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Eldoradia and *Acrocephalops* (Trilobita: Bolaspidae) from the middle Cambrian (Miaolingian) of northern Greenland (Laurentia)

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ABSTRACT

The ptychoparioid trilobites *Eldoradia* and *Acrocephalops* (Family Bolaspidae) are described from the middle Cambrian (Miaolingian Series) of northern Greenland (Laurentia). *Eldoradia*, originally described from the Secret Canyon Shale of Nevada, is recorded from south-western Wulff Land, North Greenland, where it occurs together with *Modocia* and *Olenoides*. *Eldoradia caeruleioris* n. sp. is established. The occurrence of *Eldoradia* in the lower part of the Blue Cliffs Formation indicates a minimum late middle Cambrian age (Miaolingian Series, Guzhangian Stage) for the base of the formation. Type material of *Acrocephalops*, a relative of *Eldoradia* originally proposed on the basis of material from the Miaolingian Series (Wuliuan Stage) of Inglefield Land, North-West Greenland, is redescribed.

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Intercontinental biostratigraphic nomenclature in the middle and late Cambrian (Miaolingian and Furongian series) is dominated by agnostoids (Robison 1976; Babcock et al. 2017). Polymeroid trilobites are often endemic to specific palaeocontinents but they form the basis for biostratigraphic correlation of cratonic faunas where agnostoids are rare or absent. In a review of the distribution of trilobites from the Holm Dal Formation (Miaolingian, Guzhangian Stage) of North Greenland, Robison (1988) noted that the highly fossiliferous outer shelf succession yielded 43 polymeroid genera of which only 12 percent occurred on other palaeocontinents than Laurentia. In contrast, the 12 agnostoid genera had a world wide distribution.

Eldoradia Resser, 1935, the principal subject of this paper, is endemic to Laurentia. Palmer (2005) noted its similarity with *Nepea* Xiang & Zhang, 1985 from northern Tianshan, Xinjiang, China, in reviewing the problems of provincial taxonomy within Cambrian trilobite studies, but a close relationship between the two was not supported by Paterson (2005).

Eldoradia occurs in restricted inner shelf successions in Nevada and Utah but it is not well known; only cranidia have been described (Palmer 1954). Nevertheless, the genus has acquired biostratigraphic utility in poorly fossiliferous Cambrian successions in Utah (Hintze 1974; Hintze & Robison 1975). Robison (1976) recognised an *Eldoradia* Assemblage-zone in the restricted shelf environments of the Great Basin, where *Eldoradia* is conspicuous in the Fish Springs Member of the Trippe Limestone of Utah (Hintze & Robison 1975). The assemblage-zone was considered to be a correlative of the late *Bolaspidella* Assemblage-zone and the *Lejopyge calva* Assemblage-zone of open shelf environments (Robison 1976; Briggs & Robison 1984; Babcock et al. 2014), constituents of the Guzhangian Stage of current international usage.

In the present paper, the description of *Eldoradia* from the Blue Cliffs Formation in southern Wulff Land (Ineson & Peel

1997; Figs. 1, 2) extends the known range of the genus from Utah and Nevada to a distant margin of Laurentia on the present day margin of the Arctic Ocean. As in the western USA, *Eldoradia* also occurs in a restricted shelf environment in the lower Blue Cliffs Formation (Ineson & Peel 1997). As in Utah, the occurrence lies within a poorly fossiliferous interval and is of added importance in providing a firm age determination (Guzhangian Stage) for the basal Blue Cliffs Formation.

Of particular interest in the context of northern Greenland is the relationship of *Eldoradia* to the first described bolaspideid genus, *Acrocephalops*, which was proposed by C. Poulsen (1927) on the basis of specimens from the Cape Wood Formation in Inglefield Land, North-West Greenland. Original material of the type species *Acrocephalops gibber* Poulsen, 1927 is redescribed for comparison (Fig. 3B–F).

Geological background

The Blue Cliffs Formation was proposed by Ineson & Peel (1997) as a unit within the Ryder Gletscher Group of Peel & Wright (1985), see also Ineson & Peel (1987, 1997) and Higgins et al. (1991). The group consists of a succession of Cambro–Ordovician platform interior carbonate and subordinate siliciclastic sediments that crops out all across northern Greenland, from Inglefield Land in the west to Kronprins Christian Land in the east. Three Cambrian formations form the lower part of the group in its type area of southern Wulff Land and south-east Warming Land, the Blåfjeld, Brikkerne and Blue Cliffs formations (Fig. 1C), and overlie platform margin and shelf carbonates of the Brønlund Fjord Group (Kap Troedsson and Bistrup Land formations). The Blue Cliffs Formation encompasses a varied succession of pale weathering limestones, dolostones, sandstones and mudrocks attaining 270 m in thickness in south-western Wulff Land that

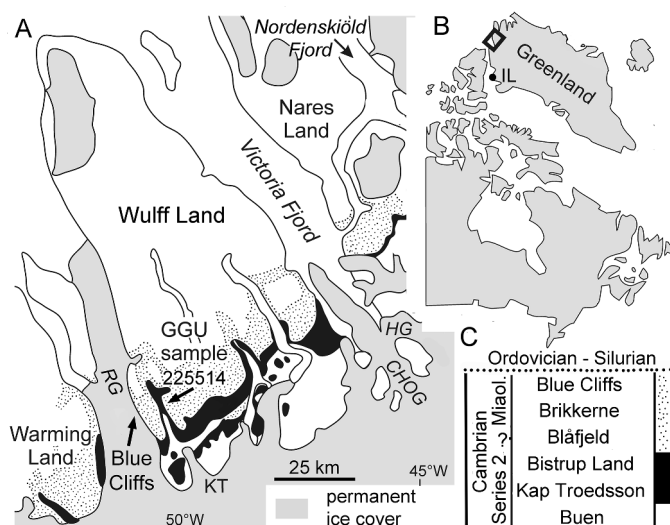


Figure 1. A, B. Locality and geological maps for GGU sample 225514, with inset in B, showing outcrops of the Brønlund Fjord Group (black) and Cambrian formations of the Ryder Gletscher Group (stippled). C. Cambrian formations with legend to geological map (A). CHOG, C.H. Ostenfeldt Gletscher HG, Harder Gletscher; IL, Inglefield Land; KT, Kap Troedsson; Miaol., Miaolingian Series; RG, Ryder Gletscher.

overlies prominent dark grey-brown dolomites of the Brikkerne Formation (Ineson & Peel 1997).

The Blue Cliffs Formation is poorly fossiliferous, yet it has yielded the oldest occurrence of fossils within the Ryder Gletscher Group in the Warming Land–Wulff Land area. In addition to *Eldoradia*, this assemblage also yields *Modocia* sp. and *Olenoides* sp. (Fig. 2). Rich Cambrian Series 2, Stage 4 faunas are known from the stratigraphically lower Kap Troedsson Formation of the Brønlund Fjord Group (Blaker & Peel 1997; Peel 2014, 2017a, 2017b) but intervening units of the Bistrup Land, Blåfjeld and Brikkerne formations are unfossiliferous.

The presence of *Eldoradia* in the Cambrian of Wulff Land was first suggested by A.R. Palmer (written communication 18 April 1980) following a brief review of collections that I made during June 1979, and the identification was supported a few years later by R.A. Robison (undated written communication); this material is described here (Fig. 2). Strata from a nearby locality within the Blue Cliffs Formation also sampled in 1979 yielded *Bolaspidella* sp., indicating the *Bolaspidella* Biozone. Re-examination of the strata in south-west Wulff Land during 1984, now assigned to the basal part of the Blue Cliffs Formation by Ineson & Peel (1997), did not produce additional material. Strata from near the middle of the formation in south-east Warming Land yielded *Terranovella* sp., indicating a Dresbachian age (Palmer in Peel 1980; middle Dresbachian, Guzhangian Stage).

Material – GGU sample 225514, collected by J.S. Peel on 26 June 1979 at an altitude of 440 m a.s.l., on the east side of the large almost north–south trending valley that parallels the coast in south-west Wulff Land (81°27' N, 49°18' W; Fig. 1A). The sample was collected from solid outcrop at a single undetermined horizon in the lowest 30 m of the Blue Cliffs Formation. It yielded about 30 trilobite sclerites, mainly

cranidia, with about equal numbers of *Eldoradia caeruleioris* n. sp. (Fig. 2A–F), *Modocia* sp. (Fig. 2H,I) and *Olenoides* sp. (Fig. 2G).

Abbreviations and repositories – Sagittal and transverse are abbreviated to (sag.) and (trans.), denoting dimensions measured parallel or transverse to the trilobite axis, respectively. GGU prefix indicates a collection made by Grønlands Geologiske Undersøgelse (Geological Survey of Greenland, now a part of the Geological Survey of Denmark and Greenland, GEUS); MGUH prefix, Natural History Museum of Denmark, Copenhagen; USNM prefix, National Museum of Natural History, Washington D.C.

PHYLUM EUARTHROPODA sensu Walossek, 1999

Class Trilobita Walch, 1771

Order Uncertain, Adrain, 2011

Family Bolaspididae Howell in Harrington et al., 1959

Discussion – Adrain (2011) considered that the placement of many families traditionally assigned to Ptychopariida Swinnerton, 1915 (Suborder Ptychopariina Richter, 1933) lacked firm support. In addition to the four genera *Acrocephalops*, *Bolaspis* Resser, 1935 *Eldoradia* and *Rawlinsella* Shaw, 1956 from the Miaolingian Series of Laurentia, grouped together in the Bolaspididae by Howell in Harrington et al. (1959), Rozova (1964) added a fifth genus, *Bolaspidaspis*, from the Cambrian of Siberia to the family. Characteristic features of bolaspidids include the wide (sag.) frontal area with a swelling on the preglabellar field. Similar, but often more pronounced preglabellar swellings are present in many Cambrian trilobites and were interpreted by Fortey & Hughes (1998) as possible brood pouches in sexual dimorphs, see also Cederström et al. (2011).

Acrocephalops gibber, the type species of *Acrocephalops*, was described by C. Poulsen (1927) on the basis of two cranidia (Fig. 3B–F) collected from boulders at Kap Frederik VII (79° 02.5'N, 68°33'W) in Inglefield Land, North-West Greenland (Fig. 1B). C. Poulsen (1927) considered these cranidia to have been derived from the *Glossopleura* Biozone (Miaolingian Series, Wuliuan Stage; Delamaran Stage of the North American standard). However, on the basis of *in situ* collections made in Inglefield Land by J.C. Troelsen during the Danish Thule – Ellesmere Island Expedition 1939–1941 (Troelsen 1950), V. Poulsen (1964), established that *Acrocephalops* occurred together with *Glyphaspis perconcava* Poulsen, 1927 and *Glyphaspis parkensis* Rasetti, 1951 in strata assigned to the *Bathyuriscus–Elrathina* Biozone of the Cape Wood Formation, but he neither illustrated nor described the new material. Bordonaro et al. (2013) regarded *Glyphaspis* Poulsen, 1927 as a junior subjective synonym of *Blainia* Walcott, 1916, which was followed with reservation by Peel (2020a; 2021) in describing the fauna of the Telt Bugt Formation of Dagaard-Jensen Land, North Greenland. The *Bathyuriscus–Elrathina* Biozone, equivalent to the Topazan Stage of North American usage (upper Wuliuan Stage), was renamed the *Ehmaniella* Biozone by Sundberg (2005) and McCollum & Sundberg (2007), a name also used by Robison

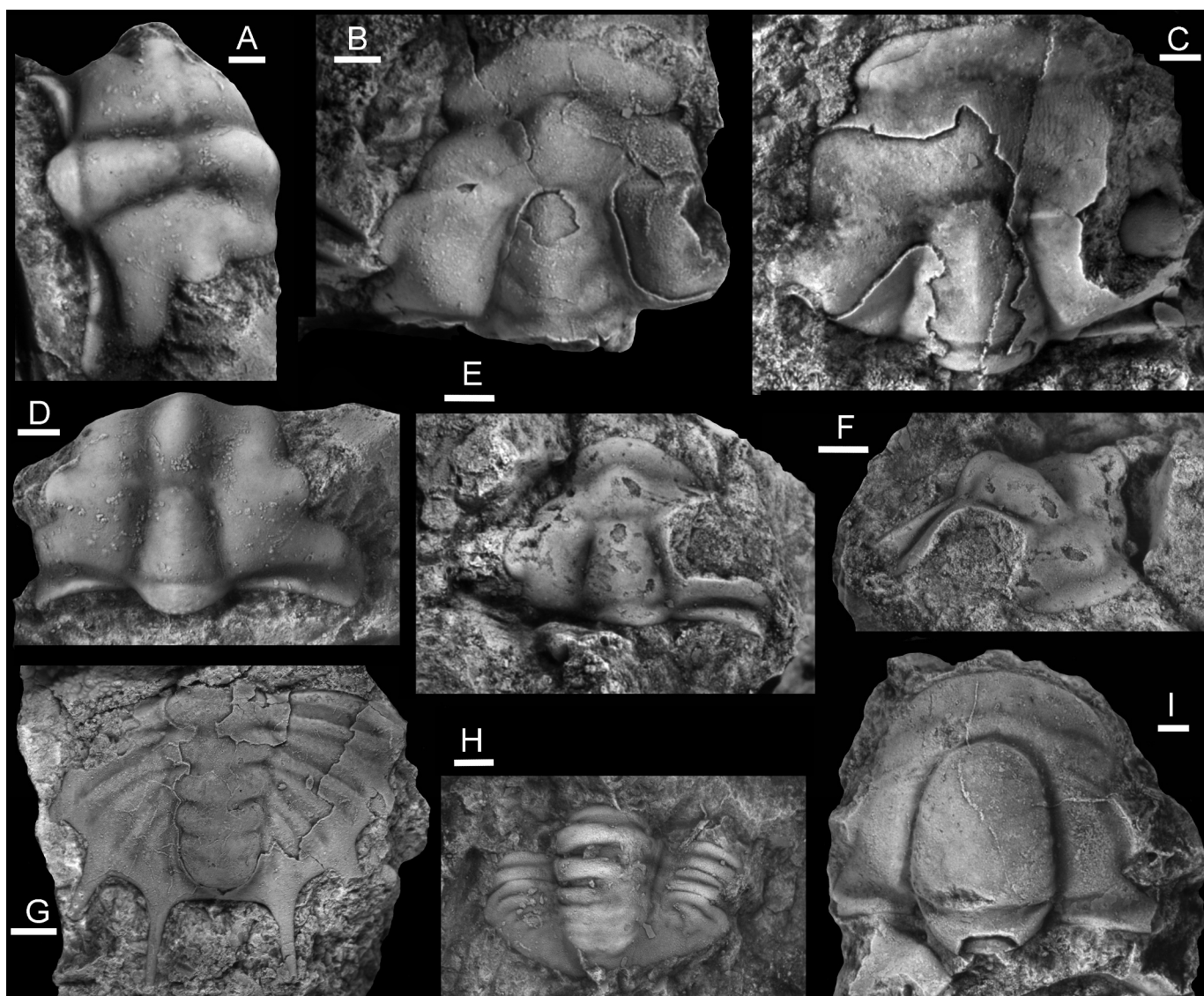


Figure 2. Trilobites from GGU sample 225514. Blue Cliffs Formation, south-west Wulff Land, North Greenland. **A–F.** *Eldoradia caeruleioris* n. sp. **A, D.** cranium with anterior border broken away, MGUH 33 525, in oblique lateral and dorsal views. **B.** partly exfoliated cranium, MGUH 33 526. **C.** partly exfoliated cranium, MGUH 33 527. **E, F.** cranium, MGUH 33 528, holotype, in dorsal and oblique anterior views. **G.** *Olenoides* sp, pygidium, MGUH 33 529. **H, I.** *Modocia* sp. **H.** pygidium, MGUH 33 530. **I.** cranium, MGUH 33 531. Scale bars: 1 mm, except G (3 mm).

(1976). Resser (1935, 1938) assigned several Miaolingian species from the Appalachians to *Acrocephalops* but Schwimmer (1989) referred most of them to *Alokistocare americanum* (Walcott, 1916), which Sundberg (1999) transferred to *Altiocculus* Sundberg, 1994.

Bolaspis was established by Resser (1935) and in addition to the type species, *Bolaspis labrosa* (Walcott, 1916; Fig. 3A), he assigned five other species to *Bolaspis*, mainly on the basis of co-occurring material from Meagher, Montana. The brief text accompanying each assignment cited only the original illustrations of Walcott (1916), without making further additions or giving additional illustrations. Deiss (1939) described five new species from the *Ehmania* fauna of the Pagoda Limestone of northwestern Montana, but noted that *Bolaspis labrosa* occurred in the Wolsey Shale in central Montana. Deiss (1939, p. 74) suggested that *Bolaspis? unica* Deiss, 1939 may be intermediate between *Acrocephalops* and *Bolaspis*; he made no mention of *Eldoradia*.

Eldoradia derives its name from the Eldorado limestone of the Eureka district of Nevada. In proposing *Eldoradia*, Resser (1935, p. 26) considered that it lay morphologically between *Bolaspis* and *Acrocephalops*, but nearer to the former. In addition to the type species, *Ptychoparia? linnarssoni* Walcott, 1884, Resser (1935) assigned *Ptychoparia? prospectensis* Walcott, 1884 and a new species, *Eldoradia lata* Resser, 1935, to *Eldoradia*, all based on figures in Walcott (1884, 1916) and without additional illustration.

Palmer (1954) described the holotype crania of the two species described by (Walcott 1884, see also Walcott 1916) on which Resser (1935) established *Eldoradia*: *Eldoradia linnarssoni* and *E. prospectensis*. *Eldoradia lata* was considered to be a junior synonym of the type species *Eldoradia linnarssoni* by Palmer (1954). *Eldoradia dunbari* Lochman, 1938, from the March Point Formation of Newfoundland, was excluded from *Eldoradia* by Palmer (1954). In an unpublished thesis, Dengler (2005) proposed a new species of *Eldoradia* from the Cow Head Group of western Newfoundland. A new species,

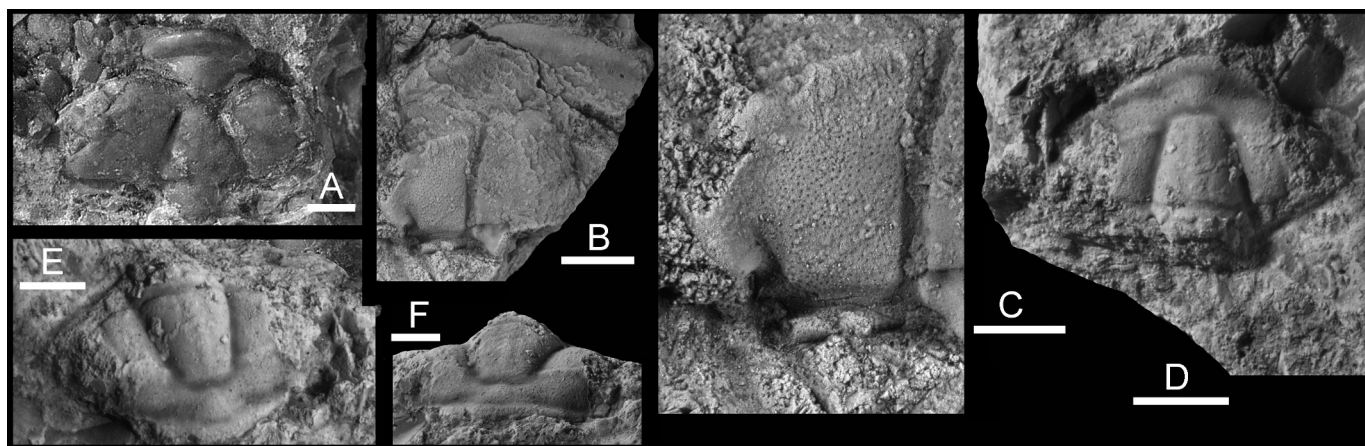


Figure 3. *Bolaspis* and *Acrocephalops*. **A.** *Bolaspis labrosa* (Walcott, 1916), USNM PAL 61 575, holotype, cranium, Meagher Formation, Montana, USA, illustrated with a coloured image online as *Bolaspis labrosa* Resser in the National Museum of Natural History, Washington D.C. (https://www.si.edu/object/nmnhpaleobiology_3036348). **B–F.** *Acrocephalops gibber* Poulsen, 1927, Cape Wood Formation, Inglefield Land, North-West Greenland. **B, C.** MGUH 2299, paralectotype, partly exfoliated fragment of cranium in dorsal view, with detail of palpebral lobe and ornamentation of interocular area (**C**). **D–F.** lectotype, MGUH 2300, broken cranium in dorsal, oblique anterior, and anterior views. Scale bars: 2 mm except C (1 mm).

Eldoradia caerulioris, is described here from the Blue Cliffs Formation of North Greenland (Fig. 2A–F).

Rawlinsella was proposed by Shaw (1956) with type species *Acrocephalites? glomeratus* Walcott, 1916 from the Buck Spring Formation, late middle Cambrian, of Rawlins, Carbona County, Wyoming. The occipital ring is not preserved in the illustrated specimen (Shaw 1956, pl. 9, figs 7–9), and the frontal area, including border, is about two thirds the length (sag.) of the remaining glabella. The lateral margins of the fixed cheeks are also incomplete, but the latter appear to be narrower (trans.) than the glabella at mid-length. The cranium of *Rawlinsella* has similar proportions to that of *Acrocephalops* but the preglabellar swelling does not impinge on the anterior border or displace the uniformly rounded margin anteriorly.

Bolaspidaspis was described by Rozova (1964) from the Sami (Saami) and Sahai (Sakha) formations (Guzhangian) of the Siberian platform, with type species *Bolaspidaspis puta* Rozova [Rosova], 1964, and was considered by its author to lie closest to *Rawlinsella* among described bolaspidids. It is readily distinguished from *Bolaspis* (Fig. 3A) by its narrow (trans.) interocular areas and the much greater width (trans.) of the anterior area of the cranium between the facial sutures; this is almost twice the maximum width of the glabella compared to *Bolaspis* where it is only slightly wider than the glabella at its posterior margin. *Bolaspidaspis* is also characterised by a large spine on the occipital ring and strongly expressed convex anterior border.

Genus *Acrocephalops* Poulsen, 1927

Type species – *Acrocephalops gibber* Poulsen, 1927 from the Cape Wood Formation of Inglefield Land, North-West Greenland.

Acrocephalops gibber Poulsen, 1927 Figure 3B–F

1927 *Acrocephalops gibber* C. Poulsen, p. 275, pl. 17, fig. 1,2.
1964 *Acrocephalops gibber*; V. Poulsen, p. 54.

Lectotype – MGUH 2300, designated as holotype by V. Poulsen (1964), the specimen illustrated by C. Poulsen (1927), (pl. 17, Fig. 2) and derived from talus of the Cape Wood Formation, Inglefield Land, North-West Greenland.

Other figured material – MGUH 2299, paralectotype, same locality as lectotype.

Description – Both of the cranidia figured by C. Poulsen (1927) are incomplete. In the lectotype, the left lateral margin is represented by a line of fracture from the anterior margin to the posterior border furrow, and the posterior limb of the fixed cheek and its posterior border are missing (Fig. 3D). The right side is broken away in similar fashion, although a portion of the furrow between the interocular area and the palpebral lobe is retained, indicating that the interocular area is about half the corresponding width (trans.) of the glabella. The occipital ring is incomplete. The glabella has straight sides and tapers anteriorly towards the truncated anterior, the latter being about half the width (trans.) of the glabellar width measured at the occipital furrow. Anterior to the glabella, the frontal area has a length (sag.) corresponding to two thirds of the glabellar length, exclusive of the occipital ring. It is delimited from the glabella, as are the fixed cheeks, by a broad axial furrow. Two thirds of the length (sag.) of the frontal area is formed by the preglabellar field that is swollen medially into a triangular form (Fig. 3E), with bounding shallow depressions extending obliquely forward, and deepening, from the anterior corners of the glabella towards the anterior margin (Fig. 3D–F). The anterior margin is arched medially in plan view (Fig. 3D), but also slightly in anterior view (Fig. 3F), with a shallowly convex border. The border furrow is shallow and broad, deflected anteriorly around the anterior margin of the preglabellar swelling. Broad, low, eye ridges extend with slight postero-lateral obliquity across the fixed cheeks from slightly posterior of the anterior angulations of the glabella. Details of the palpebral lobes are

not preserved. The surface is ornamented with a fine granulation and pitting most clearly visible at the anterior (Fig. 3F).

The frontal margin in the paralectotype cranium (Fig. 3B) is slightly more uniformly convex than in the lectotype. Most of the right side has been broken away, with much of the remaining thick exoskeleton exfoliated; it is traversed by a prominent fracture acquired and repaired during the original preparation. The left side is covered by matrix to the anterior of the palpebral lobe, but the convex form of the latter is discernible even though it is damaged anteriorly (Fig. 3C), continuing via the broad, shallow, eye ridge to meet the axial furrow. At its maximum width (trans.), the palpebral lobe and interocular area are equal in width to the glabella. The furrow between the palpebral lobe and the interocular area deepens posteriorly such that the posterior termination of the palpebral lobe is raised above the posterior limb of the fixed cheek (Fig. 3C). A deep narrow notch appears to be developed between the raised posterior lobe and the adjacent anterior edge of the posterior fixed cheek, but the latter is covered by matrix, distal to the posterior termination of the palpebral lobe. The nature of the genal angle and the lateral extent of the posterior limb are therefore unknown, but the latter was certainly much greater than is currently visible in the specimen. Where preserved, the posterior border and posterior border furrow are prominent and equal in expression. The occipital ring is broken but the shape of the left side suggests that it may have been produced into a blunt medial spine; the occipital ring is prominent on the internal mould of the axis but obscure on its outer surface. Ornamentation on the interocular area (Fig. 3C) consists of fine pits and granules, the latter often extended into short ridges.

Discussion – The illustrations of the type specimens of *Acrocephalops gibber* given by C. Poulsen (1927, pl. 17, fig. 1,2) appear to have been restored as regards the lateral margins of the cranidia and the degree of emphasis of the preglabellar swelling. The drawing of *Acrocephalops* given by Howell in Harrington et al. (1959, fig. 227.1) indicates short eyes whereas the palpebral lobes in *Acrocephalops gibber* persist almost to the posterior border furrow (Fig. 3C,D). Thus, the reconstruction of the posterior limbs of the cranidium given by Howell in Harrington et al. (1959), not least as regards the width (trans.) of the limb is not supported.

Resser (1945) proposed *Acrocephalops? arizonaensis* on the basis of a complete specimen with 16 thoracic segments from the Flour Sack Member of the Bright Angel Shale (Miaolingian) in the Grand Canyon. The specimen was refigured by Norr et al. (2016, fig. 6A) and it differs from *Acrocephalops gibber* in the uniformly convex anterior margin to its wider frontal area, with sutures curving strongly in towards the eyes. The posterior limbs of the fixed cheeks extend distally well beyond the line of the palpebral lobes, as may also be the case, but not preserved, in the types of *Acrocephalops gibber*.

Resser (1935) referred three species from the Appalachians to *Acrocephalops* and later (Resser 1938) recognised six species of *Acrocephalops* from the

Miaolingian of Georgia and Virginia. Resser's (1938) illustrations are too small for meaningful comparison, but four of these species were referred to *Alokistocare americanum* (Walcott, 1916) by Schwimmer (1989), which Sundberg (1999) transferred to *Altiocculus* Sundberg, 1994.

Rozova (1964, pl. 12, figs. 9, 13) referred fragmentary cranidia from the Guzhangian of Siberia to *Acrocephalella* sp. 1 that are closely similar to the *Acrocephalops gibber* as regards the shape of the glabella and frontal area.

Bolaspidaspis puta differs from *Acrocephalops gibber* in terms of its much more strongly expressed anterior border of uniform width in which the anterior margin is not displaced anteriorly around the preglabellar swelling. Its palpebral lobes are shorter, terminating just posterior of the mid-length of the glabella (Rozova 1964, pl. 12, fig. 17), whereas they extend almost to the posterior border furrow in *Acrocephalops gibber* (Fig. 3B–D). The presence in *Acrocephalops gibber* of the prominent occipital spine characteristic of *Bolaspidaspis* cannot be discounted since the posterior margin is broken in both available specimens.

Genus *Eldoradia* Resser, 1935

Type species – *Ptychoparia? linnarssoni* Walcott, 1884 from the Secret Canyon Shale, Eureka, Nevada, middle Cambrian (Miaolingian Series).

Discussion – A diagnosis of *Eldoradia* was given by Palmer (1954, p. 76) who provided stereoscopic illustrations of the type cranidia of the two species on which Resser (1935) established the genus: *Eldoradia linnarssoni* (Walcott, 1884) and *E. prospectensis* (Walcott, 1884). The drawing of *Eldoradia linnarssoni* presented by Howell in Harrington et al. (1959) fails to reproduce the weakly expressed, shallow anterior border furrow that forms a tangent to the anterior of the preglabellar swelling and delimits a narrow, shallowly convex, outward sloping border (Palmer 1954, pl. 16, fig. 9).

In terms of the prominent swelling on the preglabellar area, *Eldoradia* is similar to *Acrocephalops* from the Cape Wood Formation of Inglefield Land (Fig. 3B–F), but it is distinguished by the much greater length (sag.) of its frontal area. The front of the glabella in *Eldoradia* lies at about half the length (sag.) of the cranidium, whereas the frontal area is only about a quarter of the length of the cranidium in *Acrocephalops*. Similarly, the width of the interocular area in *Eldoradia* and *Bolaspis* is greater than the corresponding transverse glabellar width, but less than this distance in *Acrocephalops*, *Rawlinsella* and *Bolaspidaspis*. The palpebral lobes in *Acrocephalops* are much longer (sag.) than those in *Eldoradia*, extending almost to the posterior border furrow (Fig. 3C).

Eldoradia caeruleioris n. sp.

Figure 2A–F

Holotype – MGUH 33 528 from GGU sample 225514, lower Blue Cliffs Formation, Cambrian, Miaolingian Series, Guzhangian Stage, south-western Wulff Land (Fig. 1).

Additional material – MGUH 33 525–MGUH 33 527 and six additional specimens from the same sample as the holotype.

Diagnosis – Species of *Eldoradia* with an arched anterior margin and broad, shallowly convex border.

Etymology – From the latin, *caerulus*, meaning blue, reflecting the proximity to the spectacular Blue Cliffs that form the south-west margin of Wulff Land, along Ryder Gletscher, which gave their name to the Blue Cliffs Formation.

Description – Only cranidia are available; they are trapezoidal in form, with the maximum transverse width at the anterior margin about two thirds of that at the posterior margin. Maximum cranial length (sag.) is two thirds of total transverse width, or slightly less. The glabella is conical, with straight sides, narrowing towards the flattened or slightly convex anterior. Its length, exclusive of the occipital ring, is slightly less than the sagittal length of the frontal area, measured along the axial plane. The anterior margin is medially arched (Fig. 2B,E) in plan view, but more uniformly convex in the largest specimen (Fig. 2C). The shallowly convex border occupies about one third of the length of the frontal area and is delimited from the preglabellar area by a broad furrow. This preglabellar area displays a median boss that extends from the axial glabellar furrow to the border furrow and is circular (Fig. 2B) to antero-posteriorly oval (Fig. 2D) in plan view. The lateral margins of this boss are initially coincident with the axial furrows of the glabella, but splay anteriorly; they may be clearly expressed (Fig. 2A,D) or obscure as they cross the prefrontal area. Anteriorly, the median boss is variably impressed into the border, as reflected in the curvature of the frontal margin of the cranidium.

The glabella is delimited laterally by deep axial furrows, but the transverse anterior furrow against the median boss is shallow. The occipital furrow and occipital ring are similarly narrow, the latter increasing in length medially to its convex posterior (Fig. 2D). Two or three pairs of short glabellar furrows are weakly expressed, the posterior pair curving obliquely backwards towards the occipital ring.

The fixed cheeks slope in towards the glabella and the crest of the palpebral lobes attains a similar height as the glabella. The anterior margin of the palpebral lobes lies slightly in advance, or laterally of, the front of the glabella, and a transverse, broad, shallow, eye ridge joins the lobe to the axial furrow. The palpebral lobes are short, about half or less than the length of the glabella. They are strongly curved on their outer side and increasingly elevated above an inner furrow towards the posterior. At mid-length of the palpebral lobe, the fixed cheek is about one and a half times the corresponding width of the glabella (Fig. 2E). The facial suture posterior of the palpebral lobe is distinctly notched before curving towards the acutely pointed genal angle. The posterior cranial border furrow is strongly expressed, widening distally. A fine granulation is present on the surface of the best preserved material (Fig. 2B).

Discussion – *Eldoradia caerulioris* differs from *Eldoradia linnarssoni* and *Eldoradia prospectensis* in terms of its arched frontal margin and the greater width of its anterior border. The anterior border is much more strongly delimited than in *E. linnarssoni*, which has a more slender glabella. The available small sample from Wulff Land shows variation in the width of the glabella, the degree of arching of the anterior margin and the expression of the border furrow in front of the median boss. This variation seems to encompass much of the morphological difference in glabellar shape between *Eldoradia linnarssoni* and *Eldoradia prospectensis*. Palmer (1954) speculated that these might prove to be a single species but their occurrences are separated by a substantial interval of strata. Available Greenland cranidia attain a length of about 8 mm, the same as the holotype of *Eldoradia linnarssoni* but almost twice as large as the holotype of *Eldoradia prospectensis*. In the largest specimen from Greenland (Fig. 2C), the anterior margin is more uniformly convex, and the border furrow broader and less distinct than in other specimens (Fig. 2B,E). A specimen lacking the anterior border (Fig. 2A,D) compares well with Palmer's (1954, pl. 16, fig. 9) illustration of the holotype of *Eldoradia linnarssoni* in which the anterior border is obscure in terms of glabellar proportions, whereas the holotype of *Eldoradia prospectensis* (Palmer 1954, pl. 16, fig. 8) and other Greenland specimens have a more conical glabella, with a distinct border furrow.

The holotype of *Bolaspis labrosa* (Fig. 3A) differs from *Eldoradia caerulioris* in its proportionately wider, almost triangular glabella and uniformly convex anterior margin and border. The preglabellar swelling is triangular in shape and does not impinge upon the border. This glabellar form is also seen in *Bolaspis globulifera* Deiss, 1939 from the Pagoda Limestone of Montana. In other species assigned to *Bolaspis* by Deiss (1939), the glabella is narrower, with a truncated anterior margin and slight anterior tapering.

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Data archiving statement

This published work and the nomenclatural acts it contains have been registered in ZooBank: <http://zoobank.org/pub:9FDC76CE-375F-4472-BDF4-CC0CE5F93A45>

Disclosure statement

No potential conflict was reported by the author.

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