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New information on olenelline trilobites from the Early Cambrian Sekwi Formation, Northwestern Canada

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Abstract

A new species of olenelline trilobite, *Nevadella keelensis,* is described from the lower Cambrian Sekwi Formation, Mackenzie Mountains, Canada. The difficulty in discerning between *Nevadia* and *Nevadella* genera is discussed, and a revision of the two genera is suggested, particularly with the addition of *Nevadella keelensis* n. sp. A holmiid trilobite, *Esmeraldina rowei*, was also confirmed in the same locality. The specimen of *E. rowei* represents the narrow form of a species known for great variability in cephalic form. These trilobites belong to the fauna emerging during the Cambrian radiation and may carry particular importance to systematics and macroevolution.

Introduction

Olenellines are a diverse and biogeographically, biostratigraphically and evolutionarily significant Early Cambrian trilobite group. The Lower Cambrian of the Mackenzie Mountains, Canada, has yielded a number of species of olenelline trilobites described in Fritz (1972, 1973). This study presents new material collected from N63˚31.160' W 128˚10.285', approximate altitude 1768 meters (Fig. 1), the *Nevadella* zone of the Early Cambrian (Branchian) Sekwi Formation, Mackenzie Mountains, Northwestern Territories, Canada. The material of interest hails from a locality that has facies of a distinctive lithology relative to other localities in the Sekwi Formation: they are principally red siltstones whereas the Sekwi Formation regionally is composed principally of shallow to deep-water carbonate interbedded with black shale (Fritz 1976*a*, 1976*b*; Krause and Oldershaw 1978; Dilliard et al. In press). Material occurs in the units 230-240 meters above the base of the section (Fig. 2). Olenelline genera known from the *Nevadella* zone of the Sekwi Formation include the eponymous *Nevadella* Raw, 1936, along with *Bradyfallotaspis* Fritz, 1972, and *Holmiella* Fritz, 1972.

SYSTEMATIC PALAEONTOLOGY

Terminology used follows Lieberman (1998, 1999, 2001). Specimens are housed in the Prince of Wales Northern Heritage Center, Yellowknife, Northwest Territories, Canada (PWNHC) and the University of Kansas Natural History Museum and Biodiversity Institute, Division of Invertebrate Paleontology (KUMIP). Quotation marks around taxon name denotes a paraphyletic group, following Wiley (1979).

Order Redlichiida Richter, 1932

Suborder Olenellina Walcott, 1890

Superfamily “Nevadioidea” Hupé, 1953

Genus *Nevadella* Raw, 1936

Nevadella keelensis new species

(Figs. 3*c* and 3*d*)

= ?*Nevadella* sp. 2 Fritz, 1972, p. 24, pl. 5, figs. 12-15.

TYPES: Holotype cephalon KUMIP 319926 and paratype PWNHC 2009.20.47 from locality given above (Figs. 1, 2).

OTHER MATERIAL EXAMINED: Fragmentary cephala PWNHC 2009.20.48 and 2009.20.49 from same locality.

ETYMOLOGY: Named after the Keele River, the large river that the locality overlooks.

DIAGNOSIS: Glabella tapering evenly and slightly anteriorly. Anterior border relatively wide, length (exsag.) approximately equal to length (sag.) of L0. Frontal lobe does not contact anterior border furrow; plectrum present. S2 straight and not conjoined medially. Extraocular region broad, width (tr.) approximately 100-120 percent width of glabella at L1.

DESCRIPTION: Cephalic length (sag.) 45-55 percent of width (tr.). Anterior cephalic border moderately long, length (exsag.) equal to length (sag.) of L0, may be rounded ridge or flattened ledge. Frontal lobe does not contact anterior border furrow; plectrum present. Anterior margins of frontal lobe at each side of midline deflected posteriorly at roughly 40 degree angle relative to transverse line. Length (sag.) of LA long, equal to 1.5 times length of L0 and L1 medially.

Lateral margins of LA proximal to lateral margins of L0. Ocular lobes contact frontal lobe at posterior parts of frontal lobe; outer band of ocular lobe near lateral margin of LA does not expand prominently exsagittally; ocular lobes gradually increase dorso-ventral elevation between axial furrows and mid-point of ocular lobes; region of anterior part of ocular lobe between putative visual surfaces is in contact with LA. Line from posterior tip of ocular lobe to junction of posterior margin of lobe with glabella forms 15-20 degree angle with sagittal line. Posterior tips of ocular lobes developed opposite medial part of distal margin of L0 or S0. Width of interocular area approximately equal to 1.0-1.4 times width of ocular lobe at its midlength. Distal margins of L3 is straight. S3 either not prominently incised or poorly preserved, not conjoined. Lateral margins of glabella between L0-L2 convergent. S2 not conjoined medially, straight, and directed inward and posteriorly at roughly 35-45 degrees to transverse line. L2 and L3 do not merge distally. Distal margins of L2 when proceeding anteriorly converge. S1 convex anteriorly and sinuous. Distal sector of S0 is convex anteriorly with proximal end well posterior of distal end. Extraocular region opposite L1 broad, width (tr.) approximately 100-120 percent width of glabella at L1. Genal spine angle developed opposite medial part of distal margin of L0. Intergenal angle relative to transverse line deflected at roughly -10 to 5 degrees. Posterior cephalic border transverse.

DISCUSSION: *Nevadella keelensis* shares characters of both *Nevadella* and the closely related *Nevadia*, and a future revision of the two genera may be necessary. In this case, the bulk of the character information supports an assignment of this species to *Nevadella*. For instance, LA is relatively long (sag.) which is typical of *Nevadella* and not *Nevadia* according to the phylogenetic hypothesis and generic assignments presented in Lieberman (2001). Further, S0 is convex anteriorly as in *Nevadella*, and the anterior and lateral borders are relatively longer (sag.)

and wider (tr.). However, there are some characters more consistent with an assignment to *Nevadia*. For instance, the cephalon is relatively broad (tr.) and S2 is straight, as in *Nevadia*. Unfortunately, no intergenal ridge is preserved in this material—another character used to distinguish between the genera. *Nevadella keelensis* n. sp. can be distinguished from *Nevadia weeksi* Walcott, 1910 by having a relatively shorter (tr.) extraocular area and longer (exsag.) anterior border. *Nevadella keelensis* also does not have a conjoined S3 and S2, contra the condition in *Nevadia weeksi*. *Nevadia fritzi* Lieberman, 2001 differs from *N. keelensis* by having a relatively shorter ocular lobe; conjoined S3; and the glabella constricting at L1. Note that several other species have the glabella constricting at approximately L1 or L2 including *Nevadella mountjoyi* Fritz, 1992, *N. eucharis* (Walcott 1913), *N. perfecta* (Walcott 1913), *N. parvoconica* (Fritz 1992), and *Nevadia bacculenta* (Fritz 1972). Also, *N. keelensis* differs from *Nevadia bacculenta* in having a more evenly tapering glabella and relatively longer ocular lobes. *Nevadia faceta* (Fritz 1972), another species found in the Mackenzie Mountains, has a shorter extraocular area relative to *N. keelensis* and the glabellar furrows are more prominently conjoined. Fritz (1972) described and illustrated *Nevadella* sp. 2 from the Sekwi Formation and although this material is poorly preserved and incomplete it appears closely similar to *N. keelensis* in the form and shape of the anterior border, the glabellar furrows, and the plectrum, and they are questionably treated as conspecific.

Superfamily Olenelloidea Walcott, 1890

Family Holmiidae Hupé, 1953

Subfamily Holmiinae Hupé, 1953

Genus Esmeraldina Resser and Howell, 1938

Esmeraldina sp. aff. rowei (Walcott, 1910)

(Figs. 3*a* and 3*b*)

= *Holmia rowei* Walcott, 1910 (partim), p. 292, Pl. 29, figs. 2-4, 7-11.

= *Esmeraldina rowei* Fritz, 1995, p. 714, figs. 5.1, 6.1-6.12, 7.1-7.3, 10.10, 10.11; Lieberman, 1998, p. 71, fig. 3.4; Lieberman, 1999, p. 86. figs. 15.1, 15.3; Hollingsworth, 2006, p. 319, figs. 9.1-9.9, 9.12 (see for more complete synonymy).

= *?Holmia rowei* Walcott. Fritz, 1973, p. 12.

= ?*Esmeraldina rowei* (Walcott). Fritz, 1992, p. 17.

= ?*Esmeraldina rowei* (Walcott). Fritz, 1995, p. 714.

MATERIAL EXAMINED: Cephalon KUMIP 319927 from locality described above.

DISCUSSION: This specimen can be assigned to the Holmiidae based on a number of diagnostic characters including, but not limited to, a forward expanding glabella, the convex and prominently vaulted extraocular area, and the presence of a spine or node at the axial part of L0. Further, it possesses a number of characters also shared by *Esmeraldina rowei* as described by Fritz (1995). However, poor preservation of some features precludes definitive assignment to this species. A prominent difference from the description of Fritz (1995) is in the occipital spine which does not jut out narrowly and abruptly from the occipital ring, but tapers dorsally from the posterior border of the occipital ring (Fig. 3.1). This may be an artifact of the variation within the species as discussed by Hollingsworth (2006). This specimen bears the shape of the narrower form (Hollingsworth 2006) where the ocular lobes are close to the glabellar axial furrows and the posterior border is transverse. *Esmeraldina rowei* is discussed in greater detail in Fritz (1995), Lieberman (1998), and Hollingsworth (2006).

Fritz (1973, p. 12) mentioned that he had observed *E. rowei* (or a species closely similar to it) in the Mackenzie Mountains. Fritz later (1992, p. 17, and 1995, p. 714) questionably synonymized his material with *E. rowei*. It could not be determined whether his material is indeed conspecific with the material presented here, so we have only questionably synonymized these. Fritz (1973, p. 13, pl. 2, figs. 1-6) also described and illustrated an incomplete cephalon as *Holmia*? sp. 1 from the Mackenzie Mountains, Sekwi Formation. *Holmia*? sp. 1 differs from *E.* sp. aff. *rowei* presented herein in having deeper axial furrows and more distinct glabellar furrows, less prominent lateral lobes at L0; little constriction of glabella at S1; a narrower anterior border (exsag.), and a less dorsally prominent extraocular area; thus, at this time we do not synonymize them. However, Hollingsworth (2006) has shown that *E. rowei* can be problematic to identify, as the species can vary in form.

Acknowledgments

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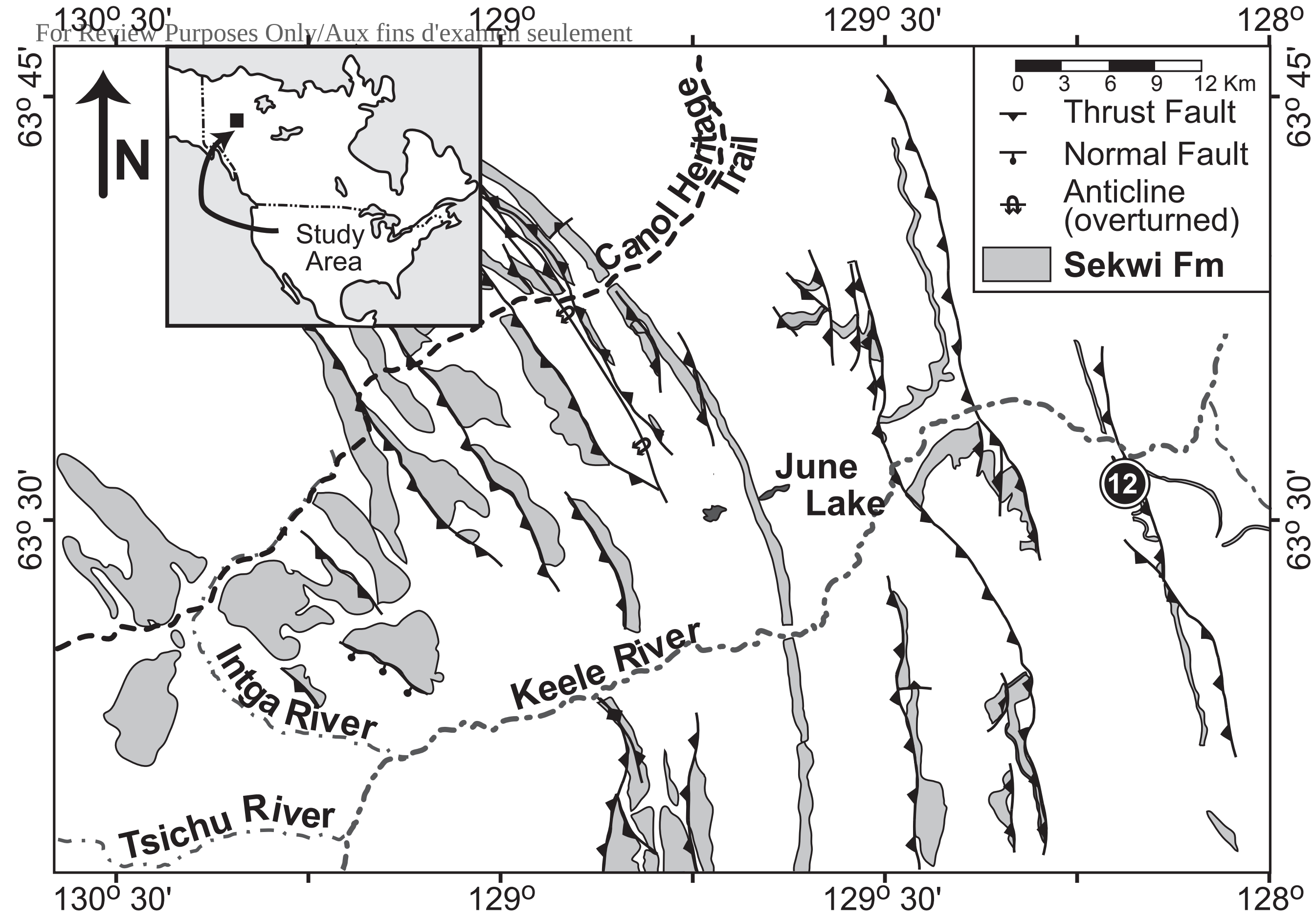
Figure Captions

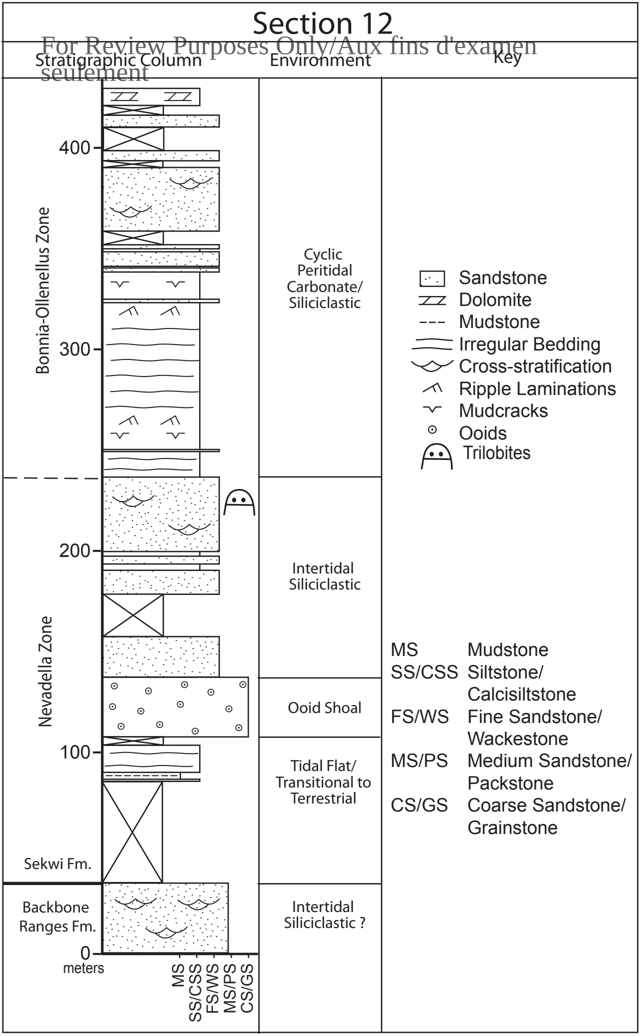
Figure 1—Geographic position of locality, indicated by a circle, which lies approximately 30 km east of the locality discussed and figured in Randell et al. (2005).

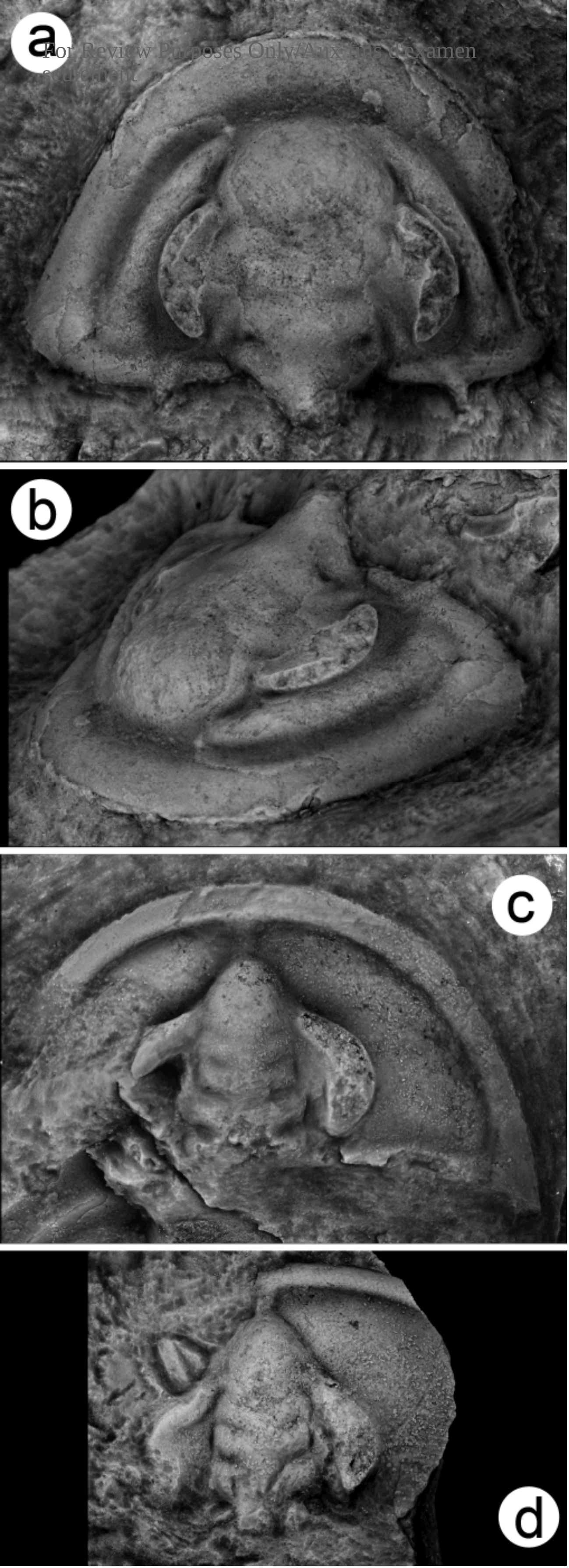
Figure 2—Measured stratigraphic section of Lower Cambrian Sekwi formation at locality containing new material.

Figure 3— Specimens collected from Lower Cambrian Sekwi Formation, Northwest Territories, Canada. *a,b, Esmeraldina* sp. aff. *rowei* (Walcott, 1910). *a,* cephalon, dorsal view, KUMIP 319926, x 2.0; *b,* oblique view of *a*, x 2.0. *c, d,* cephala of *Nevadella keelensis* n. sp. *c,*

dorsal view of holotype, KUMIP 319927, x 2.0. *d,* partial cephalon, dorsal view, PWNHC 2009.20.47, x 2.0.


130° 30'
129°
129° 30'
128°
63° 45'
63° 30'
N
Study
Area
0 3 6 9 12 Km
Thrust Fault
Normal Fault
Anticline
(overturned)
Sekwi Fm
Canol Heritage Trail
June
Lake
12
Intga River
Keele River
Tsichu River


Section 12
Stratigraphic Column
Environment
Key
Bonnia-Ollenellus Zone
Nevadella Zone
Sekwi Fm.
Backbone Ranges Fm.
400
300
200
100
0
meters
MS
SS/CSS
FS/WS
MS/PS
CS/GS
Cyclic Peritidal Carbonate/ Siliciclastic
Intertidal Siliciclastic
Ooid Shoal
Tidal Flat/ Transitional to Terrestrial
Intertidal Siliciclastic ?
Sandstone
Dolomite
Mudstone
Irregular Bedding
Cross-stratification
Ripple Laminations
Mudcracks
Ooids
Trilobites
MS Mudstone
SS/CSS Siltstone/ Calcisiltstone
FS/WS Fine Sandstone/ Wackestone
MS/PS Medium Sandstone/ Packstone
CS/GS Coarse Sandstone/ Grainstone


a
b
c
d