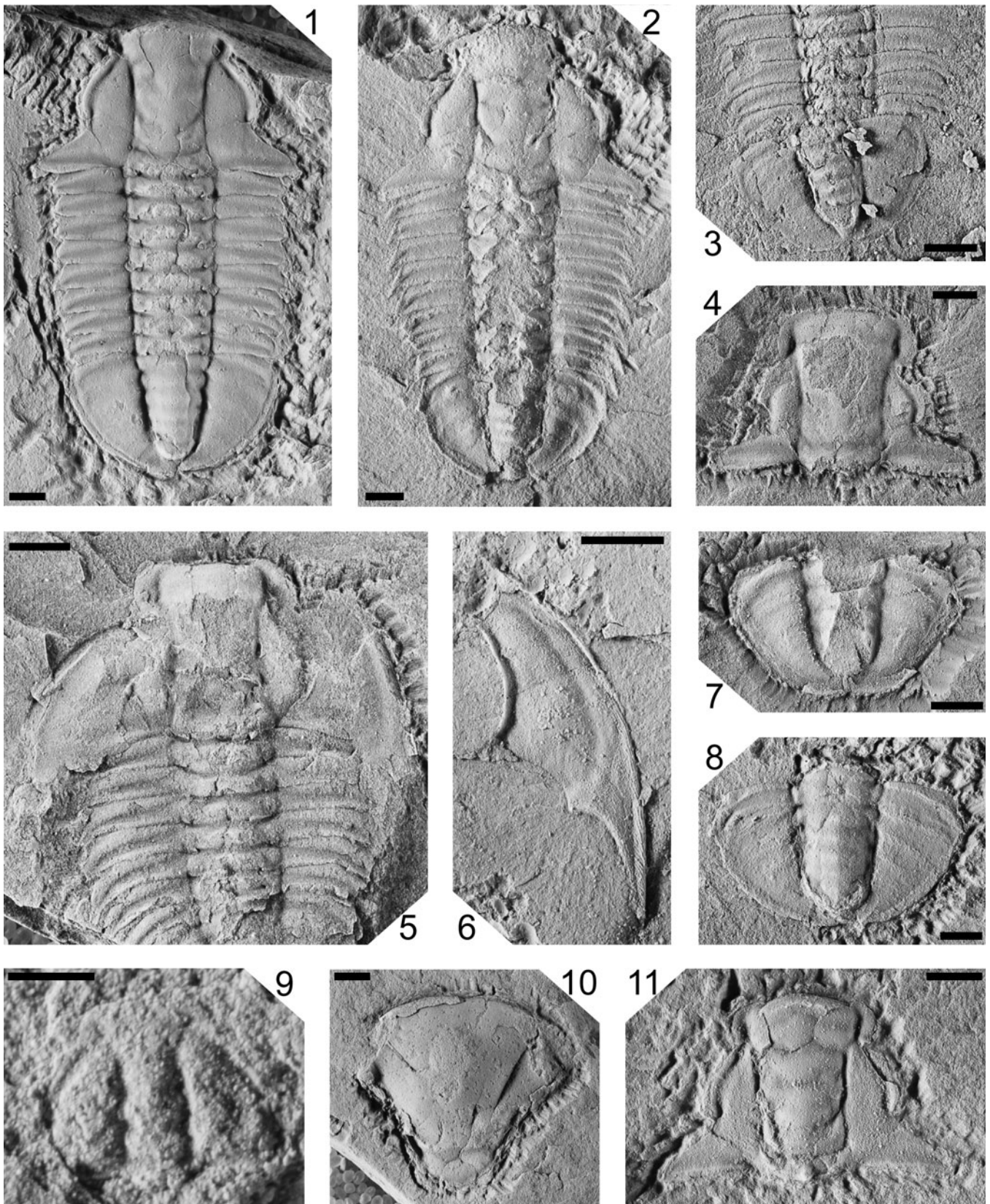


Figure 13. *Eobathyriscus mackenziensis* Handkamer and Pratt, n. gen. n. sp. from the Mount Cap Formation, Northwest Territories. (1) Paratype exoskeleton lacking free cheeks (dorsal) GSC 142310, mudstone, Carcajou Falls, *Glossopleura walcotti* Zone; (2) paratype exoskeleton lacking free cheeks (dorsal) GSC 142311, mudstone, Carcajou Falls, *Glossopleura walcotti* Zone; (3) paratype disarticulated thorax and pygidium (dorsal) GSC 142312, siltstone, Carcajou Falls, *Glossopleura walcotti* Zone; (4) paratype cranium (dorsal) GSC 142313, siltstone, Carcajou Falls, *Glossopleura walcotti* Zone; (5) paratype nearly complete exoskeleton (dorsal) GSC 142314, siltstone, Carcajou Falls, *Glossopleura walcotti* Zone; (6) paratype free cheek (dorsal) GSC 142315, mudstone, Little Bear River, *Albertelloides mischi* Zone; (7) paratype pygidium (dorsal) GSC 142316, siltstone, Carcajou Falls, *Glossopleura walcotti* Zone; (8) paratype pygidium (dorsal) GSC 142306, lime mudstone, Carcajou Falls, *Glossopleura walcotti* Zone; (9) paratype meraspid cranium (dorsal) GSC 142317, lime mudstone, Carcajou Falls, *Glossopleura walcotti* Zone, scale bar = 500 μ m; (10) paratype hypostome (dorsal) GSC 142318, lime mudstone, Carcajou Falls, *Glossopleura walcotti* Zone, (11) paratype cranium (dorsal) GSC 142319, mudstone, Carcajou Falls, *Glossopleura walcotti* Zone. All scale bars = 2 mm unless stated otherwise.

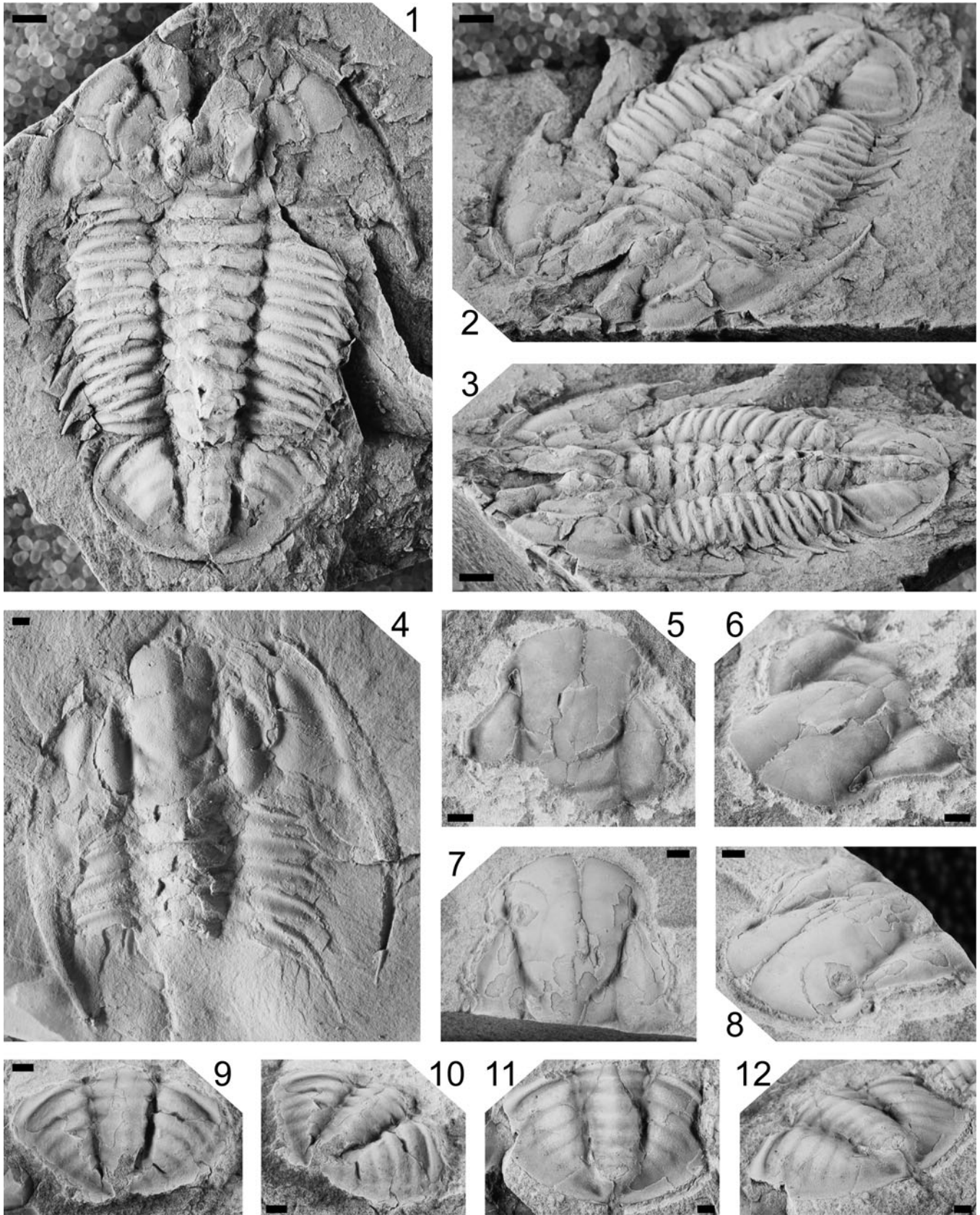


Figure 14. *Eobathyriscus macqueeni* Handkamer and Pratt, n. gen. n. sp. from the *Glossopleura walcotti* Zone, Mount Cap Formation, Carcajou Falls, Northwest Territories. (1–3) Holotype complete exoskeleton (dorsal, oblique, lateral) GSC 142320, lime mudstone; (4) paratype nearly complete exoskeleton (dorsal, lateral mold) GSC 142321, lime mudstone; (5, 6) paratype cranium (dorsal, oblique) GSC 142322, lime mudstone; (7, 8) paratype cranium (dorsal, oblique) GSC 142323, wackestone; (9, 10) paratype pygidium (dorsal, oblique) GSC 142324, lime mudstone; (11, 12) paratype pygidium (dorsal, oblique) GSC 142323; wackestone. All scale bars = 2 mm.

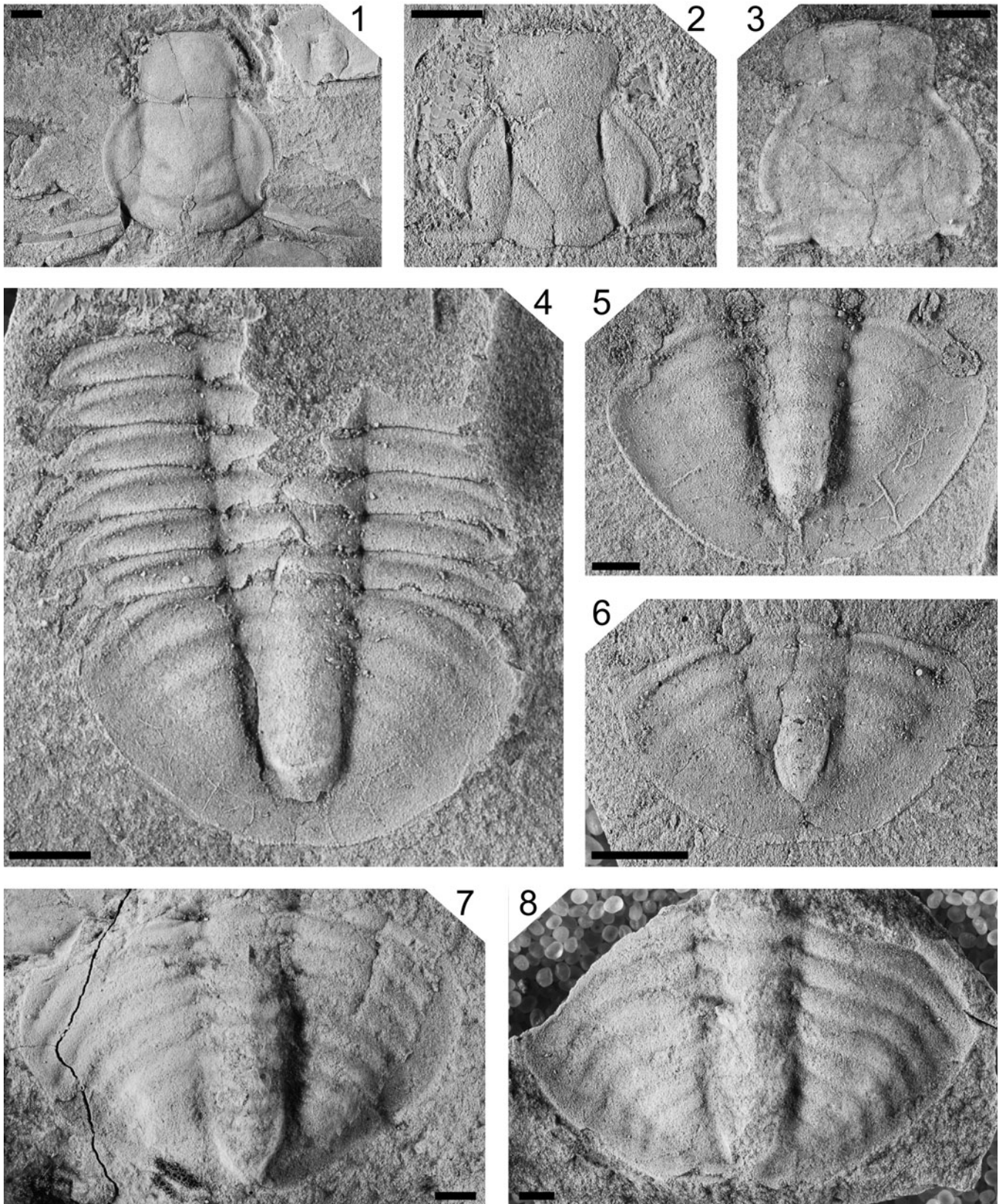


Figure 15. Dolichometopids from the *Glossopleura walcotti* Zone, Mount Cap Formation, Northwest Territories. (1–6) *Glossopleura boccar* (Walcott, 1916b), Dodo Canyon; (1) cranidium (dorsal) GSC 142448, mudstone; (2) cranidium (dorsal) GSC 142325, mudstone; (3) cranidium (dorsal) GSC 142326, lime mudstone; (4) partially complete exoskeleton lacking the cephalon (dorsal) GSC 143327, mudstone; (5) pygidium (dorsal) GSC 142328, mudstone; (6) pygidium (dorsal) GSC 142329, mudstone. (7, 8) *Polyleuraspis solitaria* Poulsen, 1927, lime mudstone, measured section 12-MWB-04; (7) pygidium (dorsal) GSC 142330; (8) pygidium (dorsal) GSC 142331. All scale bars = 2 mm.

Zone; Stephen Formation, Alberta and British Columbia, *Glossopleura* Zone (Walcott, 1916b; Rasetti, 1951); Chisholm Formation, Utah, *Glossopleura walcotti* Zone (Sundberg, 2005; McCollum and Sundberg, 2007); Bright Angel Shale, Arizona, *Glossopleura walcotti* Zone (Foster, 2011).

Material.—Eleven nearly complete exoskeletons, 28 cranidia, eight free cheeks, 13 thoracic segments, and 52 pygidia. Figured material: GSC 142325–142329, 142448.

Remarks.—*Glossopleura boccar* from the Mount Cap Formation varies in the width of the anterior glabellar lobe (Fig. 15.1 vs. 15.2, 15.3) and the depth of the pygidial border and pleural furrows (Fig. 15.4–15.6), similar to *G. boccar* in the Chisholm Formation (Sundberg, 2005, fig. 6.10–6.14). This species has been tentatively reported from the Mount Cap Formation in the subsurface of the Colville Hills as well (Somers et al., 2020).

Glossopleura youngi Handkamer and Pratt, new species

Figure 16

Holotype.—*Glossopleura youngi* (GSC 142332) from the *Glossopleura walcotti* Zone of the Mount Cap Formation, Carcajou Falls (28.5 m above the base of the Mount Cap Formation), Northwest Territories (Fig. 16.1).

Diagnosis.—*Glossopleura* with anterior glabellar lobe moderately wide, lateral glabellar furrows poorly defined or effaced, palpebral lobe long and wide, posterior border narrow; thorax with six segments; pygidial length half to three-fifths the width, axis short, anterior of border furrow, ring furrows poorly defined or effaced, pleural furrows poorly defined or effaced, border furrow well defined, border long.

Occurrence.—Mudstone and grainstone, Mount Cap Formation, Carcajou Falls, Northwest Territories, *Glossopleura walcotti* Zone.

Description.—Exoskeleton is subelliptical in outline. Exoskeleton length 18–28 mm.

Cranidium is subquadrate in outline. Axial furrow is moderately defined. Glabella is subrectangular in shape and extends to anterior border. Four pairs of lateral glabellar furrows are present. Glabella widens gently from S1 to the anterior lobe. S1 is poorly defined and oriented obliquely backwards; S2 is poorly defined or effaced and oriented obliquely backwards; and S3 and S4 are poorly defined or effaced and oriented obliquely forward. Occipital furrow is poorly to moderately defined. Length of the anterior border is less than one-tenth that of the occipital ring. Anterior course of the facial suture is slightly divergent. Width of the interocular area at the widest point is one-third that of the occipital ring. Palpebral lobe is strongly arched, with the anterior tip intersecting the axial furrow slightly posterior of S4, and the posterior tip opposite the occipital ring. Length of the palpebral lobe is three-fifths that of the glabella, and the width is slightly narrower than that of the interocular area. Posterior course of the facial suture is transverse. Width of the posterior border is two-thirds that of the occipital ring, with a moderately defined border furrow.

Free cheek width is unknown. Free cheek border comprises one-sixth the width of the free cheek. Genal spine is short.

Hypostome is unknown.

Thorax consists of six segments. Axial furrow is well defined. Pleural width is equal to or slightly wider than that of the axis, pleura with moderately defined pleural and interpleural furrows. Pleural spines are very short.

Pygidium isopygous, semicircular in outline, and the length is half to three-fifths the width. Moderately convex axis narrows gently posteriorly, with the posterior tip slightly anterior of the border furrow, and is composed of at least three rings. Axial ring furrows are poorly defined or effaced. Gently convex pleural field is slightly narrower than the axis, with two poorly defined or effaced pleural furrows. Flat border comprises one-quarter to one-fifth the length of the pygidium. Border is covered in terrace lines. Border spines are absent.

Etymology.—Named after Graham A. Young, Manitoba Museum, Winnipeg, Manitoba.

Material.—One complete exoskeleton, 21 nearly complete exoskeletons or complete exoskeletons lacking free cheeks, 10 cranidia, and 19 pygidia. Type material: holotype, GSC 142332; paratypes, GSC 142333–142341.

Remarks.—*Glossopleura youngi* Handkamer and Pratt, n. sp., has one thoracic segment fewer than in other species of *Glossopleura* for which the thorax is known. In those species, *Glossopleura* varies in having either seven or eight thoracic segments, but the number is stable within individual species. Apart from the number of thoracic segments, *Glossopleura youngi* n. sp. is similar to *G. boccar* and *G. producta* (Walcott, 1916b), differing from the former by having a more effaced glabella, a slightly longer and wider palpebral lobe, a narrower posterior border, a slightly shorter pygidial axis, a less well-defined axial furrow, a near absence of pleural furrows, and a longer border; and differing from the latter by having an more effaced glabella, a slightly shorter pygidial axis, and a longer pygidial border.

Genus *Polypleuraspis* Poulsen, 1927

Type species.—*Polypleuraspis solitaria* Poulsen, 1927, from the *Glossopleura walcotti* Zone of the lower Cape Wood Formation, Greenland.

Remarks.—Peel's (2020) generic diagnosis is followed herein. *Polypleuraspis* currently contains three species: *P. solitaria*, *P. insignis* Rasetti, 1951, and *P. glacialis* Peel, 2020, all from the *Glossopleura* Zone. Peel (2020) allowed for some intraspecific variation in the pygidium of *P. glacialis*, in outline, convexity, and shape of the median indentation of the posterior margin.

Polypleuraspis solitaria Poulsen, 1927

Figure 15.7, 15.8

1927 *Polypleuraspis solitaria* Poulsen, p. 270, pl. 16, figs. 37, 38.
2020 *Polypleuraspis solitaria*; Peel, p. 20, figs. 2D, K, L, N, P, Q, S, T, 4A–U. [see for synonymy]

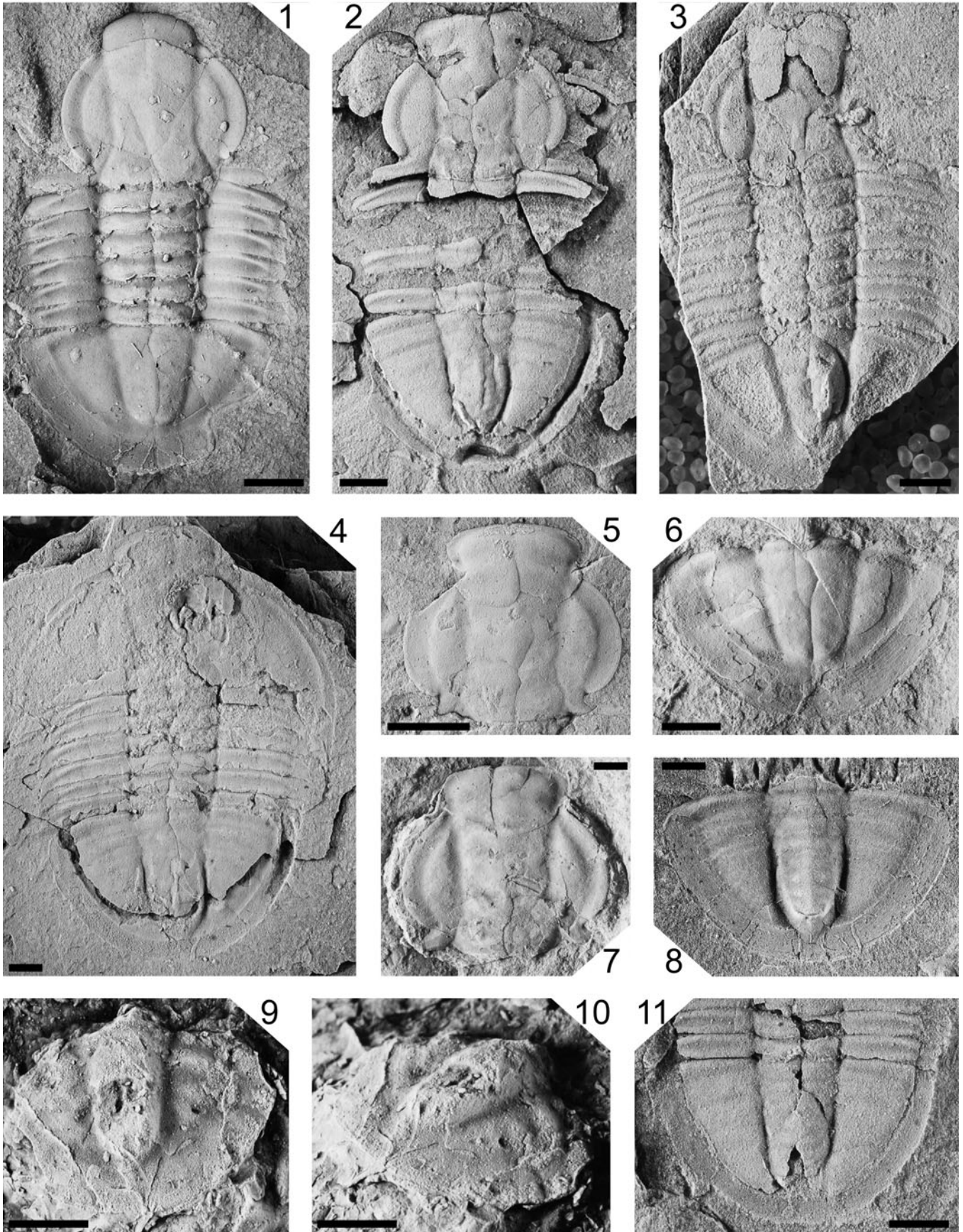


Figure 16. *Glossopleura youngi* Handkamer and Pratt, n. sp., from the *Glossopleura walcotti* Zone, Mount Cap Formation, Carcajou Falls, Northwest Territories. (1) Holotype exoskeleton lacking free cheeks (dorsal, latex mold) GSC 142332, mudstone; (2) paratype nearly complete exoskeleton (dorsal) GSC 142333, mudstone; (3) paratype partially complete exoskeleton (dorsal) GSC 142334, mudstone; (4) paratype complete exoskeleton (dorsal) GSC 142335, mudstone; (5) paratype cranium (dorsal) GSC 142336, mudstone; (6) paratype pygidium (dorsal) GSC 142337, mudstone; (7) paratype cranium (dorsal) GSC 142338, mudstone; (8) paratype pygidium (dorsal) GSC 142339, mudstone; (9, 10) paratype pygidium (dorsal, oblique) GSC 142340, grainstone; (11) paratype articulated pygidium and thorax (dorsal) GSC 142341, mudstone. All scale bars = 2 mm.

Holotype.—Pygidium (MGUH 2292) from the *Glossopleura* Zone of the lower Cape Wood Formation, northwestern Greenland (Poulsen, 1927, pl. 16, figs. 37, 38; Peel, 2020, fig. 2I, K, N).

Occurrence.—Lime mudstone, Mount Cap Formation, measured section 12-MWB-04, Northwest Territories, *Glossopleura walcotti* Zone; Cap Wood Formation, Kap Kent, Greenland, *Glossopleura* Zone (Poulsen, 1927; Peel, 2020).

Material.—Two pygidia. Figured material: GSC 142330, 142331.

Remarks.—The maximum pygidial width of these specimens is at the midlength, which is consistent with *P. solitaria*. The two pygidia in the Mount Cap Formation are wider than most specimens from northwestern Greenland. The axial nodes are preserved only on one specimen.

Genus *Sahtuia* Handkamer and Pratt, new genus

Type species.—*Sahtuia carcajouensis* Handkamer and Pratt, n. sp., from the *Glossopleura walcotti* Zone of the Mount Cap Formation, Northwest Territories.

Diagnosis.—As for species.

Etymology.—Named after the Sahtu Region of the Northwest Territories, within which the study area lies.

Remarks.—The glabellar shape and size, orientation of the palpebral lobe, size and shape of the postocular fixed cheek, lack of a fixigenal spine, narrow pygidial border, and lack of border spines indicate that *Sahtuia* Handkamer and Pratt, n. gen. belongs to Dolichometopidae and is closely related to *Bathyriscus* and *Eobathyriscus* Handkamer and Pratt, n. gen. *Sahtuia* n. gen., compared to other dolichometopids, has fewer thoracic segments and a larger pygidium. At present the genus is monospecific.

Sahtuia carcajouensis Handkamer and Pratt, new species
 Figures 17, 18

Holotype.—*Sahtuia carcajouensis* (GSC 142342) from the *Glossopleura walcotti* Zone of the Mount Cap Formation, Carcajou Falls (26.3 m above the base of the Mount Cap Formation), Northwest Territories (Fig. 17.1).

Diagnosis.—Dolichometopid with glabella anteriorly wide, palpebral lobe short, postocular fixed cheek long and wide; four thoracic segments; macropygous, eight or nine axial rings, eight or nine pleural furrows and seven interpleural furrows well defined, border short, pygidial spines absent.

Occurrence.—Mudstone, lime mudstone, wackestone, and grainstone, Mount Cap Formation, Dodo Canyon, upper *Albertelloides mischi* Zone, Carcajou Falls, *Glossopleura walcotti* Zone, Northwest Territories.

Description.—Exoskeleton is subelliptical in outline. Exoskeleton length 8–33 mm.

Cranidium is subtrapezoidal in outline. Axial furrow is well defined. Strongly convex glabella is subrectangular in outline, extending anteriorly to the border. Glabella narrows gently from the occipital ring to S1 and widens from S1 to the anterior lobe. Four pairs of lateral glabellar furrows are present. S1 is well defined and oriented obliquely backwards, S2 is moderately defined and oriented obliquely backwards, and S3 and S4 are poorly defined or effaced and oriented obliquely forward. Occipital furrow is well defined, the occipital ring bearing a medial tubercle. Length of the anterior border is one-sixth that of the occipital ring. Anterior course of the facial suture is parallel or slightly divergent. Moderately convex interocular area at the widest point is three-fifths the width of the occipital ring. Palpebral lobe is strongly arched, with the anterior tip intersecting the axial furrow opposite S4, and the posterior tip opposite the anterior-half to middle of L1. Length of the palpebral lobe is equal to half that of the glabella. Posterior course of the facial suture is oriented obliquely backwards. Posterior border is equal in width to that of the occipital ring, with a well-defined posterior border furrow.

Free cheek is slightly wider than the occipital ring and the border comprises one-fifth to one-sixth the width. Genal spine is slightly advanced and comprises slightly less than half the length of the free cheek. Free cheek is variably caecate. Terrace lines are present on the border.

Hypostome is conterminant, widening anteriorly, and narrowing gently posteriorly. Medial lobe is covered in terrace lines. The posterior lobe comprises one-quarter of the length of the hypostome.

Thorax consists of four segments. Axial furrow is well defined; each ring bearing a medial tubercle. Pleural width is one-and-one-half times that of the axis, pleura with well-defined pleural and interpleural furrows. Pleural spine is short.

Pygidium is macropygous, subelliptical in outline, and the length is equal to four-fifths the width. Strongly convex axis narrows gently posteriorly, the posterior tip intersecting the border furrow, and is composed of eight or nine rings, each bearing a medial tubercle, and a terminal piece. Axial ring furrows are well to moderately defined. Moderately convex pleural field is slightly wider than the axis, with eight or nine pleural and seven interpleural furrows. The seven anterior pleural and interpleural furrows are well defined and intersect the border furrow. The one or two posterior pleural furrows are poorly defined and do not intersect the border furrow. Flat border comprises one-tenth to slightly less than one-tenth the

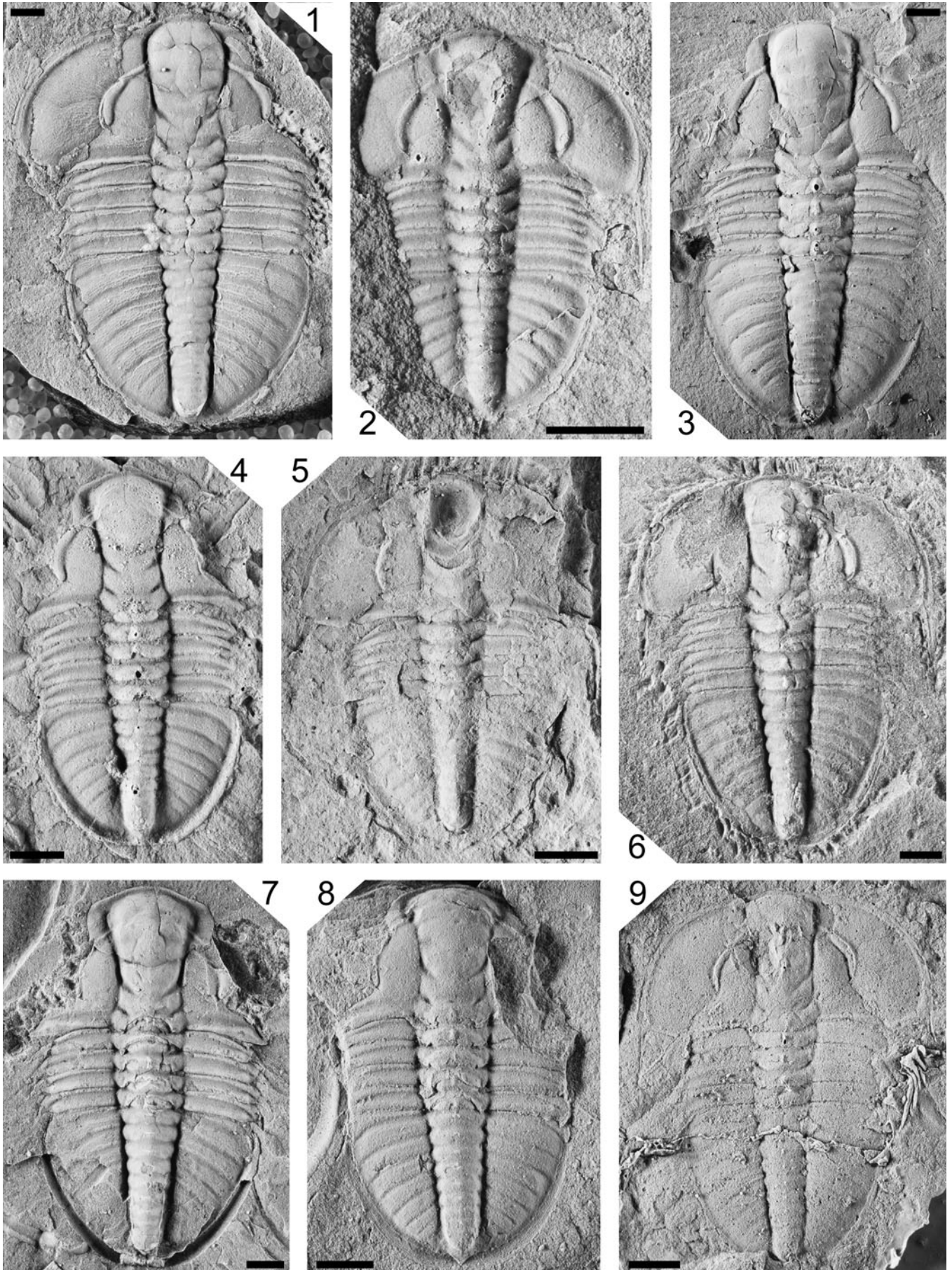


Figure 17. *Sahtuia carcajouensis* Handkamer and Pratt, n. gen. n. sp., from the *Glossopleura walcotti* Zone, mudstone, Mount Cap Formation, Carcajou Falls, Northwest Territories. (1) Holotype exoskeleton lacking a free cheek (dorsal) GSC 142342; (2) paratype complete exoskeleton (dorsal, latex mold) GSC 142343; (3) paratype exoskeleton lacking free cheeks (dorsal, latex mold) GSC 142344; (4) paratype exoskeleton lacking free cheeks (dorsal, latex mold) GSC 142345; (5) paratype nearly complete exoskeleton (dorsal) GSC 142346; (6) paratype complete exoskeleton (dorsal) GSC 142347; (7) paratype exoskeleton lacking free cheeks (dorsal) GSC 142348; (8) paratype exoskeleton lacking free cheeks (dorsal) GSC 142349; (9) paratype complete exoskeleton (dorsal, latex mold) GSC 142350. All scale bars = 2 mm.

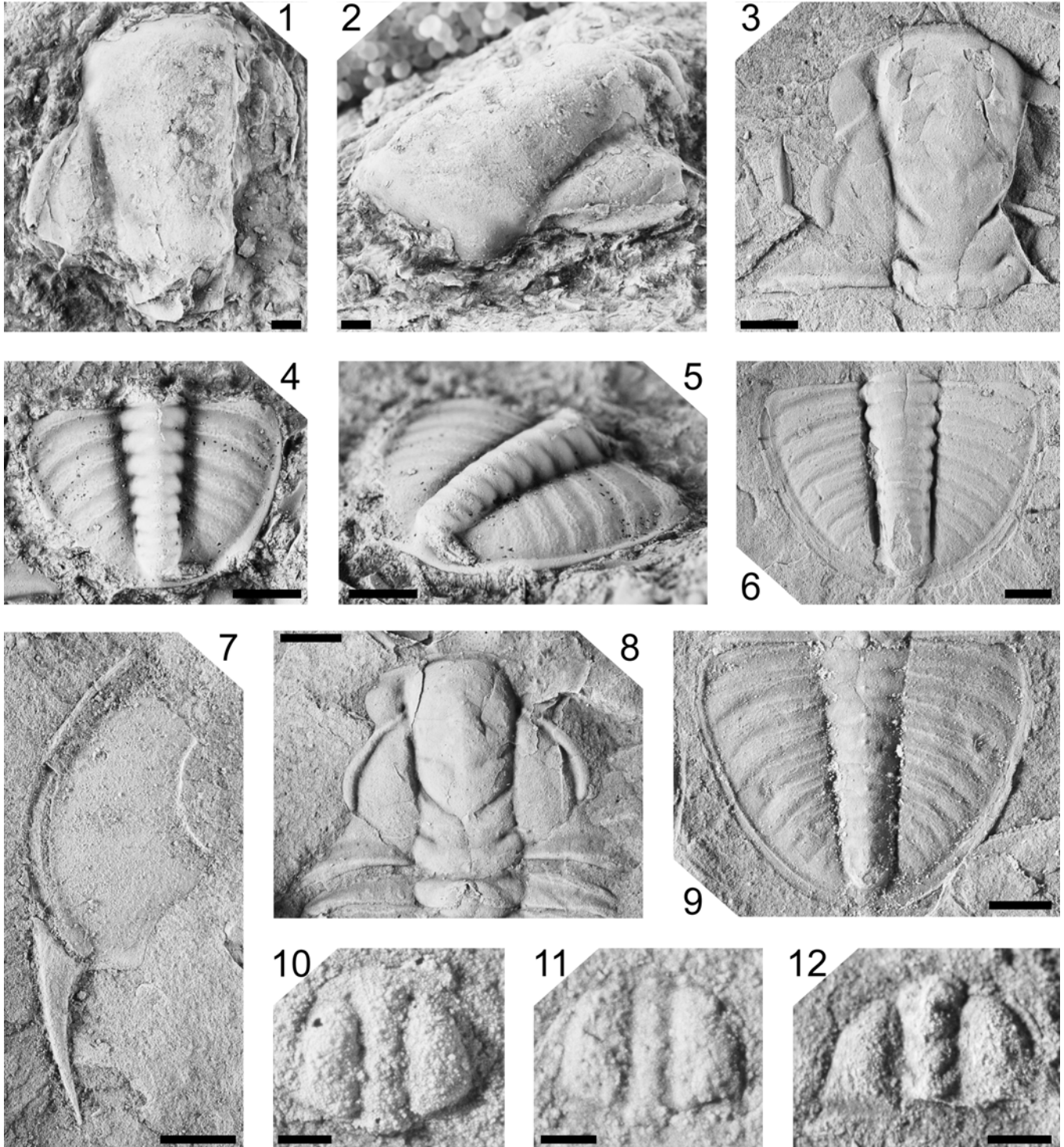


Figure 18. *Sahtuia carcajouensis* Handkamer and Pratt, n. gen. n. sp., from the *Glossopleura walcotti* Zone, Mount Cap Formation, Carcajou Falls, Northwest Territories. (1, 2) Paratype cranium (dorsal, oblique) GSC 142351, grainstone; (3) paratype cranium (dorsal) GSC 142352, mudstone; (4, 5) paratype pygidium (dorsal, oblique) GSC 142353, grainstone; (6) paratype pygidium (dorsal) GSC 142354, mudstone; (7) paratype free cheek (dorsal) GSC 142355, mudstone; (8) paratype cranium (dorsal) GSC 142356, mudstone; (9) paratype pygidium (dorsal) GSC 142357, mudstone; (10) paratype early meraspid cranium (dorsal) GSC 142358, mudstone, scale bar = 125 μ m; (11) paratype protaspid (dorsal) GSC 142359, mudstone, scale bar = 125 μ m; (12) paratype late meraspid cranium (dorsal) GSC 142360, mudstone, scale bar = 500 μ m. All scale bars = 2 mm unless stated otherwise.

length of the pygidium. Border spines are absent. Interpleural areas are caecate.

Etymology.—Named after the Carcajou River.

Material.—Fourteen complete exoskeletons, 52 exoskeletons lacking free cheeks, 17 holaspid cranidia, two meraspid cranidia, one protaspid, three free cheeks, and 30 pygidia. Type material: holotype, GSC 142342; paratypes, GSC 142343–142360.

Remarks.—*Sahtuia carcajouensis* Handkamer and Pratt, n. gen. n. sp., is distinguished by the large size of the pygidium, yet reduced number of thoracic segments in holaspids. The unrelated zacanthoidids *Mackenzieaspis parallelispinosa* Handkamer and Pratt, n. gen. n. sp., and *Dodoella kobayashii* Handkamer and Pratt, n. gen. n. sp., also both have four thoracic segments and a large pygidium.

Family Oryctocephalidae Beecher, 1897

Subfamily Oryctocarinae Hupé, 1953

Genus *Oryctocara* Walcott, 1908

Type species.—*Oryctocara geikiei* Walcott, 1908b, from the Spence Shale, Idaho

Remarks.—The diagnosis by Whittington (1995) is followed herein.

Oryctocara geikiei Walcott, 1908

Figure 20.7–20.10

1908b *Oryctocara geikiei* Walcott, p. 23, pl. 1, figs. 9, 10.

2020 *Oryctocara geikiei*; Sundberg, p. 16, fig. 15.1–15.29. [see for synonymy]

Lectotype.—*Oryctocara geikiei* (USNM 53426, 53428) from the Spence Shale, Idaho (Walcott, 1908b, pl. 1, fig. 9; Whittington, 1995, pl. 4, figs. 5, 6).

Occurrence.—Mudstone, Mount Cap Formation, Little Bear River, Northwest Territories, *Albertelloides mischi* Zone or *Glossopleura walcotti* Zone; Spence Shale, Idaho and Utah, *Glossopleura walcotti* Zone (Walcott, 1908b; Campbell, 1974; Whittington, 1995); Lakeview Limestone, Idaho, *Ptychagnostus praecurrens* Zone (Resser, 1938, 1939a; Sundberg, 2020); Stephen Formation, British Columbia, *Glossopleura walcotti* Zone (Whittington, 1995).

Material.—Ten cranidia and nine pygidia. Figured material: GSC 142377–142379.

Remarks.—Specimens of *Oryctocara geikiei* Walcott, 1908b, from the Mount Cap Formation resemble the meraspid specimens collected by Sundberg (2020, fig. 15.6, 15.8, 15.11, 15.18–15.20) from the Lakeview Limestone. The presence of this taxon in the uppermost strata of Little Bear River may indicate the *Glossopleura walcotti* Zone (Whittington, 1995; Sundberg, 2020). However, its co-occurrence with

Albertelloides eliasi Handkamer and Pratt, n. sp., as well as the lack of any other taxa indicative of the *G. walcotti* Zone makes the assignment of either zone uncertain.

Family Zacanthoididae Swinerton, 1915

Remarks.—Review of the literature has revealed that *Mexicaspis* has already been assigned as a genus name. *Mexicaspis* Lochman, 1948 (type species *Mexicaspis stenopyge* Lochman, 1948) is preoccupied by *Mexicaspis* Spaeth, 1936 (*Coptocyclus azteca*, Champion, 1894), a tortoise beetle. The replacement name *Mexicaspidella* Handkamer and Pratt is proposed herein.

Genus *Aitkenaspis* Handkamer and Pratt, new genus

Type species.—*Aitkenaspis keelensis* Handkamer and Pratt, n. gen. n. sp., from the *Aitkenaspis keelensis* Zone of the Mount Cap Formation, Little Bear River, Northwest Territories.

Diagnosis.—As for species.

Etymology.—Named after James D. Aitken of the GSC who was one of the first researchers to investigate the stratigraphy of the eastern Mackenzie Mountains in detail, and who also carried out ground-breaking studies of the Cambrian of the Canadian Rocky Mountains.

Remarks.—*Aitkenaspis* Handkamer and Pratt, n. gen., resembles *Fieldaspis* Rasetti, 1951, and *Stephenaspis* Rasetti, 1951. Cranidia of *Fieldaspis* and *Stephenaspis* differ by the distance from the posterior tips of the palpebral lobe to the axial furrow (Rasetti, 1951). This distance in the type species of *Stephenaspis*, *S. bispinosa* Rasetti, 1951, is one-quarter of the width of the occipital ring, whereas in the type species of *Fieldaspis*, *F. furcata* Rasetti, 1951, the distance is one-sixth of the width of the occipital ring. In *Aitkenaspis keelensis* Handkamer and Pratt, n. gen. n. sp., this distance is the same as in *F. furcata*. The pygidium of *Aitkenaspis* n. gen. lacks the border spines or median indentation in the posterior margin present in species of *Fieldaspis* and *Stephenaspis*, although the well-defined border furrow of *Aitkenaspis* n. gen. is within the interspecific variation of *Stephenaspis*. Thus, *Aitkenaspis* n. gen. is intermediary between *Fieldaspis* and *Stephenaspis*. At present, the genus is monospecific.

Aitkenaspis keelensis Handkamer and Pratt, new species

Figures 19, 20.1–20.6

?1996 *Zacanthoides* sp. Butterfield and Nicholas, fig. 2.5.

Holotype.—*Aitkenaspis keelensis* (GSC 142361) from the *Aitkenaspis keelensis* Zone of the Mount Cap Formation, Little Bear River, (17.7 m above the base of the Mount Cap Formation), Northwest Territories (Fig. 19.1).

Diagnosis.—Zacanthoidid with glabella anteriorly wide, palpebral lobe long; genal spine non-advanced; nine thoracic segments, pleural spines long, macropleural spines on the fifth

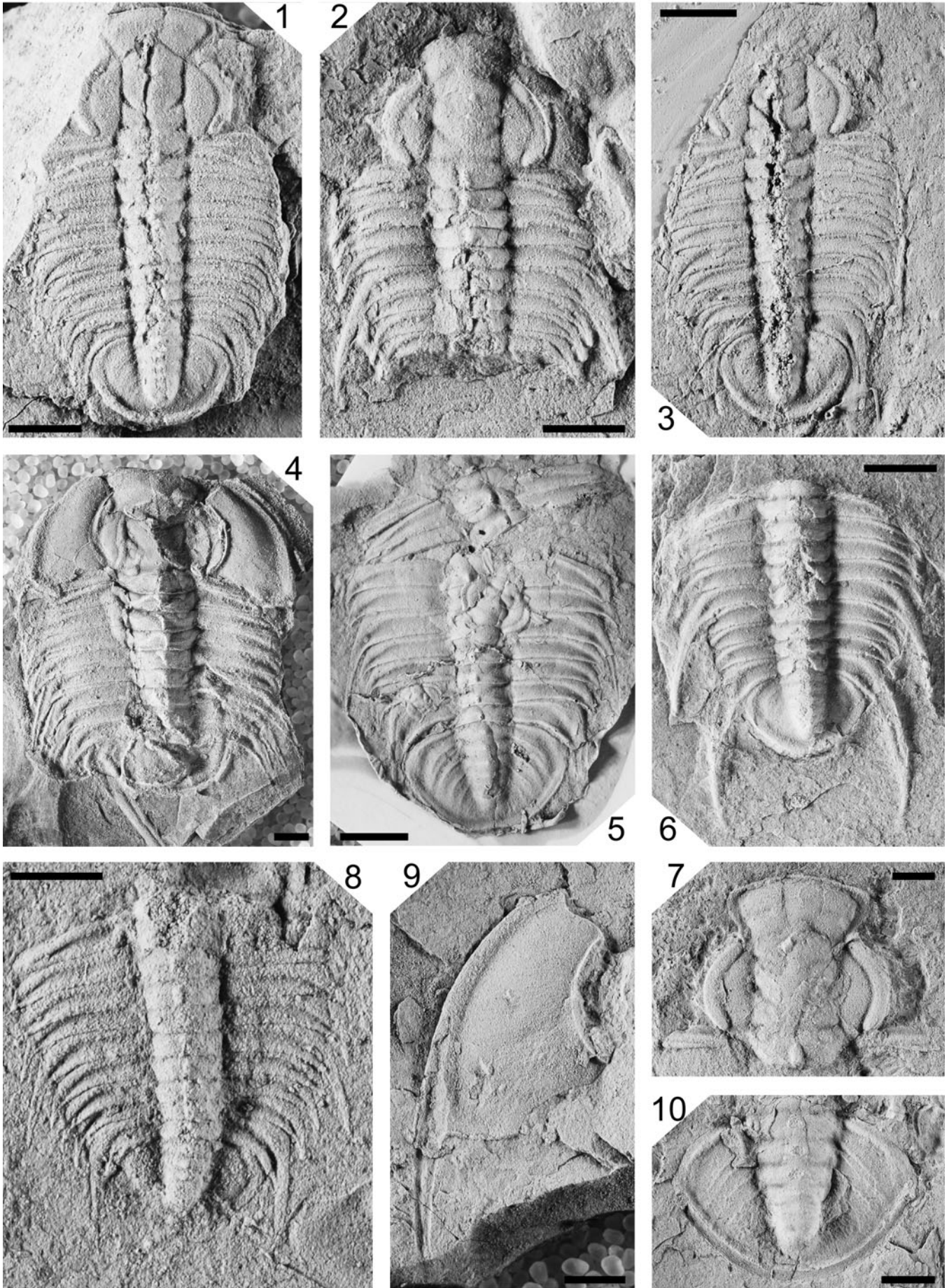


Figure 19. *Aitkenaspis keelensis* Handkamer and Pratt, n. gen. n. sp., from the *Aitkenaspis keelensis* Zone, mudstone, Mount Cap Formation, Little Bear River, Northwest Territories. (1) Holotype exoskeleton lacking free cheeks (dorsal) GSC 142361; (2) paratype exoskeleton lacking free cheeks and the pygidium (dorsal) GSC 142362; (3) paratype exoskeleton lacking free cheeks (dorsal, latex mold) GSC 142363; (4) paratype nearly complete exoskeleton (dorsal) GSC 142364; (5) paratype exoskeleton lacking the cephalon (dorsal, latex mold) GSC 142365; (6) paratype exoskeleton lacking the cephalon (dorsal) GSC 142366; (7) paratype cranidium (dorsal) GSC 142367; (8) paratype exoskeleton lacking the cephalon (dorsal) GSC 142368; (9) paratype free cheek (dorsal) GSC 142369; (10) paratype pygidium (dorsal) GSC 142370. All scale bars = 2 mm.

and ninth segments; oval-shaped pygidium subisopygous, four axial rings, four pleural furrows, border furrow well defined, border spines absent.

Occurrence.—Silty mudstone and siltstone, Mount Clark Formation, Dodo Canyon, mudstone and silty mudstone, Mount Cap Formation, Little Bear River, Northwest Territories, *Aitkenaspis keelensis* Zone.

Description.—Exoskeleton is subelliptical in outline. Exoskeleton length 10–20 mm.

Cranidium is subquadrate in outline. Axial furrow is well defined. Glabella is subquadrate in outline, extending anteriorly to the border. Glabella narrows gently from the occipital ring to S1 and widens from S1 to the anterior lobe. Four pairs of lateral glabellar furrows are present. S1 is well defined and oriented obliquely backwards; S2 is poorly defined and nearly transverse; and S3 and S4 are poorly defined and oriented obliquely forward. Occipital furrow is well defined, the occipital ring bearing a medial tubercle. Length of the anterior border is one-sixth that of the occipital ring. Anterior course of the facial suture is divergent. Interocular area at the widest point is one-third to half the

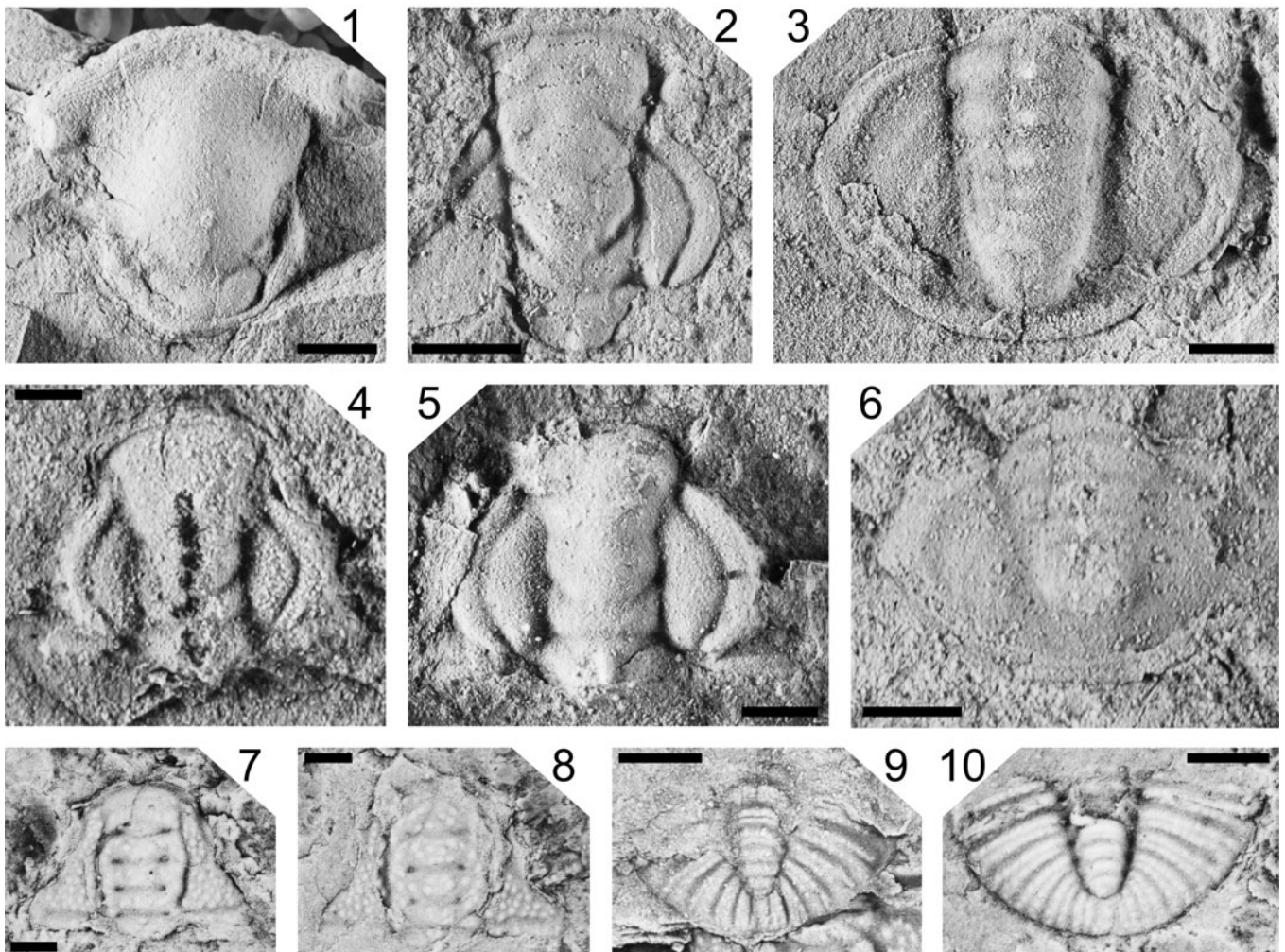


Figure 20. Corynexochids from the Mount Cap Formation, Northwest Territories. (1–6) *Aitkenaspis keelensis* Handkamer and Pratt, n. gen. n. sp., from the *Aitkenaspis keelensis* Zone; (1) paratype hypostome (dorsal) GSC 142371, mudstone, Mount Cap Formation, Little Bear River; (2) paratype cranidium (dorsal, latex mold) GSC 142372, silty mudstone, Mount Clark Formation, Dodo Canyon; (3) paratype pygidium (dorsal) GSC 142373, siltstone, Mount Clark Formation, Dodo Canyon; (4) paratype cranidium (dorsal) GSC 142374, mudstone, Mount Cap Formation, Little Bear River, scale bar = 500 μ m; (5) paratype cranidium (dorsal) GSC 142375, silty mudstone, Mount Cap Formation, Little Bear River, scale bar = 1 mm; (6) paratype pygidium (dorsal) GSC 142376, siltstone, Mount Clark Formation, Dodo Canyon. (7–10) *Oryctocara geikiei* Walcott, 1908b, mudstone, Mount Cap Formation, Little Bear River, *Albertelloides mischi* or *Glossopleura walcottii* Zone; (7) cranidium (dorsal) GSC 142377, scale bar = 350 μ m; (8) cranidium (dorsal) GSC 142378, scale bar = 400 μ m; (9) pygidium (dorsal) GSC 142379, scale bar = 500 μ m; (10) pygidium (dorsal) GSC 142377, scale bar = 750 μ m. All scale bars = 2 mm unless stated otherwise.

width of the occipital ring. Palpebral lobe is strongly arched, with the anterior tip intersecting the axial furrow opposite S3, and the posterior tip opposite the occipital furrow. Length of the palpebral lobe is two-thirds that of the glabella. Posterior course of the facial suture is transverse. Posterior border is equal in width to the occipital ring, with a poorly defined posterior border furrow. Intergonal spines possibly present, but poorly preserved if so.

Free cheek is slightly wider than the occipital ring and the border comprises one-fifth the width. Genal spine is non-advanced and comprises half of the length of the free cheek.

Hypostome is conterminant, widening anteriorly and narrowing gently posteriorly. Anterior lobe is covered in terrace lines. Posterior lobe comprises one-sixth the length.

Thorax consists of nine segments. Axial furrow is well defined; each axial ring bearing a medial tubercle. Pleura width is one-and-one-half to twice that of the axis, with well-defined pleural and interpleural furrows. Thoracic spines are moderately long; posteriorly directed macropleural spines are present on segments five and nine, with the latter extending just past to well beyond the posterior edge of the pygidium.

Pygidium subsipygous, oval in outline, and the length is equal to two-thirds the width. Axis narrows posteriorly, with the posterior tip anterior of the border furrow, and is composed of four rings, each bearing a medial tubercle, and a terminal piece. Ring furrows are moderately defined. Pleural field width is two-thirds that of the axis and has four pleural furrows, which are poorly to well defined and do not intersect the well-defined border furrow. Border comprises one-eighth the length of the pygidium. Border spines are absent. Terrace lines are variably present on the border.

Etymology.—Named after the Keele River in the eastern Mackenzie Mountains.

Material.—Two complete exoskeletons, 13 exoskeletons lacking free cheeks, 46 cranidia, 12 free cheeks, 13 thoracic segments, 27 pygidia, and one hypostome. Type material: holotype, GSC 142361; paratypes, GSC 142362–142376.

Remarks.—*Zacanthoides* sp. in Butterfield and Nicholas (1996) has a nearly identical cephalon and thorax to that of *Aitkenaspis keelensis* Handkamer and Pratt, n. gen. n. sp. The pygidium of that specimen is partially covered by matrix and thus cannot be compared to the pygidium of *A. keelensis* n. gen. n. sp.

Genus *Albertella* Walcott, 1908

Type species.—*Albertella helena* Walcott, 1908b, from the *Albertella* Zone of the Gordon Shale, Montana.

Remarks.—*Albertella* Walcott, 1908b, has a subrectangular glabella, a moderately long cranidial border, a moderately short palpebral lobe with the posterior tip opposite S1, a wide interocular area, a narrow free cheek, a macropleural third thoracic segment, a pygidium that is wider than long, a pygidial axis composed of four rings and a terminal piece, and a posterolaterally oriented pygidial border spine (Rasetti,

1951; Palmer and Halley, 1979). This genus has been recognized in the Mount Cap Formation of the Colville Hills (Sommers et al., 2020).

Albertella levis Walcott, 1917

Figure 21.1–21.6

1917 *Albertella levis* Walcott, p. 39, pl. 7, fig. 1, 1a.

Holotype.—Cranidium (USNM 63758) from the *Albertella* Zone of the Chetang Formation, Alberta (Walcott, 1917, pl. 7, fig. 1).

Occurrence.—Silty mudstone and mudstone, Mount Cap Formation, Dodo Canyon, *Albertelloides mischi* Zone, Carcajou Falls, *Glossopleura walcotti* Zone, Northwest Territories; Chetang Formation, Alberta, *Albertella* Zone (Walcott, 1917).

Material.—Twelve cranidia and 14 pygidia. Figured material: GSC 142380–142384.

Remarks.—*Albertella levis* is intermediate between *Albertella* and *Paralbertella* Palmer in Palmer and Halley, 1979. Features shared with *Albertella* include a moderately short palpebral lobe, a pygidium that is wider than long, poorly defined pleural furrows, and a pair of posterolaterally oriented border spines. Features shared with *Paralbertella* include an anteriorly wide glabella and a pygidial axis composed of five rings. The pygidium of *Albertelloides eliasi* Handkamer and Pratt, n. sp., is broadly similar to *Albertella levis*, but the exoskeleton of *A. eliasi* n. sp. is distinguished by having a longer palpebral lobe, well-defined pygidial furrows, and a shorter pygidial axis. Pygidia from the Mount Cap Formation differ from those from the Chetang Formation by having a slightly shorter pygidial axis, which is slightly anterior to the border furrow.

Genus *Albertelloides* Fritz, 1968

Type species.—*Albertelloides mischi* Fritz, 1968, from the *Albertella* Zone of the Pioche Formation, Nevada.

Remarks.—*Albertelloides* Fritz, 1968, differs from *Albertella* by having a wider anterior glabellar lobe, a longer palpebral lobe, a shorter postocular fixed cheek, a narrower, less-convex interocular fixed cheek, a wider free cheek, a non-advanced genal spine, wider thoracic pleura, and a more posteriorly located pygidial border spine. *Albertelloides* differs from *Paralbertella* by having a wider anterior glabellar lobe, a non-advanced genal spine, a thorax composed of eight instead of seven segments, four to five instead of five to seven pygidial axial rings, less well-defined pleural furrows, a shallower border furrow, and a more posteriorly located border spine.

Fritz (1968) described three species, *Albertelloides mischi*, *A. pandispinata*, and *A. sp. indet.* Campbell (1974) recognized an additional species. *Albertelloides rectimarginatus* Palmer in Palmer and Halley, 1979, and more complete material belonging to *A. mischi* were described from the Carrara Formation (Palmer and Halley, 1979), and *A. kitai* Eddy and McCollum, 1998, was described from the Pioche Formation, all from Nevada. Fritz

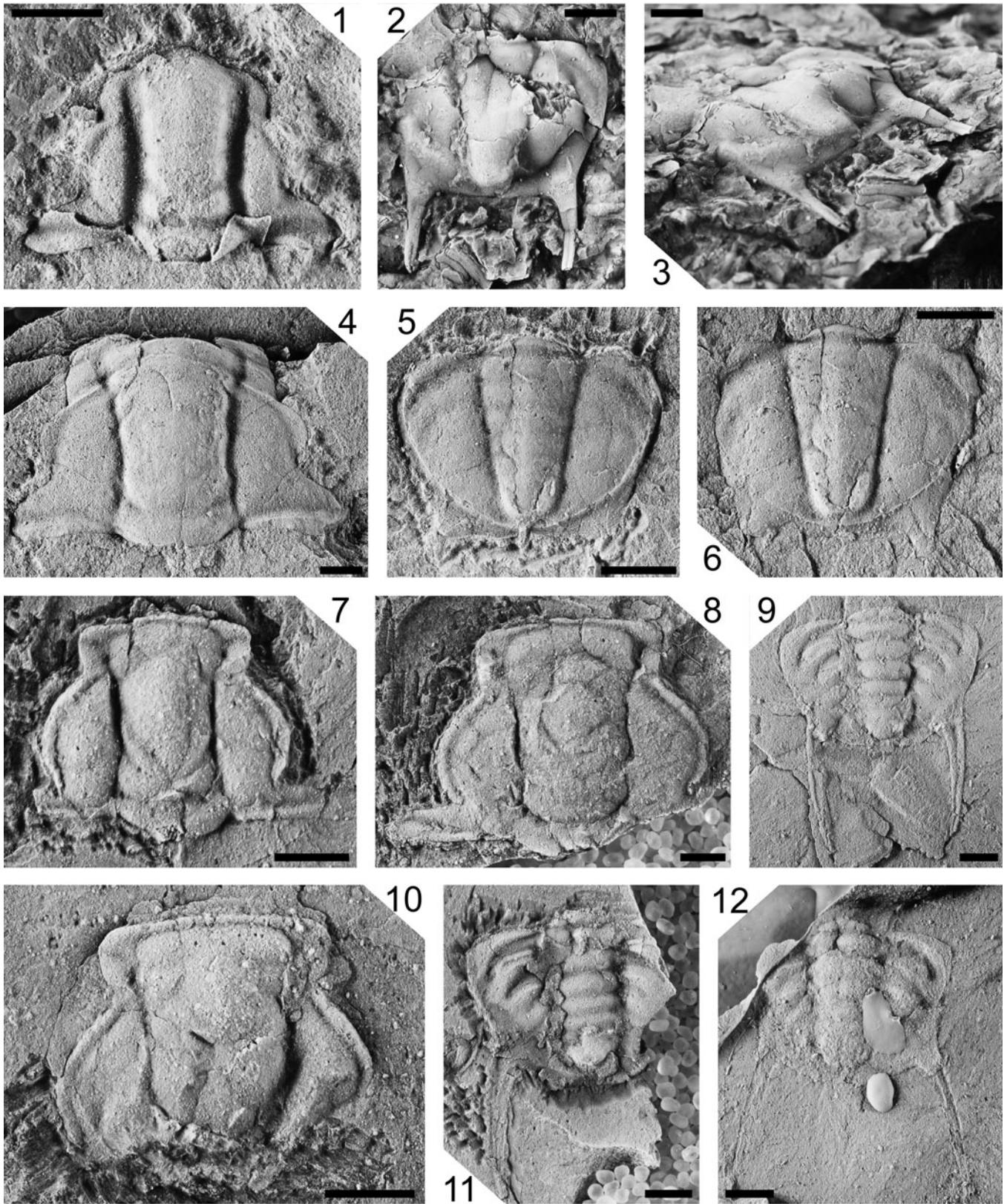


Figure 21. Zacanthoidids from the Mount Cap Formation, Carcajou Falls, Northwest Territories. (1–6) *Albertella levis* Walcott, 1917, *Glossopleura walcotti* Zone; (1) cranidium (dorsal) GSC 142380, silty mudstone; (2, 3) pygidium (dorsal, oblique) GSC 142381, grainstone; (4) cranidium (dorsal) GSC 142382, silty mudstone; (5) pygidium (dorsal) GSC 142383, silty mudstone; (6) pygidium (dorsal, latex mold) GSC 142384, silty mudstone. (7–11) *Albertelloides mischi* Fritz, 1968, silty mudstone, *Albertelloides mischi* Zone; (7) cranidium (dorsal) GSC 142385; (8) cranidium (dorsal) GSC 142386; (9) pygidium (dorsal) GSC 142387; (10) cranidium (dorsal) GSC 142388; (11) pygidium (dorsal) GSC 142389. (12) *Albertelloides pandispinata* Fritz, 1968, pygidium (dorsal) GSC 142390, silty mudstone, *Albertelloides mischi* Zone. All scale bars = 2 mm.

(1968) proposed that the pygidia of *Kochaspis maladensis* Resser, 1939b, and *K. dispar* Resser, 1939b (Resser, 1939b, pl. 13, figs. 9–12, 13–15) belong to *Albertelloides*. Sundberg and McCollum (2003a) argued that these pygidia belong to a corynexochid, but not *Albertelloides* due to the fewer axial rings. The species described by Campbell (1974, pl. 15, figs. 1, 2, 6, 7) probably also does not belong to *Albertelloides* for the same reason.

Albertelloides mischi, *A. kitai*, *A. pandispinata*, and *A. rectimarginatus* all have four or five pygidial axial rings. These species are distinguished by the variable length, width, and orientation of the pygidial border spine. *Albertelloides mischi* and *A. pandispinata* have long and narrow border spines, but differ in the orientation: subparallel in *A. mischi* and divergent in *A. pandispinata*. *Albertelloides rectimarginatus* and *A. kitai*, by contrast, have short and wide border spines: parallel and sharp-tipped in *A. rectimarginatus*, whereas they are blunt-tipped in *A. kitai* (Eddy and McCollum, 1998). The interocular area is wider in *A. rectimarginatus* and *A. kitai* and narrower in *A. mischi*. The cranium of *A. pandispinata* is unknown.

Albertelloides eliasi Handkamer and Pratt, new species
Figure 22.4–22.13

Holotype.—Pygidium (GSC 142396) from the *Albertelloides mischi* Zone of the Mount Cap Formation, Carcajou Falls (4.4 m above the base of the Mount Cap Formation), Northwest Territories (Fig. 22.6).

Diagnosis.—*Albertelloides* with cranial border short, posterior border oriented gently posterolaterally; free cheek wide, border of free cheek narrow; thoracic segments with moderately long pleural spines; pygidial pleural field wide, three pleural furrows well defined, border short, bearing one pair of moderately short, narrow, and subparallel-oriented spines.

Occurrence.—Calcareous siltstone and silty mudstone, Mount Cap Formation, Carcajou Falls and Little Bear River, Northwest Territories, *Albertelloides mischi* Zone.

Description.—Cranidium is subtriangular in outline. Axial furrow is well defined. Glabella is subparallel, extending anteriorly to the border. Glabella narrows from the occipital ring to S1 and widens from S1 to the anterior lobe. Four pairs of lateral glabellar furrows are present. S1 is well defined and oriented obliquely backwards; S2 is poorly defined and transverse; and S3 and S4 are poorly defined and oriented obliquely forward. Occipital furrow is well defined. Length of the anterior border is one-quarter that of the occipital ring. Anterior course of the facial suture is parallel to slightly divergent. Interocular area at the widest point is half to two-thirds the width of the occipital ring. Palpebral lobe is strongly arched, with the anterior tip intersecting the axial furrow opposite L4, and the posterior tip opposite the occipital furrow. Length of the palpebral lobe is two-thirds that of the glabella. Posterior course of the facial suture is oriented gently posterolaterally. Posterior border width is equal to the occipital ring, with a moderately defined border furrow.

Border of the free cheek comprises one-fifth of the width, bearing terrace lines. Genal spine is non-advanced and comprises one-third the length.

Hypostome is unknown.

Thorax consists of at least five segments. Axial furrow is well defined. Pleura width is one-and-one-half times that of the axis, with well-defined pleural and interpleural furrows. Thoracic spines are moderately long.

Pygidium is semicircular in outline and in length equal to two-thirds the width. Axis is parallel-sided, with the posterior end anterior to or intersecting the border furrow, and is composed of four to five rings and a terminal piece. Axial ring furrows are moderately to poorly defined. Pleural field width is equal to that of the axis, with four pleural furrows and three interpleural furrows. The three anterior pleural and interpleural furrows are well defined and intersect the border furrow. The posterior pleural furrow is poorly defined and does not intersect the border furrow. Border comprises one-tenth the length of the pygidium. Border spine is opposite the fourth pygidial pleural furrow, oriented subparallel, and is slightly shorter than half the length of the pygidial axis.

Etymology.—Named after Robert J. Elias, Professor, University of Manitoba, Winnipeg, Manitoba.

Material.—Three incomplete exoskeletons, 28 crania, 10 free cheeks, and 13 pygidia. Type material: holotype, GSC 142396; paratypes, GSC 142394, 142395, 142397–142403.

Remarks.—*Albertelloides eliasi* Handkamer and Pratt, n. sp., differs from other species of *Albertelloides* by having shorter cranial and pygidial borders, a posterior cranial border oriented slightly obliquely backwards, a wider pygidial pleural field, and a short and narrow border spine. Variation in the number of pygidial axial rings and orientation of the border spine are interpreted as intraspecific variation (Fig. 22.6, 22.7, 22.10).

Albertelloides mischi Fritz, 1968
Figures 21.7–21.11, 22.1–22.3

1968 *Albertelloides mischi* Fritz, p. 215, pl. 38, figs. 1–7.

1979 *Albertelloides mischi*; Palmer and Halley, p. 90, pl. 10, figs. 7–13.

Holotype.—Pygidium (USNM 153568) from the *Albertella* Zone of the Pioche Formation, Nevada (Fritz, 1968, pl. 38, figs. 5, 7).

Occurrence.—Calcareous siltstone and silty mudstone, Mount Cap Formation, Carcajou Falls and Grafe River, Northwest Territories, *Albertelloides mischi* Zone; upper member, Pioche Formation, Nevada, *Albertella* Zone (Fritz, 1968); Carrara Formation, Nevada, Zacantheid Zonule, *Albertella* Zone (Palmer and Halley, 1979).

Material.—Thirty-five crania, six free cheeks, and 21 pygidia. Figured material: GSC 142385–142389, 142391–142393.

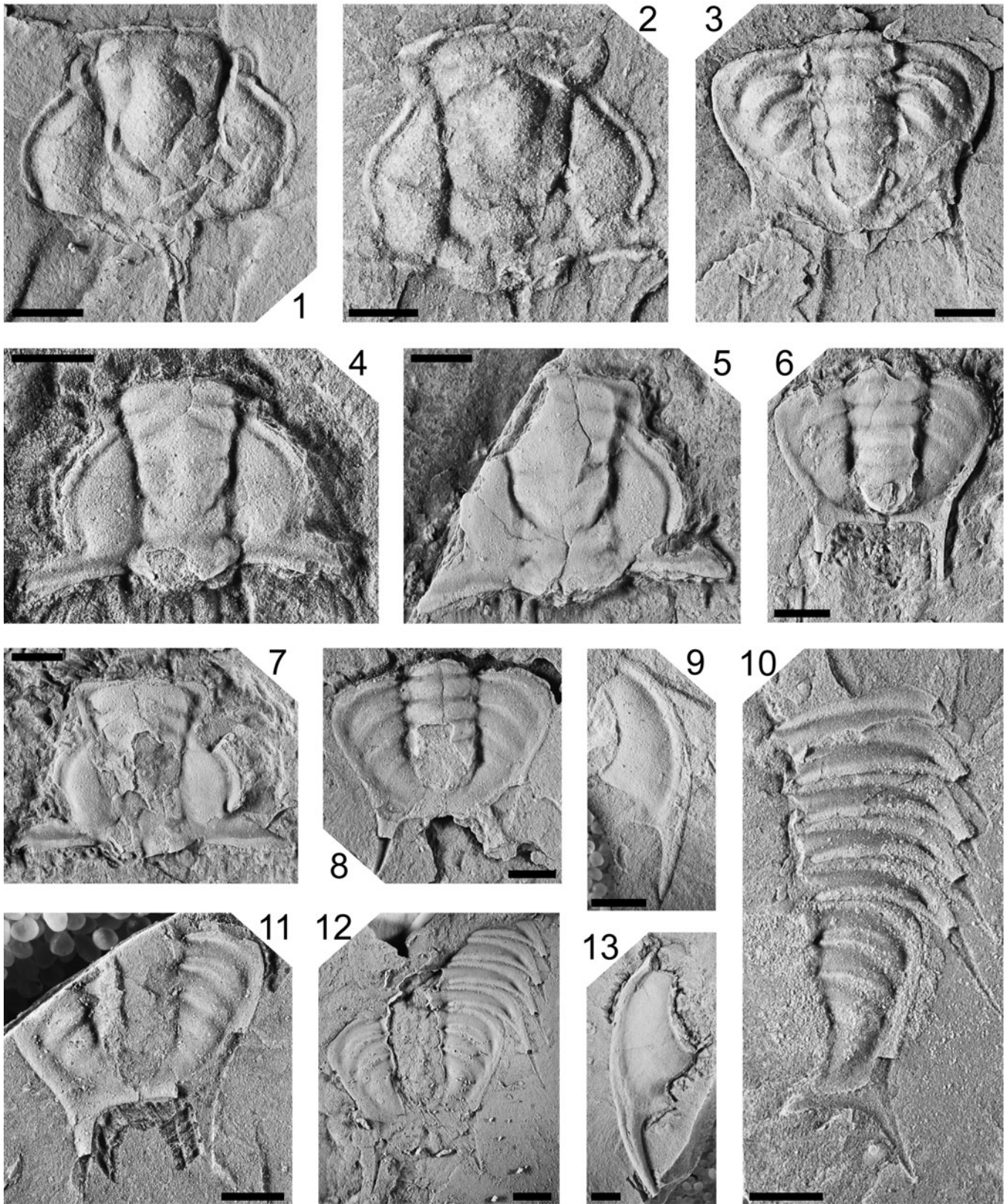


Figure 22. Species of *Albertelloides* Fritz, 1968, from the *Albertelloides mischi* Zone, silty mudstone, Mount Cap Formation, Carcajou Falls, Northwest Territories. (1–3) *Albertelloides mischi* Fritz, 1968; (1) cranium (dorsal, latex mold) GSC 142391; (2) cranium (dorsal) GSC 142392; (3) pygidium (dorsal) GSC 142393. (4–13) *Albertelloides eliasi* Handkamer and Pratt, n. sp.; (4) paratype cranium (dorsal) GSC 142394; (5) paratype cranium (dorsal) GSC 142395; (6) holotype pygidium (dorsal) GSC 142396; (7) paratype cranium (dorsal) GSC 142397; (8) paratype pygidium (dorsal) GSC 142398; (9) paratype free cheek (dorsal) GSC 142399; (10) paratype partially articulated exoskeleton (dorsal) GSC 142400; (11) paratype pygidium (dorsal) GSC 142401; (12) paratype partially articulated exoskeleton (dorsal, latex mold) GSC 142402; (13) paratype free cheek (dorsal) GSC 142403. All scale bars = 2 mm.

Remarks.—Specimens from the Mount Cap Formation differ from those of the Pioche and Carrara formations by having a slightly shorter anterior cranial border, which is interpreted as intraspecific variation (Fritz, 1968, pl. 38, figs. 1–3, 6; Palmer and Halley, 1979, pl. 10, figs. 8, 9, 13). *Albertelloides rectimarginatus* also exhibits minor variation in the length of the anterior border (Palmer and Halley, 1979, pl. 10, figs. 16, 17). The less well-defined pygidial border furrow and presence of a longitudinal groove on the border spines are attributed to compaction.

Albertelloides pandispinata Fritz, 1968
Figure 21.12

1968 *Albertelloides pandispinata* Fritz, p. 216, pl. 39, figs. 31, 32.

Holotype.—Pygidium (USNM 153597) from the *Albertella* Zone of the Pioche Formation, Nevada (Fritz, 1968, pl. 39, figs. 31, 32).

Occurrence.—Calcareous siltstone and silty mudstone, Mount Cap Formation, Carcajou Falls, Northwest Territories, *Albertelloides mischi* Zone; upper member, Pioche Formation, Nevada, *Albertella* Zone (Fritz, 1968).

Material.—Nine pygidia. Figured material: GSC 142390.

Remarks.—*Albertelloides pandispinata* from the Mount Cap Formation is nearly identical to the pygidium illustrated by Fritz (1968), although some pygidia differ by having five axial rings as opposed to four. This is interpreted as intraspecific variation by analogy with *A. mischi*, because this species, which is from both the Pioche and Mount Cap formations, ranges from five to six axial rings (Figs. 20.9, 21.3). Because the cranidium of *A. pandispinata* is unknown, it is possible that some cranidia assigned here to *A. mischi* belong instead to *A. pandispinata*.

Genus *Dodoella* Handkamer and Pratt, new genus

Type species.—*Dodoella kobayashii* Handkamer and Pratt, n. sp., from the *Albertelloides mischi* Zone of the Mount Cap Formation, Dodo Canyon (20.4 m above the base of the Mount Cap Formation), Northwest Territories.

Diagnosis.—As for species.

Etymology.—Named after Dodo Canyon, Canyon Ranges, eastern Mackenzie Mountains.

Remarks.—*Dodoella* Handkamer and Pratt, n. gen., is currently monospecific, and the most diagnostic feature is the thorax consisting of four segments. The presence of a short palpebral lobe, anteriorly widened and effaced glabella, effaced pygidial axis and pleural field, and long pygidial border spines indicate that this species belongs to Zacanthoididae and is closely related to *Mexicaspidella* Handkamer and Pratt, n. gen. (replacement name for preoccupied *Mexicaspis*) and less so to *Albertella*. *Mexicaspidella radiatus* (Palmer in Palmer and Halley, 1979) n. comb. has twice as many segments as the

type species, *Dodoella kobayashii* Handkamer and Pratt, n. gen. n. sp.

Dodoella kobayashii Handkamer and Pratt, new species
Figure 24.2, 24.5

Holotype.—*Dodoella kobayashii* (GSC 142414) from the *Albertelloides mischi* Zone of the Mount Cap Formation, Northwest Territories (Fig. 24.2).

Diagnosis.—Zacanthoidid with axial furrow moderately defined, two pairs of lateral glabellar furrows poorly defined, palpebral lobe short, posterior border long and narrow; genal spine oriented obliquely backwards; four thoracic segments; macropygous, ring furrows effaced, pleural field narrow, pleural furrows poorly defined or effaced, one pair of border spines oriented obliquely backward or subparallel.

Occurrence.—Mudstone, Mount Cap Formation, Dodo Canyon, Northwest Territories, *Albertelloides mischi* Zone.

Description.—Exoskeleton is subelliptical in outline. Exoskeleton length 16 mm.

Cranidium is subtrapezoidal in outline. Axial furrow is moderately defined. Glabella is subrectangular in outline, extending anteriorly to the border. The glabella widens gently from S1 to the anterior lobe. One pair of lateral glabellar furrows is present. S1 is poorly defined and oriented obliquely backwards. Occipital furrow is moderately defined. Anterior border and anterior course of the facial suture are unknown. Interocular area at the widest point in width is three-quarters that of the occipital ring. Palpebral lobe is strongly arched, with the anterior tip intersecting the axial furrow one-third of the glabellar length from the anterior end, and the posterior tip opposite L1. Length of the palpebral lobe is half that of the glabella. Posterior course of the facial suture is oriented obliquely backwards. Posterior border is slightly narrower than the occipital ring, with a well-defined border furrow.

Free cheek is slightly narrower than the occipital ring; the border comprises one-fourth of the width. Genal spine is slightly advanced, oriented obliquely backwards, and comprises three-fifths the length of the free cheek.

Hypostome is unknown.

Thorax consists of four segments. Axial furrow is moderately defined. Pleura is equal in width to the axis, with a moderately defined pleural furrow. Thoracic segments terminate in a short spine.

Pygidium macropygous, semicircular in outline, and the length is equal to five-sevenths the width. Moderately convex axis narrows gently posteriorly, with the posterior tip slightly anterior to or intersecting the border furrow. Ring furrows are effaced. Gently convex pleural field is slightly narrower than the axis, with one or two pairs of poorly defined pleural furrows that intersect the border furrow. Flat border comprises less than one-tenth the length of the pygidium. Flat, narrow border spine is oriented obliquely backwards or subparallel, curving medially, and in length is slightly shorter than the pygidial axis.

Etymology.—Named after Teiichi Kobayashi, who first described the Cambrian and Lower Ordovician trilobites of the Mackenzie River valley region.

Material.—One nearly complete exoskeleton lacking a free cheek; one pygidium. Type material: holotype, GSC 142414; paratype, GSC 142417.

Remarks.—One isolated pygidium (GSC 142417) is assigned to this species, along with the holotype (GSC 142414). GSC 142417 has a slightly shorter axis that does not intersect the border furrow, and wider, more strongly curved, and subparallel rather than divergent, border spines. This is interpreted as intraspecific variation, because similar variation is observed in other species such as *Paralbertella bosworthi* (Walcott, 1908b) (Walcott, 1917, pl. 7, fig. 3, 3a; Rasetti, 1951, pl. 17, figs. 1–4, 9) and *Albertella microps* Rasetti, 1951 (Rasetti, 1951, pl. 19, figs. 1, 3, 7).

Genus *Mackenzieaspis* Handkamer and Pratt, new genus

Type species.—*Mackenzieaspis parallelispinosa* Handkamer and Pratt, n. sp. from the *Glossopleura walcottii* Zone of the Mount Cap Formation, Northwest Territories.

Diagnosis.—Zacanthoidid with a glabella subrectangular, palpebral lobe long; advanced genal spines long; two or four thoracic segments, axis and pleura equal in width; macropygous, six or eight axial rings, three to five pleural furrows well defined, one pair of posteriorly located border spines.

Etymology.—Named after the Mackenzie Mountains.

Remarks.—*Mackenzieaspis* Handkamer and Pratt, n. gen. is regarded as a zacanthoidid because it has a long, subrectangular glabella, a long palpebral lobe, a short intergenal spine, and an advanced and long genal spine. This is supported by the presence of moderately long thoracic and pygidial border spines, in common with many other zacanthoidids. This genus includes two new species that have relatively few thoracic segments and larger pygidia compared to other zacanthoidids. The cephalon of *Mackenzieaspis* n. gen. is most-similar to that of *Paralbertella* and *Albertelloides*.

Mackenzieaspis parallelispinosa Handkamer and Pratt, new species

Figures 23, 24.3, 24.4, 24.6–24.11

Holotype.—*Mackenzieaspis parallelispinosa* (GSC 142404) from the *Glossopleura walcottii* Zone of the Mount Cap Formation, Carcajou Falls (26.1 m above the base of the Mount Cap Formation), Northwest Territories (Fig. 23.1).

Diagnosis.—*Mackenzieaspis* Handkamer and Pratt, n. gen. with pits along occipital furrow, palpebral lobe long; free cheek border narrow, genal spine short to moderately long, advanced, and directed posteriorly; four thoracic segments; macropygous, pygidium semicircular in outline, eight axial rings, pleural field wide, four or five pleural furrows, parallel border spines moderately long.

Occurrence.—Mudstone, lime mudstone, and grainstone, Mount Cap Formation, Carcajou Falls, Northwest Territories, *Glossopleura walcottii* Zone.

Description.—Exoskeleton is subelliptical in outline. Exoskeleton length 10–31 mm.

Cranidium is subquadrate in outline. Axial furrow is well defined. Strongly convex glabella is subrectangular in outline, extending anteriorly to the border. Four pairs of lateral glabellar furrows are present. S1 and S2 are moderately defined and oriented obliquely backward; S3 is poorly defined or effaced and transverse; and S4 is poorly defined or effaced and oriented obliquely forwards. The occipital furrow is moderately defined with one pair of pits present at the intersection with the axial furrow; the occipital ring bears a medial tubercle. Length of the anterior border is equal to one-quarter that of the occipital ring. Anterior course of the facial suture is parallel. Moderately convex interocular area at the widest point is slightly narrower than the occipital ring. Palpebral lobe is strongly arched, with the anterior tip intersecting the axial furrow at S4, and the posterior tip opposite the occipital furrow. Length of the palpebral lobe is two-thirds that of the glabella. Posterior course of the facial suture is transverse. Posterior border width is four-fifths that of the occipital ring, with a moderately defined border furrow and a short intergenal spine.

Free cheek is slightly wider than the occipital ring and the border comprises one-seventh the width. Genal spine is advanced, oriented posteriorly, and comprises half to three-fifths the length of the free cheek.

Hypostome is conterminant, widening anteriorly, and narrowing gently posteriorly. Anterior and medial lobes bear terrace lines. Posterior lobe comprises one-seventh the length.

Thorax consists of four segments. Axial furrow is well defined; each ring bearing a medial tubercle. Pleura width is equal to the axis, with well-defined pleural and interpleural furrows. Thoracic spines are moderately long.

Pygidium macropygous, semicircular in outline, and in length is equal to two-thirds the width. Axis narrows gently posteriorly, the posterior end intersecting the border furrow, and is composed of eight rings, each with a medial tubercle, and a terminal piece. Axial ring furrows are well to moderately defined. Pleural field is slightly wider than the axis, with four or five pleural furrows and three interpleural furrows. The three anterior pleural and interpleural furrows are well defined and intersect the border furrow. The one or two posterior pleural furrows are moderately to poorly defined and do not intersect the border furrow. Border comprises one-tenth the length of the pygidium. One pair of border spines is present opposite the fourth pleural furrow. Border spine is subparallel and half to one-and-one-half times the length of the pygidial axis.

Etymology.—Named after the subparallel pygidial border spines.

Material.—Twelve complete exoskeletons, 25 exoskeletons lacking free cheeks, 26 cranidia, eight free cheeks, and 44 pygidia. Type material: holotype, GSC 142404; paratypes GSC 142349, 142353, 142405–142412, 142415, 142416, 142418–142420.

Remarks.—*Mackenzieaspis parallelispinosa* Handkamer and Pratt, n. gen. n. sp., differs from *M. divergens* Handkamer and Pratt, n. gen. n. sp., by having a slightly longer palpebral lobe, advanced and parallel genal spines, and a semicircular

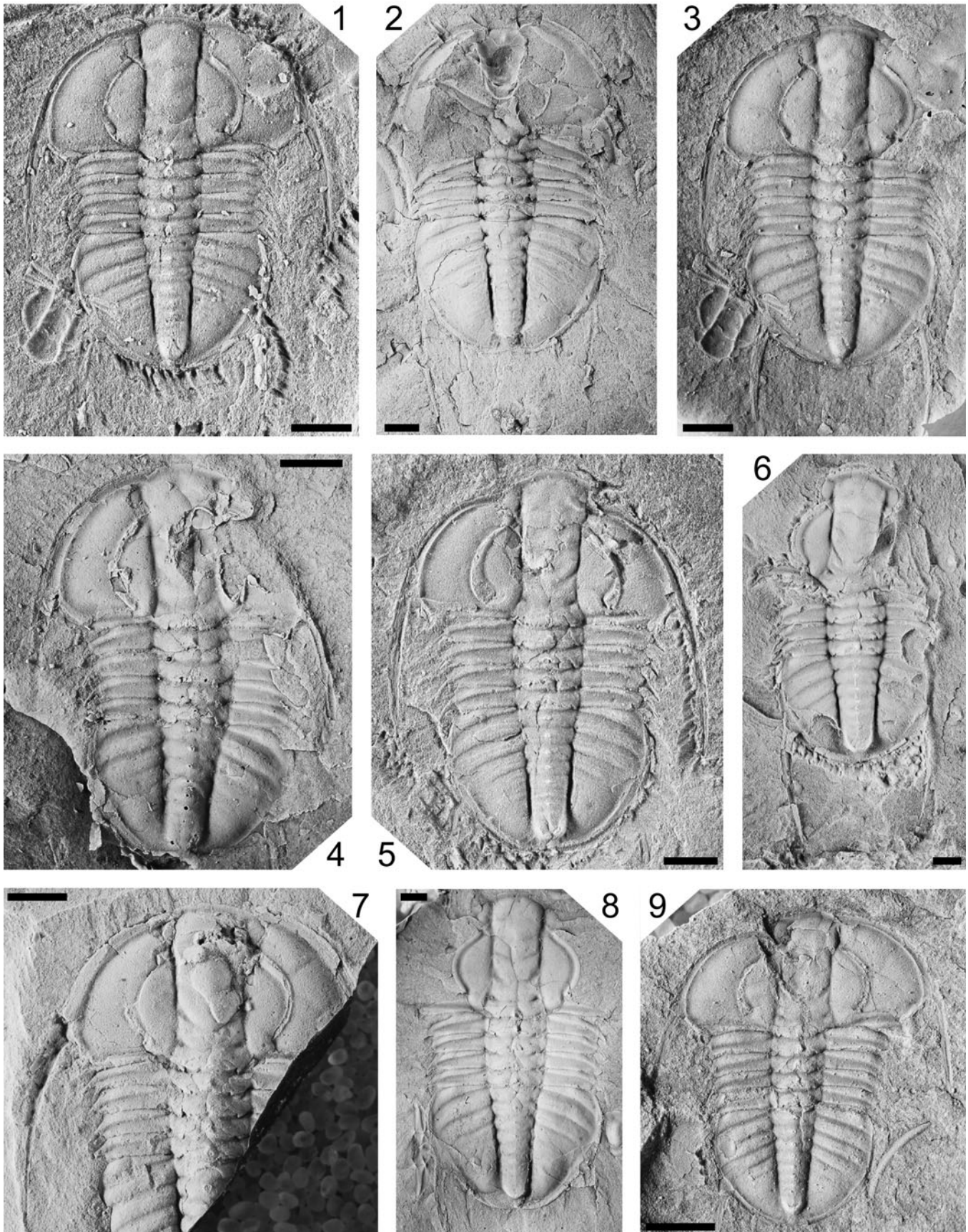


Figure 23. *Mackenzieaspis paralleleispinosa* Handkammer and Pratt, n. gen. n. sp., from the *Glossopleura walcotti* Zone, mudstone, Mount Cap Formation, Carcajou Falls, Northwest Territories. (1) Holotype complete exoskeleton (dorsal) GSC 142404; (2) paratype fractured exoskeleton (dorsal) GSC 142405; (3) paratype complete exoskeleton (dorsal, latex mold) GSC 142406; (4) paratype complete exoskeleton (dorsal, latex mold) GSC 142407; (5) paratype complete exoskeleton (dorsal) GSC 142408; (6) paratype exoskeleton lacking free cheeks (dorsal) GSC 142409; (7) paratype fractured exoskeleton (dorsal) GSC 142410; (8) paratype exoskeleton lacking free cheeks (dorsal, latex mold) GSC 142411; (9) paratype complete exoskeleton (dorsal) GSC 142412. All scale bars = 2 mm.

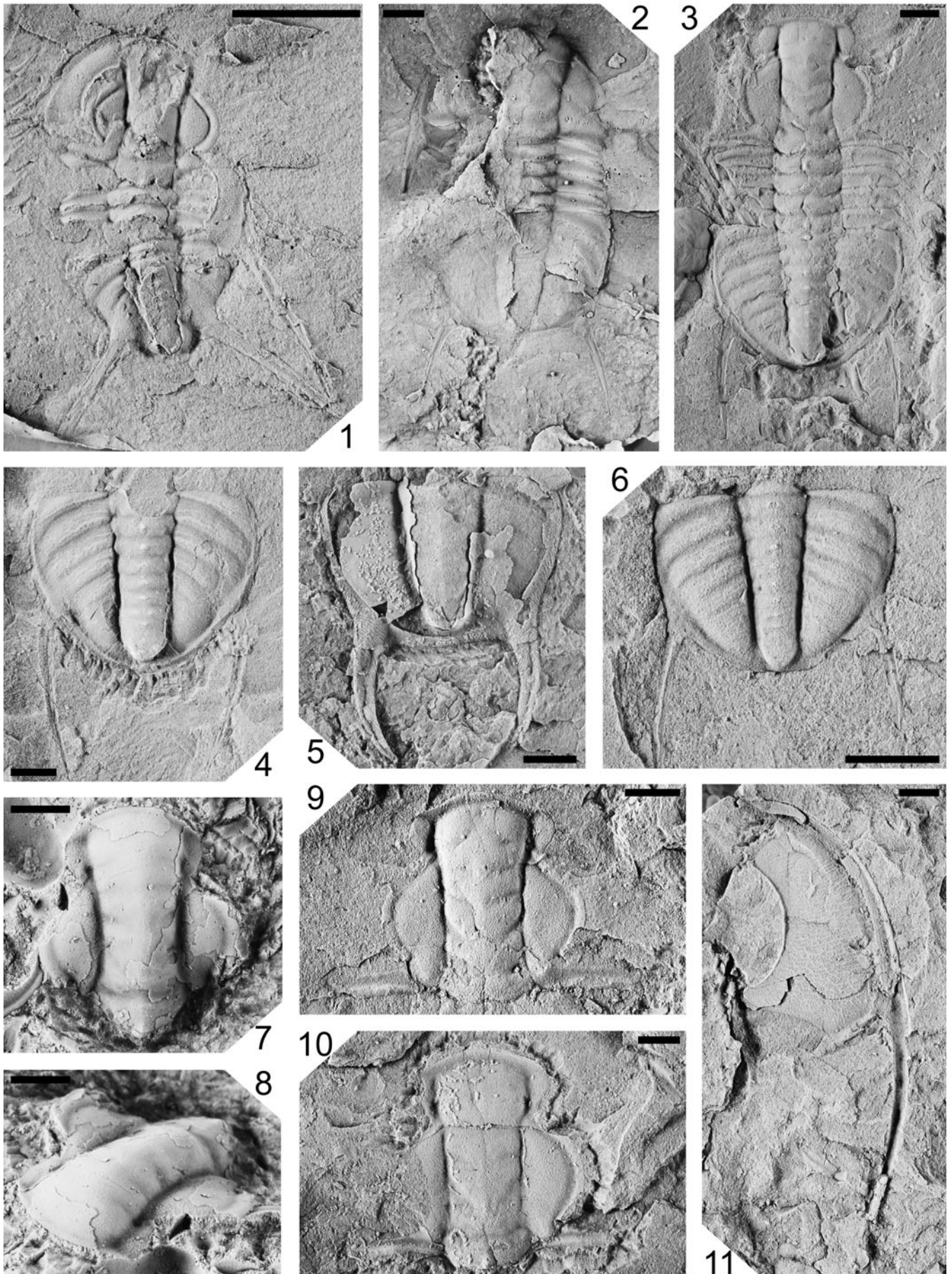


Figure 24. Zacantheidids from the Mount Cap Formation, Northwest Territories. (1) *Mackenzieaspis divergens* Handkamer and Pratt, n. gen. n. sp., holotype disarticulated exoskeleton (dorsal, latex mold) GSC 142413, mudstone, Carcajou Falls, *Glossopleura walcotti* Zone; (2, 5) *Dodoella kobayashii* Handkamer and Pratt, n. gen. n. sp., mudstone, Dodo Canyon, *Albertelloides mischi* Zone; (2) holotype exoskeleton lacking a free cheek (dorsal, latex mold) GSC 142414; (5) paratype pygidium (dorsal) GSC 142417. (3, 4, 6–11) *Mackenzieaspis parallelispinosa* Handkamer and Pratt, n. gen., n. sp., Carcajou Falls, *Glossopleura walcotti* Zone; (3) paratype exoskeleton lacking free cheeks (dorsal) GSC 142415, mudstone; (4) paratype pygidium (dorsal) GSC 142416, mudstone; (6) paratype pygidium (dorsal) GSC 142418, mudstone; (7, 8) paratype cranium (dorsal, oblique) GSC 142353, grainstone; (9) paratype cranium (dorsal) GSC 142419, mudstone; (10) paratype cranium (dorsal) GSC 142420, mudstone; (11) paratype free cheek (dorsal) GSC 142349, mudstone. All scale bars = 2 mm.

pygidium with more axial rings, a wider pleural field, more pleural furrows, and parallel border spines.

Mackenzieaspis divergens Handkamer and Pratt, new species
Figure 24.1

Holotype.—*Mackenzieaspis divergens* (GSC 142413) from the *Glossopleura walcotti* Zone of the Mount Cap Formation, Carcajou Falls (24.4 m above the base of the Mount Cap Formation), Northwest Territories (Fig. 24.1).

Diagnosis.—*Mackenzieaspis* Handkamer and Pratt, n. gen., with palpebral lobe short; free cheek border wide, genal spine long, less advanced, and oriented obliquely backwards; at least two thoracic segments; isopygous, pygidium subtriangular in outline, six axial rings, pleural field narrow, three pleural furrows, border spines extending from pleural field, oriented posterolaterally.

Occurrence.—Mudstone, Mount Cap Formation, Carcajou Falls, Northwest Territories, *Glossopleura walcotti* Zone.

Description.—Complete exoskeleton is unknown.

Cranidium is subquadrate in outline. Axial furrow is well defined. Glabella is subrectangular in outline, extending anteriorly to the border. At least one pair of lateral glabellar furrows is present. S1 is poorly defined and oriented obliquely backwards. S2, S3, and S4 are not preserved. Occipital furrow is well defined. Anterior border is in length one-quarter that of the occipital ring. Anterior course of the facial suture is parallel. Intercular area at the widest point is in width half that of the occipital ring. Palpebral lobe is strongly arched, with the anterior tip intersecting the axial furrow one-third the glabellar length from the anterior end, and the posterior tip opposite the middle of L1. Length of the palpebral lobe is half that of the glabella. Posterior course of the facial suture is transverse. Posterior border is slightly narrower than the occipital ring, with a well-defined border furrow.

Free cheek width is equal to that of the occipital ring and the border comprises one-fifth of the width. Genal spine is slightly advanced, oriented posterolaterally, and comprises two-thirds of the length of the free cheek.

Hypostome is unknown.

Thorax consists of at least two segments. Axial furrow is well defined. Pleura width is equal to the axis, with a well-defined pleural furrow. Tips of segments are unknown.

Pygidium isopygous, subtriangular in outline, and in length is equal to four-fifths the width. Axis narrows gently posteriorly; the posterior end intersecting the border furrow, and is composed of at least six axial rings. Ring furrows are poorly defined. Pleural field is equal in width to the axis, with three pleural furrows. The two anterior pleural furrows are well defined and intersect the

border furrow. The posterior pleural furrow is moderately defined and does not intersect the border furrow. Length of the border is unknown. One pair of spines extends from the pleural field posterior of the third pleural furrow; the spines are oriented posterolaterally and are twice the length of the axis.

Etymology.—Named after the strongly divergent pygidial spines.

Material.—One nearly complete exoskeleton. Type material: holotype, GSC 142413.

Remarks.—Aside from the distinctively low number of thoracic segments, the pair of strongly divergent pygidial spines that extends from the pleural field of *M. divergens* Handkamer and Pratt, n. gen., n. sp., is unusual, but similar to spines present in *Albertella longwelli* Palmer in Palmer and Halley, 1979, and *A. spectrensis* Palmer in Palmer and Halley, 1979.

Corynexochid genus and species indet.
Figure 25.13, 25.14

Occurrence.—Silty mudstone, Mount Cap Formation, Little Bear River, Northwest Territories, *Amecephalus arrosensis-Eokochaspis nodosa* Zone.

Material.—Nine cranidia, three free cheeks, and one partial thorax consisting of five segments. Figured material: GSC 142446, 142447.

Remarks.—The lack of a pygidium limits identification because early middle Cambrian corynexochids have morphologically conservative cranidia, such as in species of *Fieldaspis*, *Stephenaspis*, and *Aitkenaspis* n. gen.

Order Ptychopariida Swinnerton, 1915
Suborder Ptychopariina Richter, 1932
Superfamily Ptychoparioidea Matthew, 1887
Family Ptychopariidae Matthew, 1887
Subfamily uncertain
Genus *Caborcella* Lochman, 1948

Type species.—*Caborcella arrosensis* Lochman, 1948, from the Arrojos Formation, Sonora, Mexico.

Remarks.—*Caborcella* Lochman, 1948, is characterized by a concave preglabellar field with a well-defined border furrow (Lochman, 1948; Palmer and Halley, 1979). *Nyella* Palmer in Palmer and Halley, 1979, is similar, but differs by having a convex preglabellar field.

Caborcella collaris (Rasetti, 1951)
Figures 25.2, 25.3, 26.14, 26.15

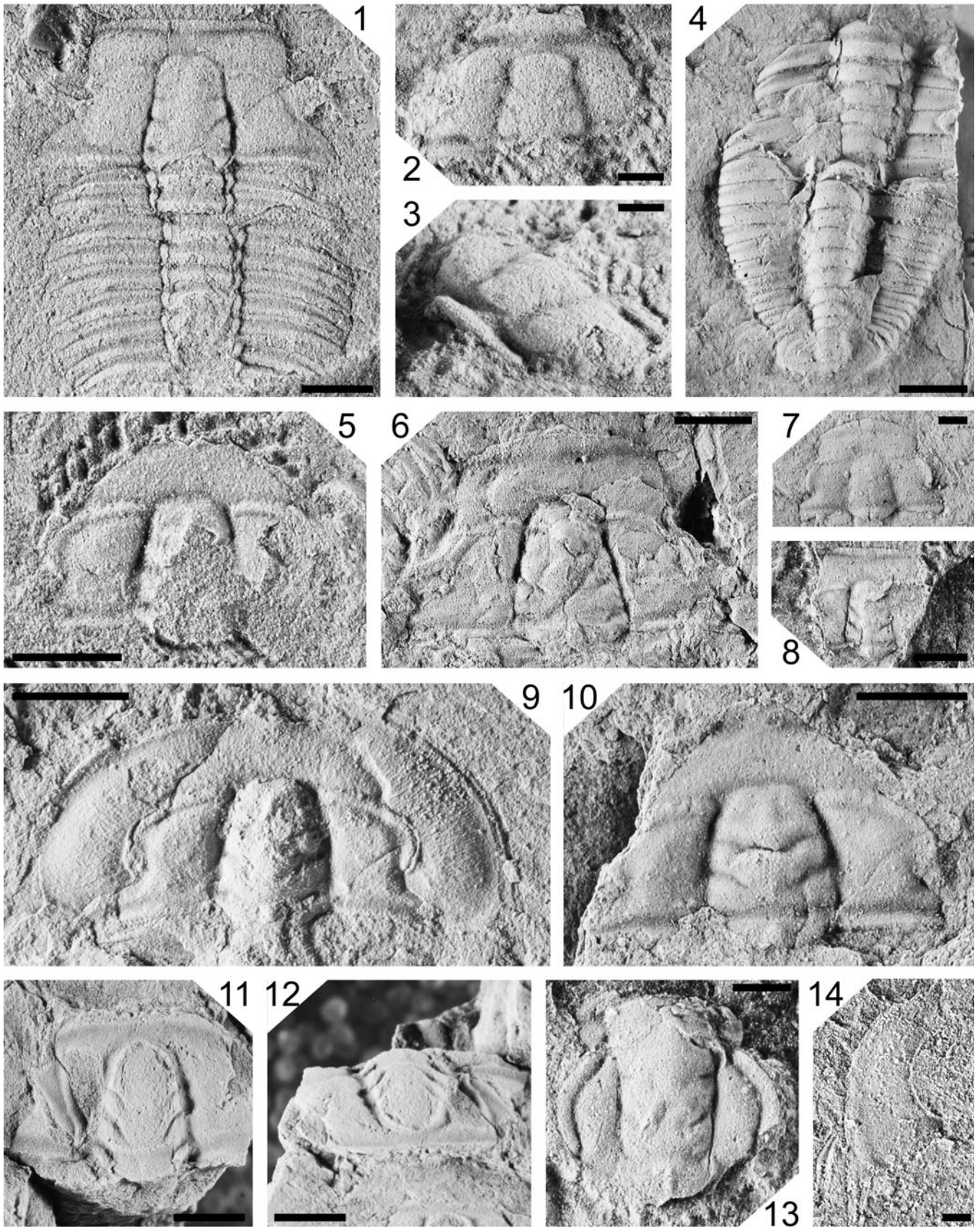


Figure 25. Trilobites of the Mount Cap Formation, Northwest Territories. (1) *Chancia maladensis* (Resser, 1939b), exoskeleton lacking free cheeks (dorsal) GSC 142436, mudstone, Mount Cap Formation, Dodo Canyon, *Glossopleura walcotti* Zone; (2, 3) *Caborcella collaris* (Rasetti, 1951), cranidium (dorsal, oblique) GSC 142437, siltstone, Mount Clark Formation, Dodo Canyon, *Amecephalus arrosensis-Eokochaspis nodosa* Zone; (4, 7) *Eokochaspis* sp. indet., mudstone, Mount Cap Formation, Little Bear River, *Aitkenaspis keelensis* Zone; (4) exoskeleton lacking the cephalon (dorsal, latex mold) GSC 142438; (7) cranidium (dorsal, latex mold) GSC 142441; (5, 9, 10) ptychoparioid gen. and sp. indet. 2, silty mudstone, Mount Cap Formation, Carcajou Falls, *Albertelloides mischi* Zone; (5) cranidium (dorsal) GSC 142439; (9) cephalon (dorsal) GSC 142443; (10) cranidium (dorsal) GSC 142444; (6, 8) *Tonopahella goldfieldensis* Sundberg and McCollum, 2003b, silty mudstone, Mount Cap Formation, Little Bear River, *Amecephalus arrosensis-Eokochaspis nodosa* Zone; (6) cranidium (dorsal) GSC 142440; (8) cranidium (dorsal) GSC 142442; (11, 12) ptychoparioid gen. and sp. indet. 1, cranidium (dorsal, frontal) GSC 142445; silty mudstone, Mount Clark Formation, Dodo Canyon, *Aitkenaspis keelensis* Zone; (13, 14) corynexochid gen. and sp. indet., silty mudstone, Mount Cap Formation, Little Bear River, *Amecephalus arrosensis-Eokochaspis nodosa* Zone; (13) cranidium (dorsal) GSC 142446; (14) free cheek (dorsal) GSC 142447. All scale bars = 2 mm.

1951 *Schistometopus collaris* Rasetti, p. 239, pl. 14, figs. 1–3.

Holotype.—Cranidium (USNM 116123) from the *Plagiura-Kochaspis* Zone of the Mount Whyte Formation, Alberta (Rasetti, 1951, pl. 14, figs. 1–3).

Occurrence.—Siltstone and silty mudstone, Mount Clark Formation, Dodo Canyon, Northwest Territories, *Amecephalus arrosensis-Eokochaspis nodosa* and *Aitkenaspis keelensis* zones; Mount Whyte Formation, Alberta and British Columbia, *Plagiura-Kochaspis* Zone (Rasetti, 1951).

Material.—Five cranidia. Figured material: GSC 142434, 142437.

Remarks.—Owing to the poor quality of the holotype of *Schistometopus typicalis* Resser, 1938, which is the type species for the genus *Schistometopus*, Sundberg (2004) advocated for the reassignment of existing species to other genera. Sundberg (2004) suggested that *S. collaris* belongs in *Caborcella*. Compared to the holotype cranidium, the cranidia from the Mount Cap Formation have a slightly longer anterior border. The presence of an occipital spine is uncertain because of poor preservation.

Genus *Chancia* Walcott, 1924

Type species.—*Chancia ebdome* Walcott, 1924, from the *Glossopleura walcotti* Zone of the Spence Shale, Langston Formation, Idaho (Maxey, 1958; Oriel and Armstrong, 1971).

Remarks.—The diagnosis of *Chancia* Walcott, 1924, used in Palmer and Halley (1979) is followed here. Walcott (1924, 1925) assigned two species to *Chancia*: *C. ebdome* Walcott, 1924, and *C. evax* Walcott, 1925. Resser (1939a) added *C. angusta* Resser. Four new species were included by Rasetti (1951): *C. latigena*, *C. bigranulosa*, *C. odarayensis*, and *C. stenometopa*. The re-assignment to *Chancia* of *Ptychoparia palliseri* Walcott, 1908a, by Rasetti (1951), *Kochina venusta* Resser, 1939b, by Fritz (1968), and *Ehmaniella maladensis* Resser, 1939b, by Palmer (in Palmer and Halley, 1979) brings the number of species to 10. In addition, Fritz (in Oriel and Armstrong, 1971) listed *C. coriacea* (Resser, 1939a). Hu (1985) added *C. conica* Hu, 1985.

Chancia ebdome, *C. evax*, *C. venusta*, *C. bigranulosa*, and *C. stenometopa* have a frontal area that is four-tenths of the total cranidial length (Walcott, 1925, pl. 17, figs. 26, 27; Resser, 1939b, pl. 6, figs. 9, 10; Rasetti, 1951, pl. 8, fig. 20, pl. 22, figs. 1–3). *Chancia evax* has a border that is one-fifth the length

of the frontal area and 24 thoracic segments. *Chancia ebdome* has a border that is one-third the length of the frontal area and 20 thoracic segments. *Chancia venusta*, *C. bigranulosa*, and *C. stenometopa* all have a border that is slightly less than half the length of the frontal area, as well as granular or finely pustulose prosopon on the cranidium. The posterior cranidial border is slightly narrower in *C. venusta* and slightly wider in *C. bigranulosa* and *C. stenometopa*. In addition, *C. venusta* has a palpebral lobe that is one-third the glabellar length, whereas *C. bigranulosa* and *C. stenometopa* have a shorter palpebral lobe that is one-fifth the glabellar length. The similarities in cranidial dimensions between *C. stenometopa* and *C. bigranulosa* indicate that the former may be synonymous with the later.

Chancia latigena, *C. palliseri*, and *C. angusta* have a frontal area that is one-third of the total cranidial length (Walcott, 1908a, pl. 3, fig. 6; Resser, 1939a, pl. 5, fig. 14; Rasetti, 1951, pl. 21, fig. 15). *Chancia palliseri* has an anterior border that is one-third the length of the frontal area, a palpebral lobe that is one-quarter the glabellar length, and 20–23 thoracic segments (Rasetti, 1951). *Chancia latigena* and *C. angusta* have a border nearly half the length of the frontal area and a palpebral lobe that is one-fifth the glabellar length. *Chancia latigena* has a narrower posterior border. *Chancia angusta* has a distinctly tapering glabella, a wider posterior border, and 18 thoracic segments (Resser, 1939b). *Chancia maladensis* has a frontal area that ranges from slightly less to slightly more than one-third of the total cranidial length, as well as an anterior border that is less than half the length of the frontal area, a palpebral lobe that is one-quarter the glabellar length, an interocular area slightly wider than the glabella, and 18 thoracic segments (Resser, 1939b, pl. 12, figs. 20, 21; Sundberg, 2018, figs. 24.1–24.6, 25.1–25.12). *Chancia odarayensis* has a frontal area that is one-fifth of the total cranidial length, as well as a border that is nearly half the length of the frontal area, a palpebral lobe that is one-quarter the glabellar length, an interocular area that is equal in width to the glabella, and at least 22 thoracic segments (Rasetti, 1951, pl. 33, fig. 16).

Chancia maladensis (Resser, 1939)

Figure 25.1

1939b *Ehmaniella maladensis* Resser, p. 60, pl. 12, figs. 17–23.

2018 *Chancia maladensis*; Sundberg, p. 31, figs. 24.1–24.6, 25.1–25.12.

Holotype.—Cranidium (USNM 98563a) from the Spence Shale, Idaho (Resser, 1939b, pl. 12, figs. 20, 21).

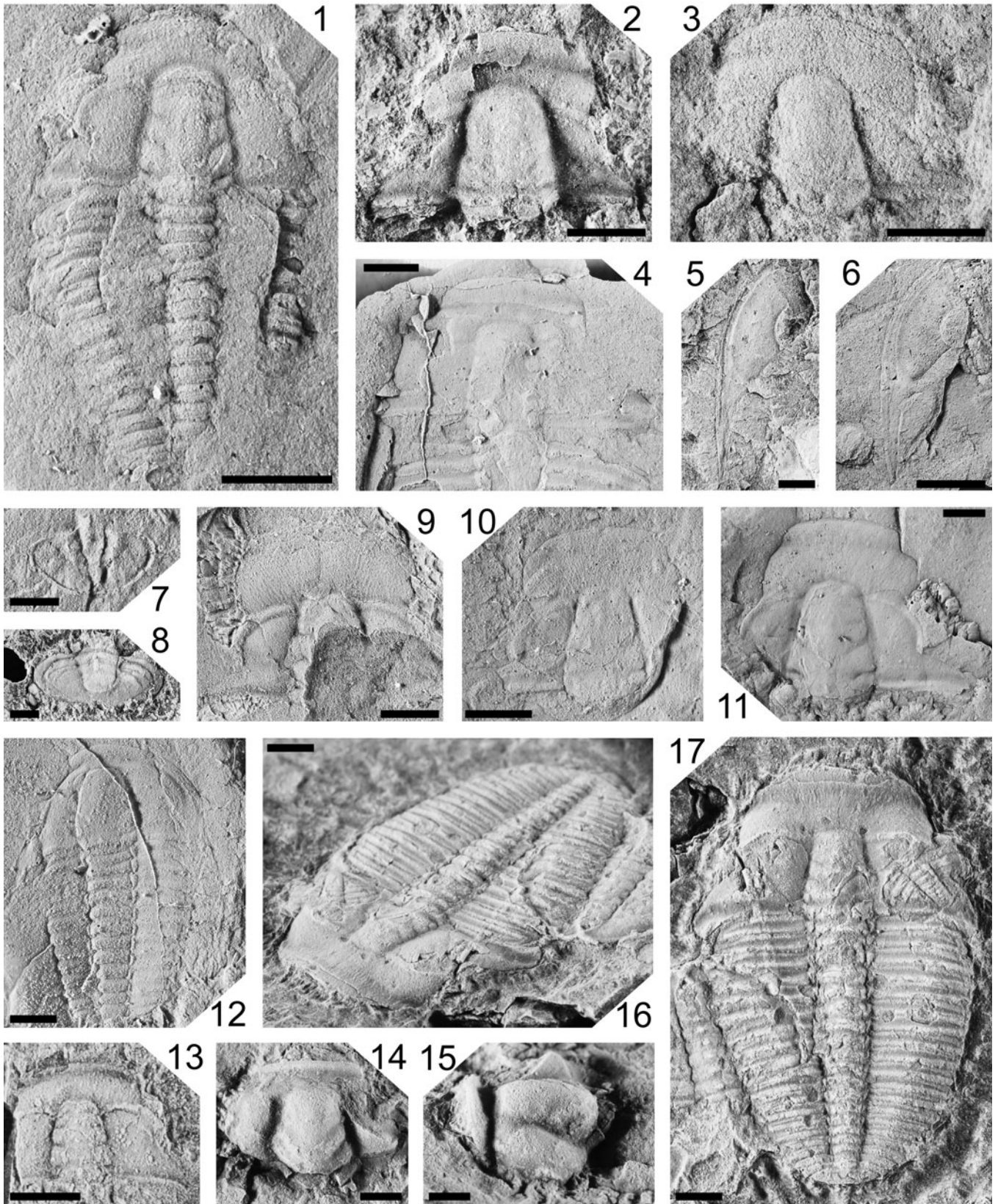


Figure 26. Ptychoparioids from the Northwest Territories. (1–7) *Tonopahella walcotti* (Sundberg and McCollum, 2000); (1) exoskeleton lacking free cheeks (dorsal, latex mold) GSC 142421, silty mudstone, Mount Cap Formation, Little Bear River, *Amecephalus arrosensis-Eokochaspis nodosa* Zone; (2) cranidium (dorsal) GSC 142422, silty mudstone, Mount Clark Formation, Dodo Canyon, *Aitkenaspis keelensis* Zone; (3) cranidium (dorsal) GSC 142423, siltstone, Mount Clark Formation, Dodo Canyon, *Amecephalus arrosensis-Eokochaspis nodosa* Zone; (4) partially complete specimen (dorsal, latex mold) GSC 142424, silty mudstone, Mount Cap Formation, Little Bear River, *Amecephalus arrosensis-Eokochaspis nodosa* Zone; (5) free cheek (dorsal) GSC 142425, silty mudstone, Mount Cap Formation, Little Bear River, *Amecephalus arrosensis-Eokochaspis nodosa* Zone; (6) free cheek (dorsal, latex mold) GSC 142426, silty mudstone, Mount Cap Formation, Little Bear River, *Amecephalus arrosensis-Eokochaspis nodosa* Zone; (7) pygidium, (dorsal, latex mold) GSC 142427, silty mudstone, Mount Cap Formation, Little Bear River, *Amecephalus arrosensis-Eokochaspis nodosa* Zone; (8) *Eokochaspis nodosa* Sundberg and McCollum, 2000, pygidium (dorsal) GSC 142428, silty mudstone, Mount Cap Formation, Little Bear River, *Amecephalus arrosensis-Eokochaspis nodosa* Zone; (9–11) *Tonopahella* sp. indet., silty mudstone, Mount Cap Formation, Little Bear River, *Amecephalus arrosensis-Eokochaspis nodosa* Zone; (9) cranidium (dorsal) GSC 142429; (10) cranidium (dorsal, latex mold) GSC 142430; (11) cranidium (dorsal) GSC 142431; (12) ptychoparioid gen. and sp. indet. 4, complete exoskeleton (dorsal, latex mold) GSC 142432, silty mudstone, Mount Cap Formation, Little Bear River, *Amecephalus arrosensis-Eokochaspis nodosa* Zone; (13) ptychoparioid gen. and sp. indet. 5, cranidium (dorsal) GSC 142433, silty mudstone, Mount Cap Formation, Little Bear River, *Amecephalus arrosensis-Eokochaspis nodosa* Zone; (14, 15) *Caborcella collaris* (Rasetti, 1951), cranidium (dorsal, lateral) GSC 142434, silty mudstone, Mount Clark Formation, Dodo Canyon, *Aitkenaspis keelensis* Zone; (16, 17) ptychoparioid gen. and sp. indet. 3, exoskeleton lacking free cheeks (oblique, dorsal) GSC 142435, mudstone, Mount Cap Formation, Carcajou Falls, *Glossopleura walcotti* Zone. All scale bars = 2 mm.

Occurrence.—Mudstone, Mount Cap Formation, Dodo Canyon, Northwest Territories, *Glossopleura walcotti* Zone; Spence Shale, Idaho (Resser, 1939b); Rachel Limestone and Emigrant Formation, Nevada, *Glossopleura walcottii Ptychagnostus praecurrens* Zone (Sundberg, 2018).

Material.—Two partially complete exoskeletons lacking free cheeks and one cranidium. Figured material: GSC 142436.

Remarks.—*Chancia maladensis* from the Mount Cap Formation resembles specimens from the Spence Shale, Emigrant Formation, and Rachel Limestone, but differs in having a slightly shorter anterior cranial border. It shares a palpebral lobe which is slightly longer than that in other species.

Genus *Eokochaspis* Sundberg and McCollum, 2000

Type species.—*Eokochaspis nodosa* Sundberg and McCollum, 2000, from the *Eokochaspis nodosa* Zone of the Comet Shale Member, Pioche Formation, Nevada.

Remarks.—The diagnosis by Sundberg and McCollum (2000) with amendments in Webster (2011a) is followed. Features used to distinguish species of *Eokochaspis* include the relative lengths of the preglabellar field and anterior border, presence of a plectrum, depth of axial and lateral glabellar furrows, width of the free cheek, length of the genal spine, number of pygidial axial rings, and presence of a medial indentation on the pygidial border. Sundberg (2004) suggested that *Eokochaspis* is polyphyletic.

Eokochaspis nodosa Sundberg and McCollum, 2000 Figure 26.8

- 2000 *Eokochaspis nodosa* Sundberg and McCollum, p. 611, fig. 7.1–7.20.
2003b *Eokochaspis nodosa*; Sundberg and McCollum, p. 967, pl. 2, figs. 1, 2, 4.
2011a *Eokochaspis nodosa*; Webster, p. 218, figs. 7.1–7.20, 28.1–28.29, 29.1–29.31.
2011 *Eokochaspis nodosa*; Webster and Zelditch, fig. 1C, D.
2014 *Eokochaspis nodosa*; Pratt and Bordonaro, p. 916, fig. 8.1–8.10.

Holotype.—Cranidium (USNM 497818) from the *Eokochaspis nodosa* Zone of the Comet Shale Member, Pioche Formation, Nevada (Sundberg and McCollum, 2000, fig. 7.1–7.3).

Occurrence.—Silty mudstone, Mount Cap Formation, Little Bear River, Northwest Territories, *Amecephalus arrosensis-Eokochaspis nodosa* Zone; Comet Shale Member, Pioche Formation, Nevada, *Eokochaspis nodosa* Zone (Sundberg and McCollum, 2000; Webster, 2011a; Webster and Zelditch, 2011); Emigrant Formation, Nevada, *Eokochaspis nodosa* Zone (Sundberg and McCollum, 2003b); Soldano Member, La Laja Formation, San Juan, Argentina, *Amecephalus arrosensis-Eokochaspis nodosa* Zone (Pratt and Bordonaro, 2014).

Material.—Two pygidia. Figured material: GSC 142428.

Remarks.—These pygidia have the typical wing nut shape of species of *Eokochaspis*. The presence of two axial rings in each pygidium is consistent with *E. nodosa* as opposed to other species of *Eokochaspis*.

Eokochaspis species indet. Figure 25.4, 25.7

Occurrence.—Mudstone and silty mudstone, Mount Cap Formation, Little Bear River, Northwest Territories, *Aitkenaspis keelensis* Zone.

Material.—One nearly complete exoskeleton and three cranidia. Figured material: GSC 142438, 142441.

Remarks.—*Eokochaspis* sp. indet. is most similar to *E. piochensis* (Palmer in Palmer and Halley, 1979), but differs by having a shorter glabella, slightly longer palpebral lobe, and less well-defined axial and lateral glabellar furrows. However, the available cranidia are small.

Genus *Tonopahella* Sundberg and McCollum, 2003

Type species.—*Tonopahella goldfieldensis* Sundberg and McCollum, 2003b, from the *Amecephalus arrosensis* Zone of the Emigrant Formation, Nevada.

Remarks.—Sundberg and McCollum (2003b) proposed this genus to account for two species classified in *Kochina* Resser, 1935, which are somewhat similar to *Amecephalus*. The cranidium of *Tonopahella* differs from that of *Amecephalus* by the constriction of the axial furrow at S2, moderately defined S1 and S2, a narrower interocular area, shorter posterior limb, an absence of the interborder furrow in the anterior border. *Tonopahella goldfieldensis* differs from *T. walcotti* (Sundberg and McCollum, 2000) by having a transverse anterior border and a less well-defined border furrow.

Tonopahella goldfieldensis Sundberg and McCollum, 2003
Figure 25.6, 25.8

2003b *Tonopahella goldfieldensis* Sundberg and McCollum, p. 981, pl. 7, figs. 1–6.

Holotype.—*Tonopahella goldfieldensis* (USNM 517665) from the *Amecephalus arjosensis* Zone of the Emigrant Formation, Nevada (Sundberg and McCollum, 2003b, pl. 7, figs. 1, 3).

Occurrence.—Silty mudstone, Mount Cap Formation, Little Bear River, Northwest Territories, *Amecephalus arjosensis-Eokochaspis nodosa* Zone; Emigrant Formation, Nevada, *Amecephalus arjosensis* Zone; Monola Formation, California, *Amecephalus arjosensis* Zone (Sundberg and McCollum, 2003b).

Material.—Three cranidia. Figured material: GSC 142440, 142442.

Remarks.—Cranidia from the Mount Cap Formation differ from the holotype in having a slightly curving anterior margin. This is intermediate between *T. goldfieldensis* and *T. walcotti*, which may suggest that the two species are synonymous.

Tonopahella walcotti (Sundberg and McCollum, 2000)
Figure 26.1–26.7

2000 *Kochina? walcotti* Sundberg and McCollum, p. 626, figs. 15.1–15.6.

2003b *Tonopahella walcotti* Sundberg and McCollum, p. 982, pl. 7, fig. 7.

Holotype.—Nearly complete exoskeleton (USNM 497954) from the *Amecephalus arjosensis* Zone of the Comet Shale Member, Pioche Formation, Nevada (Sundberg and McCollum, 2000, fig. 15.3).

Occurrence.—Silty mudstone, Mount Cap Formation, Little Bear River, siltstone and silty mudstone, Mount Clark Formation, Dodo Canyon, Northwest Territories, *Amecephalus arjosensis-Eokochaspis nodosa* and *Aitkenaspis keelensis* zones; Comet Shale Member, Pioche Shale, Nevada, *Amecephalus arjosensis* Zone (Sundberg and McCollum, 2000); Monola Formation, California, *Amecephalus arjosensis* Zone (Sundberg and McCollum, 2003b).

Material.—Two nearly complete exoskeletons, 30 cranidia, three free cheeks, and one pygidium. Figured material: GSC 142421–142427.

Remarks.—The cranidia from the Mount Cap Formation are similar to those from the Pioche and Monola formations (Sundberg and McCollum, 2000, 2003b). These specimens have a slightly shorter postocular fixed cheek compared with that of the holotype specimen, although the difference is considered negligible. The cranidium illustrated in Figure 26.2 differs from the other specimens by having a preserved shallow axial furrow and a more convex anterior border with a more well-defined border furrow. Because this specimen is preserved in siltstone instead of mudstone like the other cranidia, these differences are regarded as arising from differential compaction.

Tonopahella species. indet.
Figure 26.9–26.11

Occurrence.—Silty mudstone, Mount Cap Formation, Little Bear River, Northwest Territories, *Amecephalus arjosensis-Eokochaspis nodosa* Zone.

Material.—Thirteen cranidia. Figured material: GSC 142429–142431.

Remarks.—The constriction of the glabella opposite S2, narrow interocular area, and shorter postocular fixed cheek of these specimens are consistent with *Tonopahella*. *Tonopahella* sp. indet. is distinct by having a unique combination of morphological features among species of *Tonopahella*. The strongly divergent anterior facial suture and a curved anterior border and border furrow of *Tonopahella* sp. indet. is similar to *T. walcotti*, whereas a longer preglabellar field that is two-thirds of the length frontal area is similar to that of *T. goldfieldensis*. As stated for *T. walcotti*, the unique combination of these features may indicate that the two species are synonymous.

Ptychoparioid genus and species indet. 1
Figure 25.11, 25.12

Occurrence.—Siltstone, Mount Clark Formation, Dodo Canyon, Northwest Territories, *Aitkenaspis keelensis* Zone.

Material.—One cranidium. Figured material: GSC 142445.

Remarks.—This cranidium has a tapered glabella with two lateral glabellar furrows that curve obliquely backward, a shallow anterior border furrow, a wide fixed cheek, and an effaced ocular ridge. It bears a resemblance to *Solenopleura conifrons* Westergård, 1952, although this taxon is from Baltic and Avalonian strata of the younger *Solenopleura? brachymetopa* and *Paradoxides forchhammeri* zones (Guzhangian Stage).

Ptychoparioid genus and species indet. 2
Figure 25.5, 25.9, 25.10

Occurrence.—Silty mudstone, Mount Cap Formation, Carcajou Falls, Northwest Territories, *Albertelloides mischi* Zone.

Description.—Cranidium is subtriangular in outline. Axial furrow is well defined. Glabella is subrectangular in outline and with the axial furrow outwardly bowed slightly. Three pairs of lateral glabellar furrows are present. S1 and S2 are well defined and oriented obliquely backward and S3 is poorly defined and nearly transverse. Occipital furrow is well defined, occipital ring with a medial tubercle. Anterior border is in length one-quarter that of the preglabellar field. Border furrow is moderately defined and shallows medially. Anterior course of the facial suture is convergent. Interocular area width is three-quarters that of the glabella at the mid-point. Ocular ridge is well defined and is oriented transverse or obliquely backwards. Mid-point of the palpebral lobe opposite S2, with the anterior tip opposite L3, and the posterior tip opposite L1. Length of the palpebral lobe is nearly half that of the glabella. Posterior course of the facial suture is nearly transverse. Posterior border is slightly wider than the occipital ring, with a well-defined border furrow.

Free cheek is equal in width to the occipital ring, with a border that comprises one-fifth of the width. Genal spine is slightly advanced and comprises one-third of the length of the free cheek.

Hypostome, thorax, and pygidium are unknown.

Material.—One cephalon and 16 cranidia. Figured material: GSC 142439, 142443, and 142444.

Remarks.—This species is distinct among ptychopariids in that it has a unique combination of a short anterior cranial border, a convergent anterior facial suture, a long palpebral lobe, and a wide fixed cheek. Typically, genera with convergent facial sutures, such as *Plagiura* Resser, 1935, and *Onchocephalus* Resser, 1937, have a short palpebral lobe located anteriorly and a narrow fixed cheek. The lack of any thoracic and pygidial material of this taxon disfavors the erection of a new genus and species.

Ptychoparioid genus and species indet. 3
Figure 26.16, 26.17

Occurrence.—Mudstone, Mount Cap Formation, Carcajou Falls, Northwest Territories, *Glossopleura walcotti* Zone.

Description.—Exoskeleton is subelliptical in outline. Exoskeleton length 20 mm.

Cranidium is subtrapezoidal in outline. Axial furrow is moderately defined. Glabella is subtrapezoidal in outline. Three pairs of lateral glabellar furrows are present. S1 and S2 are poorly defined and oriented obliquely backward, and S3 is nearly effaced and transverse. Occipital furrow is moderately defined. Anterior border is slightly longer than the preglabellar field. Border furrow is moderately defined, shallowing at a poorly defined preglabellar swelling that extends into the border. Anterior course of the facial suture is convergent. Interocular area is equal in width to the occipital ring. Ocular ridge is well defined and nearly transverse; slightly bowed anteriorly. Mid-point of

palpebral lobe is opposite S2, with the anterior tip opposite L3, and posterior tip opposite L2. Length of the palpebral lobe is one-quarter that of the glabella. Posterior course of the facial suture is oriented obliquely backwards. Posterior border is in width twice that of the occipital ring, with a well-defined border furrow.

Free cheek and hypostome are unknown.

Thorax consists of 18 segments. Axial furrow is moderately defined. Pleura width is one-and-one-third times that of the axis, with well-defined pleural and interpleural furrows. Pleural spines blunt.

Pygidium micropygous, elliptical in outline, and the length is equal to one-third the width. Axis tapers gently posteriorly, with the posterior tip slightly anterior to the posterior edge of the pygidium, and is composed of two axial rings and a terminal piece. Pleural field is in width twice that of the axis, with two pairs of poorly defined pleural furrows that intersect the margin of the pygidium. Border and border spines are absent.

Material.—One complete exoskeleton lacking free cheeks. Figured material: GSC 142435.

Remarks.—The cranidium of this specimen bears a resemblance to that of species of *Amecephalus*, such as *A. piochensis* (Walcott, 1912) and *A. agnesensis* (Walcott, 1912), although differs by having a parallel as opposed to divergent anterior facial suture. Furthermore, the pygidium of this specimen is wider in proportion to its length, has well-defined pleural furrows, and lacks a border.

Ptychoparioid genus and species indet. 4
Figure 26.12

Occurrence.—Silty mudstone, Mount Cap Formation, Little Bear River, Northwest Territories, *Amecephalus arrojosensis-Eokochaspis nodosa* Zone.

Material.—One nearly complete exoskeleton. Figured material: GSC 142432.

Remarks.—The shallow border furrow, longitudinal furrow, lateral glabellar furrows, and thoracic pleural furrows as well as the weakly defined ocular ridge of this specimen are distinct. The morphology of the cranidium is similar to that of *Eokochaspis nodosa* (Sundberg and McCollum, 2000, fig. 7.1–7.4, 7.6, 7.11), but differs by having a shallow ocular ridge, absence of a glabellar constriction at S2, and narrower genal spine.

Ptychoparioid genus and species indet. 5
Figure 26.13

Occurrence.—Silty mudstone, Mount Cap Formation, Little Bear River, Northwest Territories, *Amecephalus arrojosensis-Eokochaspis nodosa* Zone.

Material.—One cranidium. Figured material: GSC 142433.

Remarks.—The features of this cranidium are general for ptychoparioids of the middle Cambrian. Distinguishing

features of Ptychoparioid gen. and sp. indet. 5 are the slightly convergent axial furrow, short border, and well-defined ocular ridge.

Acknowledgments

This project is part of the Geological Survey of Canada's Geomapping for Energy and Minerals (GEM) and Geoscience for New Energy Supply (GNES) programs, which provided bursary support for Handkamer through the Research Affiliate Program of Natural Resources Canada. Funding was also provided by Natural Sciences and Engineering Research Council of Canada (Discovery Grant awarded to Pratt) and Polar Knowledge Canada (Northern Scientific Training Program support awarded to Handkamer). Fieldwork was conducted in the Sahtu Land Claim Settlement Region under a permit issued by the Aurora Research Institute. Helicopter transportation during fieldwork was reliably provided by Sahtu Helicopters. We thank I. Pidskalny for assistance and insight with fieldwork in 2019, as well as S.A. Gouwy, F.A. Sundberg, and an anonymous reviewer for comments on the manuscript. NRCan contribution number 20210288.

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Accepted: 10 February 2022