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A new middle Cambrian bradoriid arthropod from Greenland and western Canada

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Abstract.—Circum-Laurentian middle Cambrian (Cambrian Series 3) deposits in Greenland and British Columbia yield a new hipponicharionid bradoriid arthropod, *Flumenoglacies* n. gen., characterized by a comarginal, ramp-like structure which is crested by a continuous lobe. The narrow lobe is the result of the medial fusion of anterior and posterior lobes, seemingly a recurrent theme in hipponicharionid evolution. The type species, *F. groenlandica* n. sp., is described from the Ekspedition Brae Formation (Drumian Stage) of Peary Land but the description of two unnamed species from slightly older middle Cambrian strata of the Stephen Formation of British Columbia provides additional evidence for the wide distribution of Small Shelly Faunas during the Cambrian.

Introduction

The Cambrian successions of North Greenland and western Canada are best known for their exceptionally preserved fossil biotas, namely the Sirius Passet Lagerstätte (early Cambrian) of Peary Land, North Greenland and the Burgess Shale Lagerstätte (middle Cambrian) of British Columbia (Briggs et al., 1994; Peel and Ineson, 2011; Erwin and Valentine, 2013). Yet these unique deposits form just a small part of thick Cambrian successions that outcrop extensively in their respective segment of the Laurentian margin. Cambrian strata in North Greenland were deposited within the transarctic Franklinian Basin (Higgins et al., 1991; Trettin, 1991; Ineson and Peel, 1997). Cambrian strata in British Columbia form part of the Sauk megasequence of the Canadian Cordillera, an almost continuous period of deposition along the passive margin of western Laurentia (Gabrielse and Yorath, 1991; Aitken, 1993; Pyle, 2012).

Faunas of macrofossils are well documented from parts of these Cambrian successions (e.g., Rasetti, 1951; Peel, 1988, 1994; Blaker and Peel, 1997; Geyer and Peel, 2011) but the study of Small Shelly Fossils (microscopic skeletal remains recovered through digestion of carbonate sediments with weak acids) is still in its infancy, with just a few isolated studies (e.g. Skovsted and Peel, 2001; Atkins and Peel, 2008; Caron et al., 2010, 2014; Clausen and Peel, 2012; Topper et al., 2013). Ongoing studies in both British Columbia and the Peary Land region indicate, however, that lower and middle Cambrian Small Shelly Fossils from these regions conform to the picture of assemblages distributed widely around the Laurentian margin (Landing et al., 2002; Skovsted, 2006; Skovsted and Peel, 2007, 2010). This paper strengthens this perception by describing a new genus of bivalved arthropod, *Flumenoglacies* n. gen., from the middle Cambrian of Peary Land and British Columbia.

Flumenoglacies is assigned to a group of lower–middle Cambrian hipponicharionid bradoriids in which the discrete anterior and posterior lobes of the bivalved carapace characteristic of the nominate genus *Hipponicharion* Matthew, 1886 are confluent, producing a continuous narrow lobe which forms the crest of a prominent comarginal ramp-like structure (Fig. 1). A similar continuous comarginal lobe is also present in *Meishucunella* Jiang, 1982 (Hou et al., 2002), considered to be possibly the oldest bradoriid by Zhang (2007), and *Neokunmingella* Zhang, 1974 originally described from the lower Cambrian of China. The great age difference between the Chinese species and *Flumenoglacies* suggests that development of a continuous (confluent) lobe may be a repeated feature of hipponicharionid evolution.

A full account of the systematics and distribution of bradoriid and phosphatocopid faunas of North America (mainland Laurentia and Avalonia) is given by Siveter and Williams (1997). Within Greenland (also Laurentia), lower Cambrian bradoriids have been described from North-East Greenland by Poulsen (1932) and Skovsted (2006) and from the Buen Formation of North Greenland by Siveter et al. (1996). Descriptions of bradoriids from British Columbia are restricted to a single species from the Burgess Shale (Siveter and Williams, 1997) although one of the new taxa described herein and a potential new species from the thin Stephen Formation at Stanley Glacier were illustrated by Caron et al. (2014, suppl.-fig. 6o, q) and Caron et al. (2010, fig. DR3L), respectively.

Williams et al. (2007) stated that early Cambrian hipponicharionids such as *Hipponicharion* and *Albrunnicola* Martinsson, 1979, in which the anterior and posterior comarginal lobes are separate, are characteristic of Baltic, Avalonian, and west Gondwanan faunas in middle to high latitudinal settings. The record of hipponicharionids from the lower Cambrian of North-East Greenland by Skovsted (2006) indicates that this distribution extended to tropical latitudes in Laurentia. Williams et al. (2007) additionally reported that *Neokunmingella* and *Meishucunella*, forms in which the

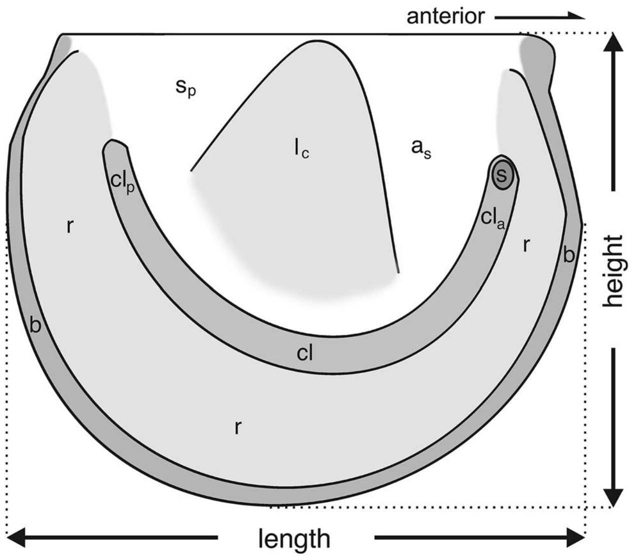

Figure 1. Schematic drawing of a right valve of *Flumenoglacies groenlandica* n. gen., n. sp. illustrating morphological terminology used in the text. The admarginal brim (b) with admarginal ridge, is separated from the comarginal ramp (r) by a shallow groove. The crest of ramp is marked by broadly u-shaped, comarginal lobe (cl) resulting from the medial fusion of the anterior (cl_a) and posterior (cl_p) lobes; the anterior lobe culminates in a spine (s). A ventrally broadening, subtriangular central lobe (l_c) is bounded laterally by faint anterior (a_s) and posterior (s_p) sulci.

comarginal lobes coalesce as in *Flumenoglacies*, inhabited warm tropical waters in South China during the early Cambrian. This tropical setting is confirmed by the description herein of *Flumenoglacies* from the middle Cambrian of Laurentia, although *Neokunmingella* and *Wimanicharion* Hinz-Schallreuter, 1993a are also recorded tentatively from middle latitude Avalonia during this time (Williams et al., 2007).

Material and methods

Flumenoglacies groenlandica n. gen. n. sp., the type species of *Flumenoglacies*, is described from the Ekspedition Brae Formation in its type area at Henson Gletscher, western Peary Land (Ineson and Peel, 1997). This formation is composed of highly fossiliferous mudstone and limestone dominated slope deposits that accumulated during periods of lowstand of sea level (Ineson and Peel, 1997). GGU sample 271573 was collected by John S. Peel on July 2, 1978 from 8 m above the base of the formation at the head of Henson Gletscher, southwest Peary Land, North Greenland (82°10' N, 39°40' W). This is locality 4 of Blaker and Peel (1997, fig. 8A) and locality 5 of Geyer and Peel (2011, fig. 1). The outcrop lies at the cliff top forming the eastern side of the glacier, at an altitude of about 605 m above sea level.

The basal beds of the Ekspedition Bræ at Henson Gletscher have yielded an apparent *Bolaspidella* Zone (middle Cambrian; Cambrian Series 3) fauna (Palmer and Peel, 1979). R. A. Robison (written communication, 1987) dated an equivalent horizon in Freuchen Land, 40 km to the west, to the *Ptychagnostus atavus* Zone, the basal zone of the Drumian Stage (Cambrian Series 3). The latter zone is equivalent to the lower part of the *Bolaspidella* Zone (Babcock et al., 2007).

Flumenoglacies n. sp. and *Flumenoglacies*? sp. originate from limestone samples taken at two separate sections of the Stephen Formation in Kootenay National Park. The first section is exposed near Stanley Glacier where six shale-carbonate cycles of the thin Stephen Formation conformably overlie cryptalgal dolostones of the Cathedral Formation (Caron et al., 2010; Gaines, 2011). Sample 08-153 yielding *Flumenoglacies*? sp. was collected by M. Streng in August 2008 from a packstone horizon within the upper part of the first lithostratigraphic cycle. The second section is located near Marble Canyon, only a few kilometers west of the Stanley Glacier section, and has recently been described by Caron et al. (2014). Here, the upper part of a basinal expression of the Stephen Formation is exposed, characterized by two thick shale units (>20 m) separated by a ca. 10 m thick unit of thin bedded, dark grey carbonate mudstones (Caron et al., 2014). Sample 12-257B yielding *Flumenoglacies* n. sp. represents such a mudstone bed and was collected from talus by M. Streng in August 2012.

The samples from British Columbia have both been assigned to the upper *Ehmaniella* Zone, corroborated by the co-occurrence of the trilobites *Ehmaniella burgessensis* and *Spencella* sp. at Stanley Glacier (Caron et al., 2010) and *Bathyuriscus* sp., *Ehmaniella* cf. *burgessensis*, *Itagnostus* cf. *interstrictus* and *Ptychagnostus* cf. *praecurrens* at Marble Canyon (Caron et al., 2014).

Specimens were released from their carbonate host rock by digestion in 10% acetic acid (GGU sample 271573) or 10% formic acid (samples 08-153, 12-257B), hand-picked, and then coated with gold prior to scanning electron microscopy.

Systematic paleontology

MGUH indicates the type collection of the Geological Museum, Copenhagen University, a part of the Natural History Museum of Denmark. GGU indicates a sample collected by the Geological Survey of Greenland (*Grønlands Geologiske Undersøgelse*), Copenhagen, now a part of the Geological Survey of Denmark and Greenland. Specimens from British Columbia are deposited in the collections of the Royal Ontario Museum (ROM) in Toronto, Canada.

Order Bradoriida Raymond, 1935
Family Hipponicharionidae Sylvester-Bradley, 1961

Genus *Flumenoglacies* new genus

Type species.—*Flumenoglacies groenlandica* n. gen. n. sp. from the Ekspedition Bræ Formation (middle Cambrian; Cambrian Series 3, Drumian Stage), Peary Land, North Greenland.

Diagnosis.—Equivalved, slightly postplete carapace; lateral profile semicircular with greatest length at two thirds of valve height; dorsal margin straight. Admarginal ridge narrow, shallowly convex, seemingly continuous between cardinal corners, passing onto shallowly convex, inclined, ventrolateral surface of comarginal ramp. Ramp culminates in narrow, broadly U-shaped, comarginal lobe, representing the coalesced anterior and posterior lobes. Inner slope of coalesced lobe steepened at the anterior and posterior extremities; medially it passes more gradually into the broad and low central lobe that is bounded by shallow anterior and posterior sulci. Anterior lobe increasing in relief ad-dorsally but terminating before the dorsal margin; may culminate in a short spine. Ornamentation of numerous weakly anastomosing ridges (fingerprint pattern) parallel to the free margin and curving around the anterior and posterior terminations of the ramp onto its ad-dorsally sloping surface: central lobe smooth but often with wrinkles.

Etymology.—From Latin ('river of ice'), alluding to the collection locality of the type species above the narrow Henson Gletscher.

Remarks.—Univalve larvae of the type described in lower Cambrian bradoriids from China (Zhang and Pratt, 1993; Zhang, 2007) and other juvenile growth stages have not been recognized in *Flumenoglacies*. This may suggest ecological separation of adult populations of *F. groenlandica* since the same sample as the type species contains trilobite protaspids of similar morphology and size to the bradoriid larvae described by Zhang (2007). Although enhanced by diagenesis, the wrinkles on the dorsal surface between the comarginal lobe and the dorsal hinge (Fig. 2.1, 2.3) can be compared with traces of the circulatory system described in other Cambrian crustaceans by Vannier et al. (1997).

Hipponicharion eos Matthew, 1886 from the lower Cambrian Hanford Brook Formation of New Brunswick, the type species of *Hipponicharion* redescribed by Siveter and Williams (1997), has a similar lateral profile to *Flumenoglacies* but the anterior and posterior lobes are straight, not perfectly comarginal, and clearly separate, unlike the continuous comarginal lobe of *Flumenoglacies*.

In *Neokunmingella*, from the lower Cambrian Canglangpu Formation, Yunnan, China, the confluent anterior and posterior lobes form a narrow, convex-sided ridge, the crest of which lies close to the free margin (Hou et al., 2002), in contrast with *Flumenoglacies* where the crest lies at about one third of the height of the carapace (Fig. 2.1). The elongate carapace has an upturned marginal brim and the elongate central lobe lies parallel to the dorsal margin, in contrast with the broad, low, central lobe of *Flumenoglacies*.

Wimanicharion, described from a boulder of lower Cambrian deposits in Sweden and potentially also from the middle Cambrian of Nova Scotia (Wiman, 1903; Hinz-Schallreuter, 1993a; Siveter et al., 1994; Williams et al., 2007), differs from *Flumenoglacies* in that its confluent anterior and posterior lobes delimit a V-shaped lobe behind which the enclosed surface is deeply excavated, particularly at mid-length. In contrast, a uniformly semicircular ramp and lobe enclosing a surface that slopes gently from the crest toward the dorsal margin is present in *Flumenoglacies*.

The comarginal ramp and lobe of *Flumenoglacies* resembles the continuous comarginal lobe of *Meishucunella* from the lower Cambrian Yuanshan Formation of Yunnan, China, but the central lobe in the latter is located close to the anterodorsal margin (Hou et al., 2002). *Cambraechmina* Hinz-Schallreuter, 1993b from the middle Cambrian (*Triplagnostus gibbus* Zone; Cambrian Series 3, Stage 5) of Queensland, Australia, differs from *Flumenoglacies* in carrying a prominent, boss-like central lobe (Hinz-Schallreuter, 1993b). The genus was considered to be a junior synonym of *Neokunmingella* Zhang, 1974 by Hou et al. (2002) but Zhang (2007) left this issue in abeyance.

In addition to the type species from the Ekspedition Bræ Formation of Peary Land, North Greenland (middle Cambrian; Cambrian Series 3, Drumian Stage), two related taxa are described from the Stephen Formation of British Columbia (middle Cambrian; Cambrian Series 3, Stage 5) under open nomenclature.

Flumenoglacies groenlandica new species
Figure 2.1–2.10

Diagnosis.—Species of *Flumenoglacies* with anterior portion of comarginal lobe culminating in a spine that is inclined toward the dorsal margin at an angle of about 45 degrees and ornamented with low tubercles. Central lobe increases in width away from the dorsal margin toward the comarginal lobe. Furrow separating admarginal rim from broad comarginal ramp usually indistinct.

Description.—Carapace equivalved, with a straight dorsal hinge and semicircular, slightly postplete lateral profile; anterodorsal curve located lower on valve than postero-dorsal curve. Greatest length at about two thirds of valve height, with length almost one fourth greater than height. Junction between dorsal hinge and anterior and posterior margins angular, recurved into slight spines. Each valve divided into a dorsal and a ventrolateral surface at the crest of a broad comarginal ramp, the crest lying at about one third of the height of the valve medially. Ventrolateral surface (ramp) shallowly convex, inclined, becoming concave anteriorly and posteriorly as the comarginal lobe is approached; rising abruptly from the narrow, shallowly convex rim, the junction marked by a comarginal furrow of variable depth which appears to correspond to a shallowly convex ridge ornamented with numerous fine tubercles on the valve interior (Fig. 2.9). Anterior part of lobe elevated to form a parallel-sided ridge, steepened on the inner side, which culminates in a short, stubby spine directed ad-dorsally at an angle of about 45 degrees. Thereafter the ridge decreases rapidly in relief to terminate short of the dorsal hinge. Posterior part of lobe also ridge-like but less steeply elevated than anterior section. Medially, the anterior and posterior lobe segments coalesce and pass with only slight relief into a diffuse, broad, and shallowly convex central surface which narrows and increases in relief relative to laterally disposed shallow anterior and posterior sulci to form a triangular central lobe; anterior sulcus more clearly defined than posterior one. Ornamentation of weakly anastomosing comarginal lines (fingerprint pattern; Fig. 2.10) which curve around the ad-dorsal terminations of the crest, weakly developed or absent on the central lobe. Anterior spine and adjacent upper surface of crest with small, closely spaced stubby spines. Undersurface of rim with closely spaced fine tubercles; inner surface of latero-marginal surface with scattered pits of unknown origin (Fig. 2.9).

Etymology.—From Greenland (Danish, Grønland).

Types.—Holotype, MGUH 30496; paratypes, MGUH 30497–MGUH 30499 from GGU sample 271573, south-west Peary Land, North Greenland (82°10' N, 39°40' W).

Material.—About 20 almost complete valves and numerous fragments from the same locality and horizon.

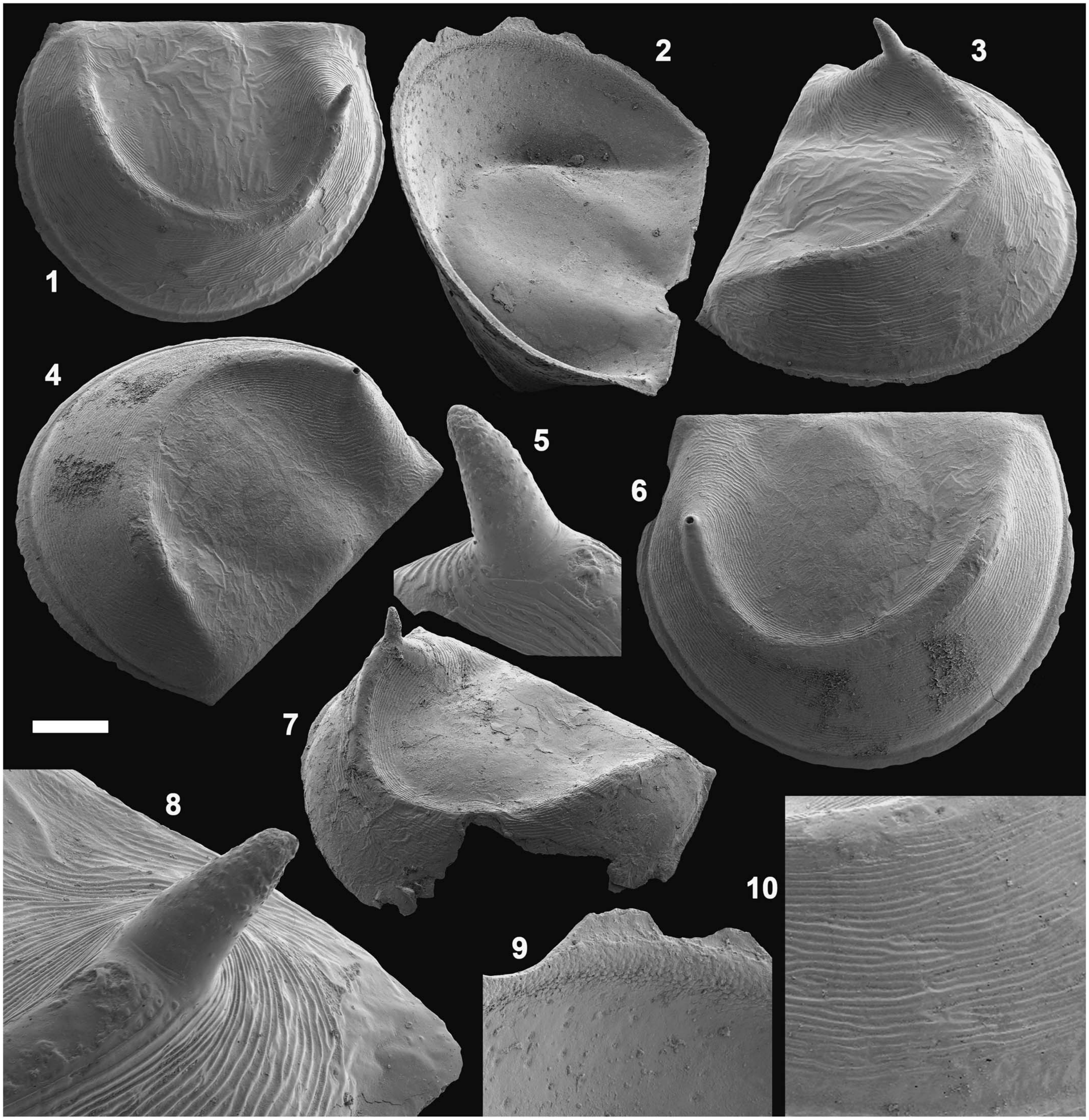

Figure 2. *Flumenoglacies groenlandica* n. gen. n. sp., Ekspedition Brae Formation, Peary Land, North Greenland. (**1**, **3**, **5**, **8**, **10**), MGUH 30496, holotype, right valve. (**2**, **9**), MGUH 30497, paratype, internal of left valve (**2**) with detail of ornamented brim and pitted interior (**9**). (**4**, **6**), MGUH 30498, paratype, left valve. (**7**), MGUH 30499, paratype, left valve. Scanning electron micrographs. Scale bar represents 200 μm (**5**, **8**, 60 μm; **8**, **10**, 80 μm).

Occurrence.—Ekspedition Brae Formation of Peary Land, North Greenland (middle Cambrian; Cambrian Series 3, Drumian Stage).

Remarks.—The holotype of *Flumenoglacies groenlandica* has a length of 1.0 mm and a height of 0.8 mm (Fig. 2.1); a paratype is 1.16 mm long and 0.96 mm high (Fig. 2.6) and this size range is typical of the available material. *Flumenoglacies* resembles *Cambraechmina marginata* Hinz-Schallreuter, 1993b, from the middle Cambrian (*Triplagnostus gibbus* Zone; Cambrian Series 3, Stage 5) of Queensland, Australia, but the latter species is more elongate than *F. groenlandica* and carries a prominent, boss-like central lobe. The crest of the comarginal ramp in *F. groenlandica* lies at about one third of the distance from the margin to the dorsal hinge whereas it is much closer to the margin in *C. marginata*. No anterior spine is reported in *C. marginata*.

Flumenoglacies groenlandica differs from *Wimanicharion matthewi* (Wiman, 1903) (Hinz-Schallreuter, 1993a; Siveter et al., 1994; Williams et al., 2007) in that the crest of the comarginal lobe composed of coalesced anterior and posterior lobes, is located further (ad-dorsally) from the free margin; it also encloses a surface which slopes gently from the crest toward the dorsal margin (Wiman, 1903; Hinz-Schallreuter, 1993a; Siveter et al., 1994; Williams et al., 2007). In the lectotype of *W. matthewi*, which has a length of 4.4 mm, the two lobes delimit a V-shaped ramp behind which the enclosed surface is deeply excavated, particularly at mid-length, although in an additional specimen from the type locality illustrated by Siveter et al. (1994, pl. 21, 1a, b) the ramp is more semicircular and less excavated medially. The central lobe in *F. groenlandica* is broad, low and expands away from the dorsum toward the ramp; it is located centrally, as distinct from the anterior position of the narrow, parallel-sided lobe of *W. matthewi*. Unlike *F. groenlandica*, a spine is not present on the anterior lobe in *W. matthewi*. *Wimanicharion*? *confluens* (Ulrich and Bassler, 1931), from the middle Cambrian McLean Brook Formation, Cape Breton, Nova Scotia, has a more angulated lateral profile than the uniformly convex profile of *F. groenlandica*, with a more steeply inclined dorsal slope of the confluent lobes; but the dorsal margin is not preserved (Siveter et al., 1994; Siveter and Williams, 1997).

In *Neokunmingella* cf. *minuta* Zhang, 1974, as illustrated by Hou et al. (2002), the confluent anterior and posterior lobes form a narrow, convex-sided ridge, the crest of which lies close to the free margin, in contrast with *F. groenlandica* where the crest lies at about one third of the height of the carapace (Fig. 2.1). The carapace is more elongate, with an upturned marginal brim separated from the confluent lobes by a relatively broad channel. The elongate central lobe is distinct and parallel to the dorsal margin, in contrast with the broad, low, central lobe of *Flumenoglacies*. A spine on the anterior lobe is not reported in *Neokunmingella*. *Neokunmingella shuensis* Zhang, 2007 from the lower Cambrian Yuanshan Formation of Sichuan, China, has a much more strongly postplete, almost triangular, carapace in contrast to the uniformly convex lateral profile of *F. groenlandica*. The elongate central lobe is connected to the posterior termination of the confluent comarginal lobes by a low ridge. *Neokunmingella moroensis* Betts et al., 2014, from the early Cambrian of South Australia, is also more strongly postplete than *F. groenlandica* (Betts et al., 2014). An internal mold from the middle Cambrian of Shropshire, United Kingdom, referred to *Neokunmingella* sp. (Williams and Siveter, 1998, pl. 2, fig. 8; Hou et al., 2002, p. 401) has a subtriangular, almost equidimensional lateral profile and prominent central lobe quite distinct from *F. groenlandica*.

Flumenoglacies new species
Figure 3.1–3.2

2014 Bradoriid, n. gen. n. sp.; Caron et al., suppl.-fig. 8o, q.

Description.—Single right valve, incompletely preserved with dorsal margin and anterior cardinal corner, including anterodorsal curve and termination of anterior lobe, missing. Valve semicircular, postplete in lateral profile with indistinct postero-dorsal curve. Valve is longer than high, measuring 1.09 mm in length and 0.78 mm in height. Comarginal lobe, formed by the medial fusion of anterior and posterior lobe, divides valve into an inclined ventrolateral and a medially swollen dorsal surface. Ventrolateral surface gently convex, steeply inclined, becoming concave at the transition to comarginal lobe; delineated from distinct admarginal ridge by equally distinct concave furrow. Anteriorly, ventrolateral surface almost vertical to commissural plane rising toward a strongly elevated anterior end of comarginal lobe (Fig. 3.2). Posteriorly, ventro-lateral surface less inclined and comarginal lobe less elevated. Inner slopes of elevated anterior and posterior lobe segments less inclined than outer. Medially, ridge forming the connection between anterior and posterior lobe rather low and indistinct, poorly demarcated from valve surface. Broadly convex central lobe defined laterally by shallow sulci characterizes the dorsal surface. Ornamentation of weakly anastomosing comarginal fine lines present on ventrolateral surface; dorsal surface smooth.

Material.—Single right valve (ROM 63012) from the upper Stephen Formation at Marble Canyon.

Occurrence.—Upper “thick” Stephen Formation, Kootenay National Park, British Columbia, Canada (middle Cambrian, Cambrian Series 3, Stage 5, *Ehmaniella* Biozone).

Remarks.—Despite the incomplete preservation, the visible characters of the single valve from Marble Canyon, such as an admarginal ridge, medially conjoined anterior and posterior lobes with the anterior lobe strongly elevated relative to the posterior, the ornamentation of the ventrolateral surface, as well as the development of the dorsal surface, support assignment to *Flumenoglacies*. The specimen differs from the type species by its more steeply inclined ventrolateral surface, accordingly the comarginal lobe is closer to the free margin than in *F. groenlandica* n. sp. The furrow separating the admarginal ridge from the comarginal ramp is more distinct in *F.* n. sp, but quite distinct furrows have also been observed in larger specimens of *F. groenlandica*. Although indistinct in both taxa, the medial connection of the anterior and posterior lobes is more strongly developed in *F. groenlandica*. The development of a spine on the anterior lobe of *F.* n. sp. is unclear as the tip of the lobe is not preserved. A new species is not formally erected due to the incomplete preservation and lack of additional specimens.

Flumenoglacies n. sp. is similar to juvenile specimens of *Neokunmingella* cf. *minuta* (Hou et al., 2002, fig. 24 b–d) with respect to overall shape and size, form of the admarginal ridge, and the differently inclined outer slopes of the anterior and posterior lobe. In addition, the central lobe of *Neokunmingella* is less distinct in juvenile specimens, resembling the swelling in the dorsal area of *Flumenoglacies* n. sp. No ornamentation of the outer valve surface is preserved in *Neokunmingella*. The two taxa can be distinguished by the position of the comarginal lobe, which is more distally located relative to the free margin in *Flumenoglacies* n. sp.

Flumenoglacies? sp.
Figure 3.3–3.5

Description.—Single valve incompletely preserved with dorsal half of valve broken off. Preserved ventral half shows an evenly

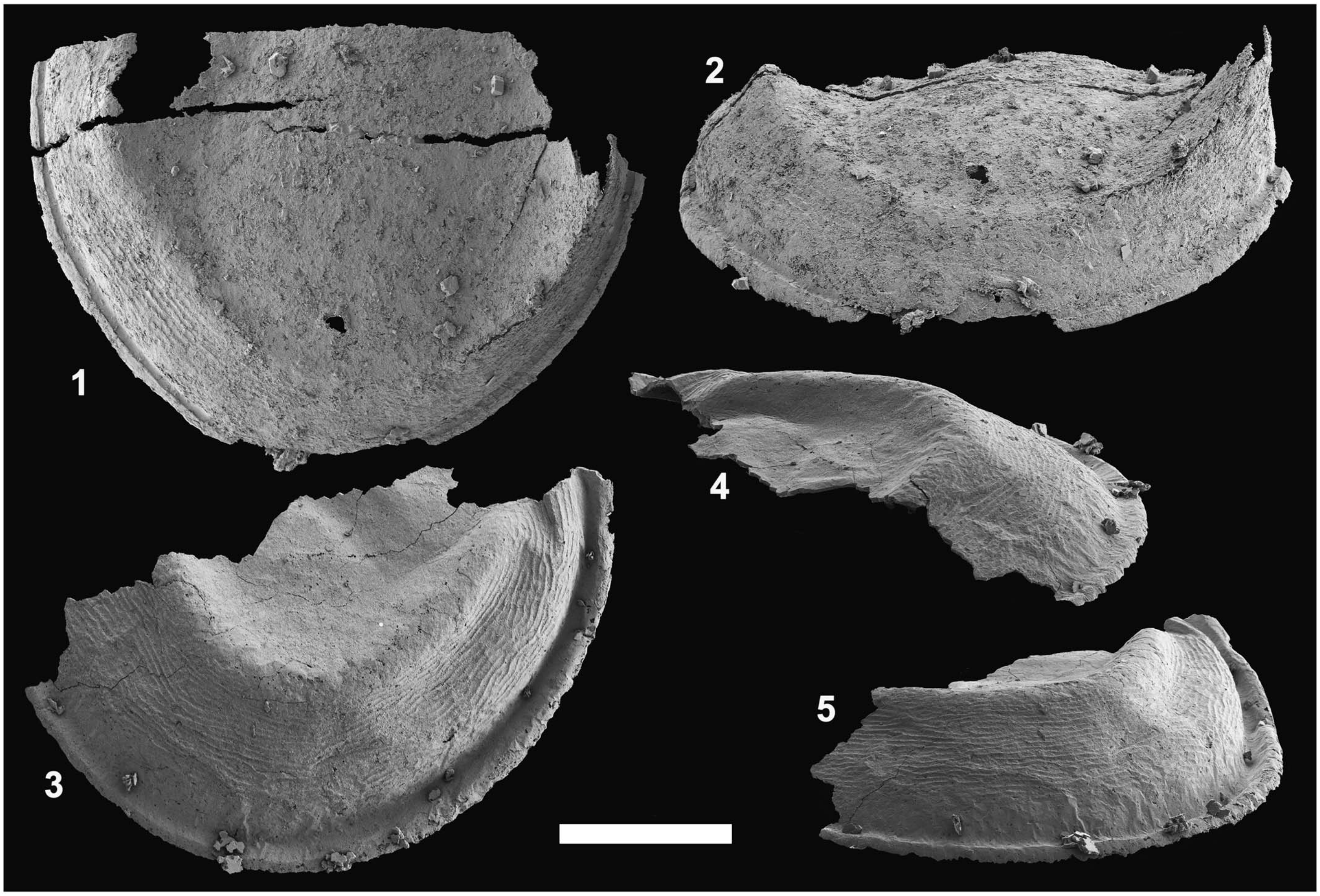

Figure 3. Specimens referred to *Flumenoglacies* from Kootenay National Park, Canada. (**1**, **2**), *Flumenoglacies* n. sp., thick Stephen Formation at Marble Canyon (ROM 63012). (**1**), lateral view of right valve. (**2**), ventral view showing medial connection between anterior and posterior lobe. (**3–5**), *Flumenoglacies*? sp., thin Stephen Formation at Stanley Glacier (ROM 63013). (**3**), Lateral view of right? valve. (**4**), Oblique posterior? view showing inclination of comarginal ramp. (**5**), Oblique ventral view. Scanning electron micrographs. Scale bar represents 300 μm.

rounded ventral margin characterized by a broad admarginal ridge. Broad concave furrow separates ridge from moderately inclined ventrolateral ramp-like surface. Ridge and furrow more strongly developed along the presumed anterior margin (see Remarks, below). Slightly concave to straight ventrolateral surface inclined at about 45 degrees to commissural plane, separated from the flat remaining part of the preserved valve by a distinct, evenly elevated, convex comarginal ridge. Ornamentation of weakly anastomosing comarginal fine lines present on ventrolateral surface; dorsal surface and ridge smooth.

Material.—Single right? valve (ROM 63013) from the middle Stephen Formation at Stanley Glacier.

Occurrence.—Middle part of "thin" Stephen Formation as exposed at Stanley Glacier, Kootenay National Park, British Columbia, Canada (middle Cambrian, Cambrian Series 3, Stage 5, *Ehmaniella* Biozone).

Remarks.—The comarginal lobe described for *F. groenlandica* and *F.* n. sp. does not exactly parallel the free margin of their valves since the distance between lobe and margin increases posteriorly (Figs. 2.1, 2.6., 3.1). The same broadening of the ventrolateral surface is observed in *Flumenoglacies*? sp. Accordingly, the side with the narrower ventrolateral surface is interpreted as representing the anterior end of the valve, suggesting that the single valve of *Flumenoglacies*? sp. is a right valve.

The comarginal ridge, interpreted as the result of the medial fusion of anterior and posterior lobe, and the ornamented ventrolateral surface defined distally by an admarginal ridge suggest affiliation with *Flumenoglacies*. With its moderately inclined and broad, ramp-like ventrolateral surface, the specimen of *Flumenoglacies*? sp. is more similar to *F. groenlandica* n. sp. than to *F.* n. sp. It differs from *F. groenlandica* by its broader admarginal ridge, although the strong development of the ridge in *Flumenoglacies*? sp. might result from taphonomic processes. Additionally, the comarginal ridge seems to be more strongly elevated medially and does not show any signs of height increase toward its anterior or posterior ends. The comarginal ridge also appears to be more angular in *Flumenoglacies*? sp., in comparison to the evenly rounded ridge in *F. groenlandica*. The lack of the dorsal half of the valve, however, makes the generic affiliation conjectural as the presence of many generic characters could not be observed, e.g., the characteristic elevated anterior lobe or the broad central lobe. For this reason, the specimen from Stanley Glacier is only questionably referred to *Flumenoglacies* at this time.

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