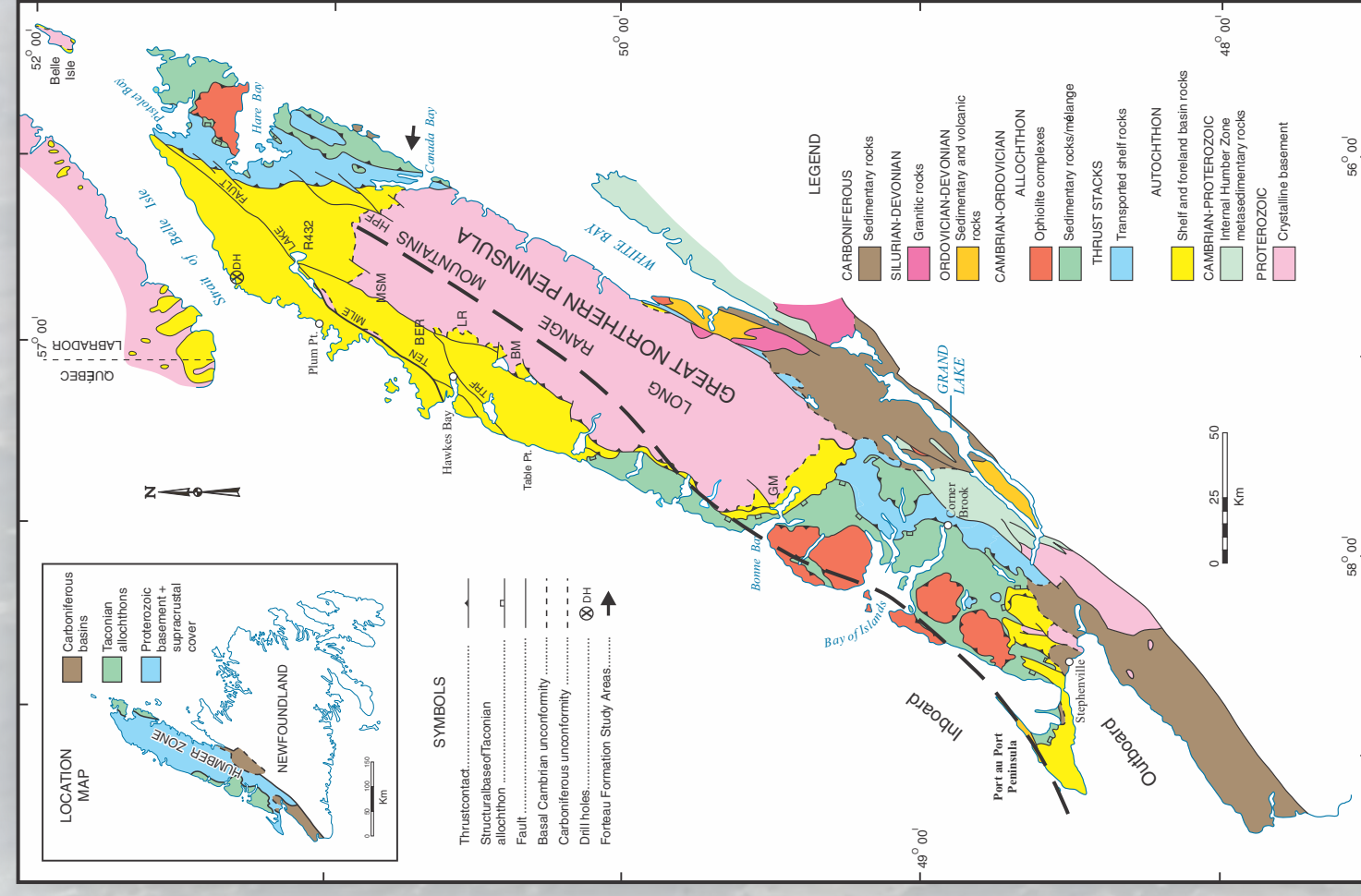


TRILOBITE-BASED RECOGNITION OF THE EARLY—MIDDLE CAMBRIAN (DYERAN—DELAMARAN) BOUNDARY IN THE LABRADOR GROUP, WESTERN NEWFOUNDLAND

Douglas Boyce and Ian Knight

Paleontological and lithological studies of mixed siliciclastic—carbonate, predominantly shallow-water successions of the Forteau and Hawke Bay formations (Labrador Group), ongoing since 1976 (34 measured sections; 434 fossil collections) have recently been reassessed. Until now, the succession has been broadly known to include late Early Cambrian to Middle Cambrian strata, but identification of the late Early Cambrian Dyeran Stage—early Middle Cambrian Delamaran Stage boundary has been elusive.

Recent examination of data collected from measured sections exposed on the shores of Weymouth Cove and Bridge Cove, Chimney Arm, Canada Bay has highlighted a diverse fauna of previously unidentified trilobites, and indicates that the boundary is present in a thinly bedded, deeper water, fossiliferous succession of shale, siltstone, sandstone and lime mudstone to packstone. The condensed succession lies close to the base of a unit of thinly bedded quartzose sandstone and shale that was previously placed in the lower half of the Hawke Bay Formation in the area by Knight and Boyce (1987). This seems to concur well with data collected near Hawkes Bay and in Gros Morne National Park, where trilobites clearly indicate that the base of the Hawke Bay Formation must lie in the latest Early Cambrian. However, metre-scale parasequences of thick white quartz arenite and dark shale in these two areas likely precludes more biostratigraphic precision, making the Canada Bay section of special biostratigraphic significance along the length of Appalachia's Laurentian margin.



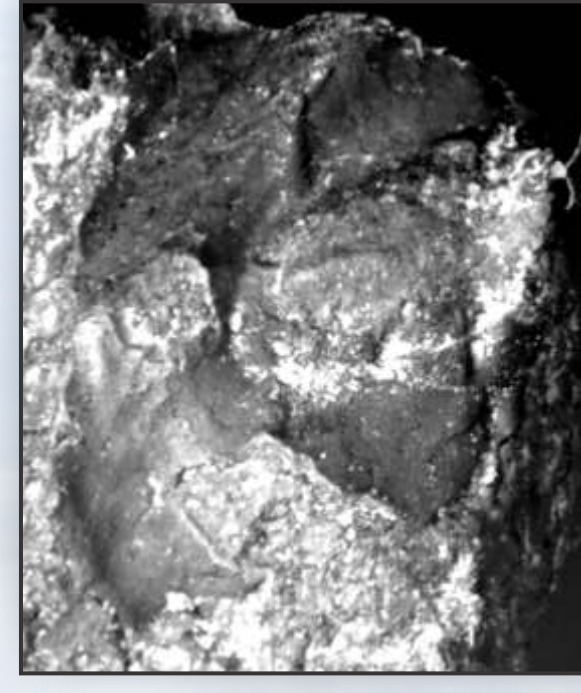
Geology map of western Newfoundland showing the primary geological terranes. Arrow points to study area. GM - Gros Morne National Park.

The Trilobite Taxa

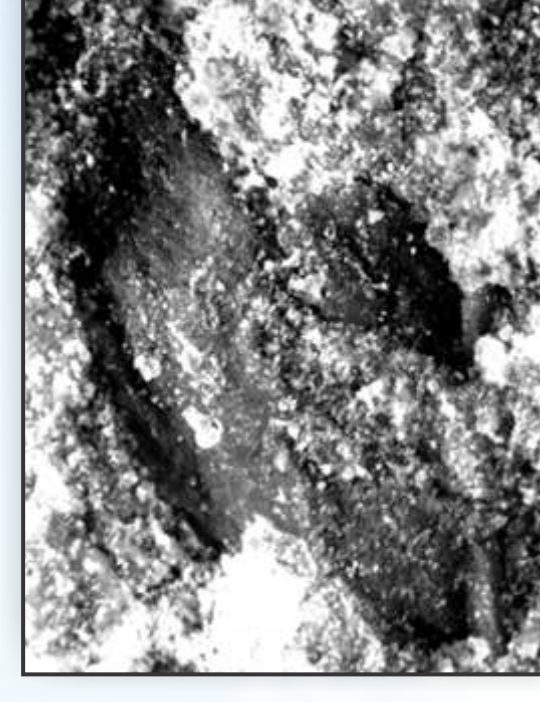
The fauna in Weymouth Cove (K86-120 and 122) is characterized by the following trilobite taxa (in ascending order):

- Austinvillea virginica* Resser, 1938b (1986F0777)
- olenellid gen. et sp. undet. (1986F077, 1986F147)
- Olenellus howelli* Meek in White, 1874? (1986F076, 1986F078, 1986F140)
- Bonnia columbensis* Resser, 1936 (1986F078)
- Bristolia mohavensis* (Crickmay in Hazzard and Crickmay, 1933) (1986F078)
- Periomma* sp. undet. (1986F078)
- Alokistocare* / *Amecephalus* sp. undet. (1986F075B)

Alokistocare / *Amecephalus* sp. undet. also occurs in section K86-74 at Bridge Cove, 2km south of Weymouth Cove (Knight and Boyce, 1987).



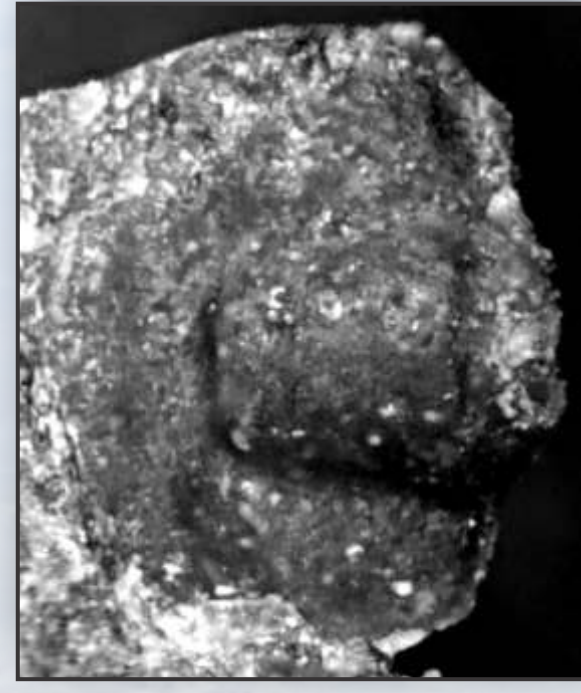
Cranidium of *Alokistocare* / *Amecephalus* sp. undet. (1987F148-001), 7 mm wide.



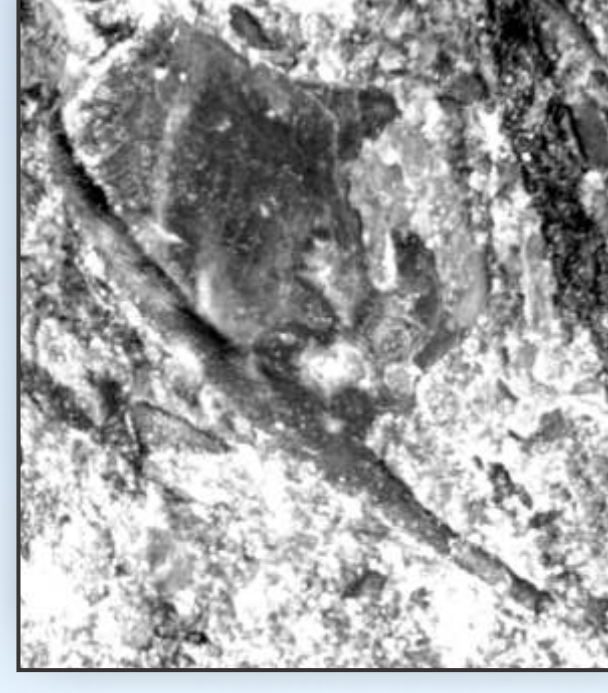
Deformed cranidium of *Alokistocare* / *Amecephalus* sp. undet. (1986F075B-002), 5 mm long.



Cephalon of *Olenellus howelli* Meek in White, 1874? (1986F140-003), 24 mm long (clay cast).



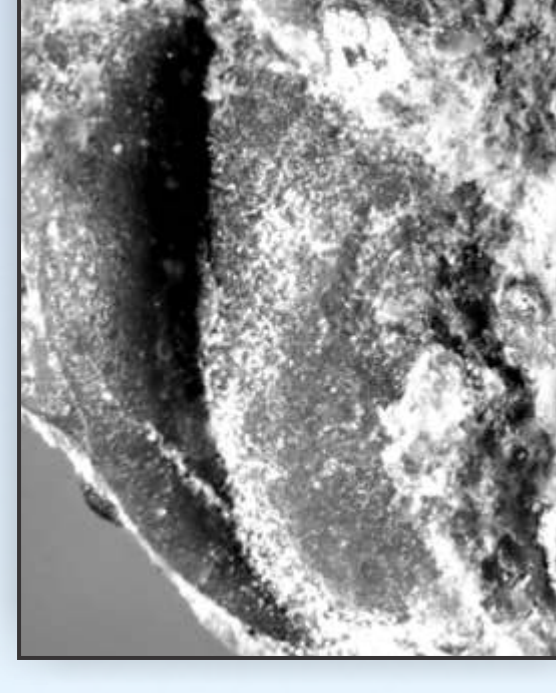
Pygidium of *Bonnia columbensis* Resser, 1936 (1986F078-005), ~5 mm long.



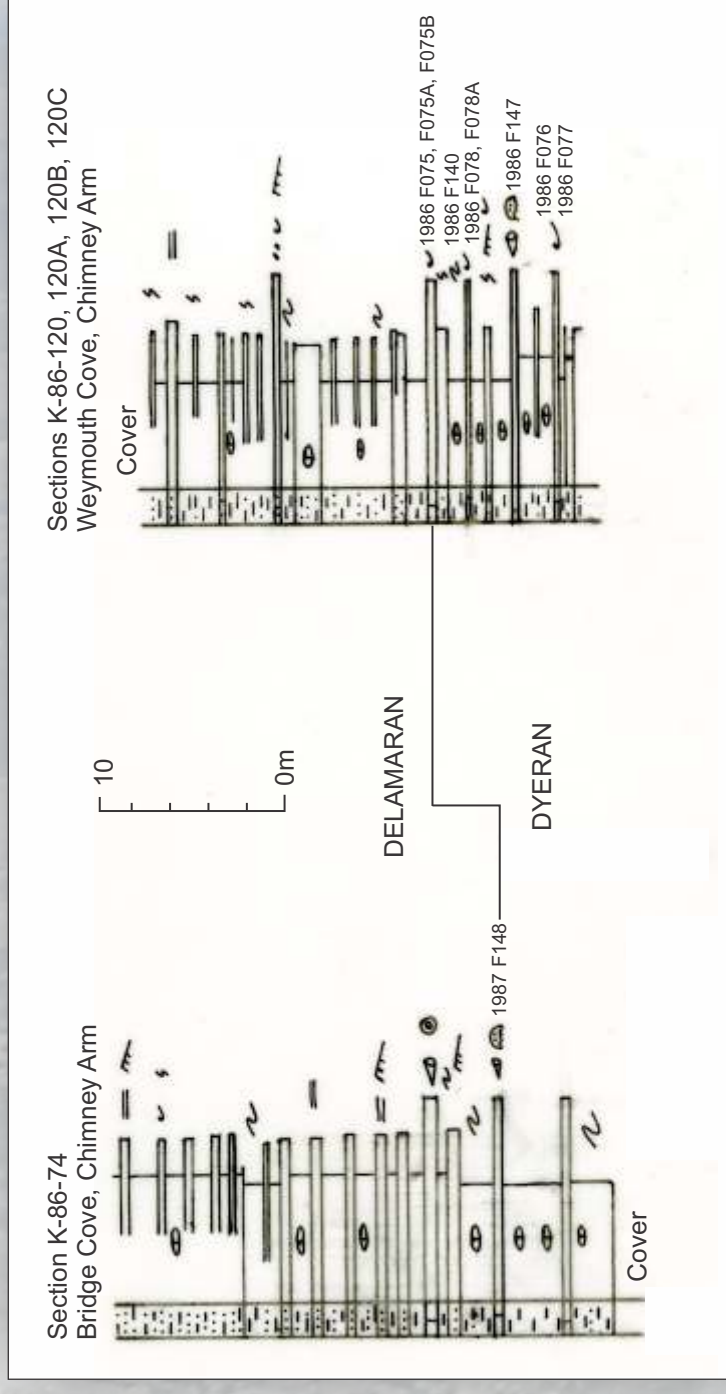
Fragmentary cephalon of *Bristolia mohavensis* (Crickmay in Hazzard and Crickmay, 1933) (1986F078-016), 15 mm long (lateral border and genal spine).



Juvenile cephalon of *Olenellus howelli* Meek in White, 1874? (1986F076-001), 2 mm long.



Fragmentary cranidium of *Austinvillea virginica* Resser, 1938b (1986F077-001), 4 mm wide.



Bridge Cove and Weymouth Cove composite sections, showing the positions of the 1986 & 1987 trilobite collections, and the Early—Middle Cambrian (Dyeran—Delamaran) boundary.

Global Stage and Series	Series (Palmer 1998)	Stages (Palmer 1998)	Trilobite Zones (Sawyer Formation (Price, 1972))	Titlelle Zengha (Hollingsworth, 2011)	Newfoundland Stratigraphy
Stage 4	Murchison	Dyeran	Bonnia Olenellus	<i>Nephrolepis multinodis</i> <i>Bolbolencelis eurypora</i> <i>Peacockella iddingsi</i> <i>Bristolia insculens</i> <i>Bristolia mohavensis</i> <i>Acrochaspis arcuatus</i>	Hawke Bay Formation
Stage 3				<i>Nevadella excharis</i> <i>Nevadella adlypensis</i> <i>Avaldataspis maris</i> <i>Grandmaspiss patulus</i> <i>Emmerdina rowei</i>	Eschsch Formation
Stage 2				<i>Faltrispis</i> <i>Fitzaspis</i>	Badgore Formation
No stages designated				No Trilobites	

Global and Laurentian series and stages of the Early Cambrian and early Middle Cambrian (from Hollingsworth, 2011).

Stage	Biozone	Sub-biozone	Hawkes Bay	Port au Port Peninsula	Gros Morne National Park	Canada Bay
Topazan	<i>Ehmanella</i>	<i>Altitaculus</i> <i>Ehmanella</i> <i>Ehrlichella</i> <i>Proehmanella</i>		<i>Ehmanella</i>	<i>Ehmanella claudensis</i> <i>Olenoides longispinus</i> <i>Polypileuraspis</i> <i>Glossopleura walcotti</i>	<i>Ehmanella claudensis</i> <i>Olenoides longispinus</i> <i>Glossopleura walcotti</i>
Delamaran		<i>Glossopleura walcotti</i> <i>Mexicella mexicana</i> <i>Poliella denticulata</i> <i>Amecephalus arroyensis</i> <i>Eokoehaspis nodosa</i> <i>Nephrolepis</i> <i>Bolbolencelis multinodis</i> <i>Bolbolencelis eurypora</i>		<i>Glossopleura walcotti</i> <i>Mexicella mexicana</i> <i>Poliella denticulata</i> <i>Amecephalus arroyensis</i> <i>Eokoehaspis nodosa</i> <i>Nephrolepis</i> <i>Bolbolencelis multinodis</i> <i>Bolbolencelis eurypora</i>	<i>Mexicella mexicana</i> <i>Alberella highlandensis</i> unnamed <i>Alberella aspinosa</i>	<i>Pharmigomoides</i> "Prolostracrus" <i>Amecephalus</i>
Dyeran (uppermost)		<i>Peacockella iddingsi</i> <i>Bristolia insculens</i> <i>Bristolia mohavensis</i> <i>Acrochaspis arcuatus</i>	<i>Mesonacis fremonti</i> <i>Fritzenellus lapworthi</i>	<i>Mesonacis fremonti</i> <i>Bonnia-Olenellus</i> (subsurface)	<i>Mesonacis fremonti</i> <i>Bonnia-Olenellus</i> (undivided)	<i>Bonnia-Olenellus</i> (undivided)

Legend: ■ FORTEAU FM ■ HAWKE BAY FM ■ MARCH POINT FM
Dyeran to Topazan biostratigraphy of western Newfoundland.

Significance and Laurentian Correlation of the Trilobite Taxa

Most of the Chimney Arm taxa are of known late Dyeran age. *Austinvillea virginica* was originally described from the Shady Formation (Virginia, USA) and, subsequently, from late Early Cambrian boulder G-25 of the deep water Grosse Roches Formation, Québec. *Bonnia columbensis* occurs just below the disconformable 'top' of the type *Bonnia*–*Olenellus* Zone in the Sekwi Formation (Mackenzie Mountains, northwestern Canada). *Bristolia mohavensis* is the nominate species of the late Dyeran *Bristolia mohavensis* Zone in the Latham Shale (Great Basin, western USA). *Olenellus howelli* is recorded from the uppermost Dyeran Combined Metals Member of the Pioche Formation (Great Basin, Nevada).

Alokistocare and *Amecephalus*, however (closely similar general) are characteristic of the Middle Cambrian, which post-dates the last occurrence of olenellid trilobites in Laurentia. *Alokistocare* / *Amecephalus* sp. undet. suggests a correlation with the early Delamaran *Amecephalus arroyensis* Zone. The underlying, earliest Delamaran *Eokoehaspis nodosa* Zone appears not to be represented in the Chimney Arm sections.