A NEW CAMBRIAN FAUNA FROM WESTERN NEWFOUNDLAND.

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ABSTRACT. Strata exposed in Bonne Bay in western Newfoundland have yielded a small trilobite fauna that apparently represents the *Crepicephalus* zone. The strata are tentatively correlated with the Upper Cambrian blocks in the Cow Head breccia.

ACKNOWLEDGMENTS AND DESCRIPTION

THE material described on the following pages was collected in 1945 by Dr. Helgi Johnson and the present writer, when the latter was engaged in mapping the Bonne Bay—Trout River area in western Newfoundland. A general description of the geology of the area will be published by the Geological Survey of Newfoundland. The writer wishes to thank Mr. Claude K. Howse, Government Geologist of Newfoundland, for the opportunity to make these studies. He also takes this opportunity to express his deep appreciation of Dr. C. O. Dunbar's kindness in placing the facilities of the Yale Peabody Museum at the writer's disposal. To Mrs. R. Balk (Dr. Christina Lochman) thanks are due for helpful conferences and for the opportunity to study type material of Cambrian trilobites. Mr. Percy Morris assisted in the preparation of the illustrations.

The object of the present article is to draw attention to the occurrence in the Cambrian sequence in Bonne Bay of a hitherto unknown fauna. The writer hopes that future students will endeavor to secure additional material.

Lower Cambrian strata are extensively exposed along the northeast coast of the East Arm of Bonne Bay. In Southeast Arm, at the head of East Arm, the Lower Cambrian formations are overlain by a sequence of at least 531 feet of black, gray, or pink limestone, which is commonly oolitic and interbedded with intraformational conglomerates; creamy white, black or gray, thin-bedded dolomite, the gray varieties ordinarily weathering buff or rusty red; and dark gray to greenish gray shale. The name *East Arm formation* is proposed for these strata.

The lower contact is not exposed, but the contrast between the predominantly calcareous rocks of the East Arm forma-

tion and the arenaceous sediments of the Lower Cambrian suggests the presence of a disconformity. The contact with the overlying dolomites of the St. George group cannot be accurately located because of the scarcity of fossils and the apparent absence of a disconformity.

The East Arm formation corresponds to Beds C 10—C 14 and part of Bed D1 of the section that was measured at the head of East Arm by James Richardson (Logan, 1863, pp. 867-868). The locality was also visited by Schuchert and Dunbar (1934, p. 60). Helgi Johnson (1941) reports the occurrence in Bonne Bay of "interbedded argillites, cherts, and dolomites," aggregating 300 to 400 feet and being of Upper (?) Cambrian age. These beds probably belong to the East Arm formation.

The fossils described below were collected from Bed 13 (Text Fig. 1), at a level about 330 feet above the lowest exposed bed, measured at right angles to the stratification.

SYSTEMATIC DESCRIPTIONS.

Genus *Blountiella* Resser, 1938.

Blountiella ? johnsoni Troelsen, n.sp.

Pl. 1, Figs. 4-6.

A number of small cranidia agree in most respects with the genus *Blountiella* as defined by Resser (1938). In his diagnosis of the genus, Resser (idem, p. 65) mentioned the occurrence of "a rather heavy rim [border[1]], thickened, usually striated, and straight." According to Lochman and Duncan (1944, p. 54), however, the genotype and some of the other species assigned to *Blountiella* possess a flat, vertical border, which the two authors regard as a generic character. As the present species has a thickened border, it probably does not belong to the genus *Blountiella* although it seems to be closely related to it.

Many of the specimens from the East Arm formation have suffered distortion, and the following description therefore refers only to the two or three best preserved specimens.

The cranidium is wide and short; in the holotype, the greatest width of the cranidium is 8 millimeters, while its length is 3.6 millimeters.

[1] The terminology used in the present paper is the one that has been proposed by Howell, *et al.* (1947).

The glabella is subquadrate, moderately convex, and broadly rounded anteriorly. Glabellar furrows are absent; in squeezed specimens, however, there commonly are indications of cross wrinkles that may have had their origin in incipient glabellar furrows.

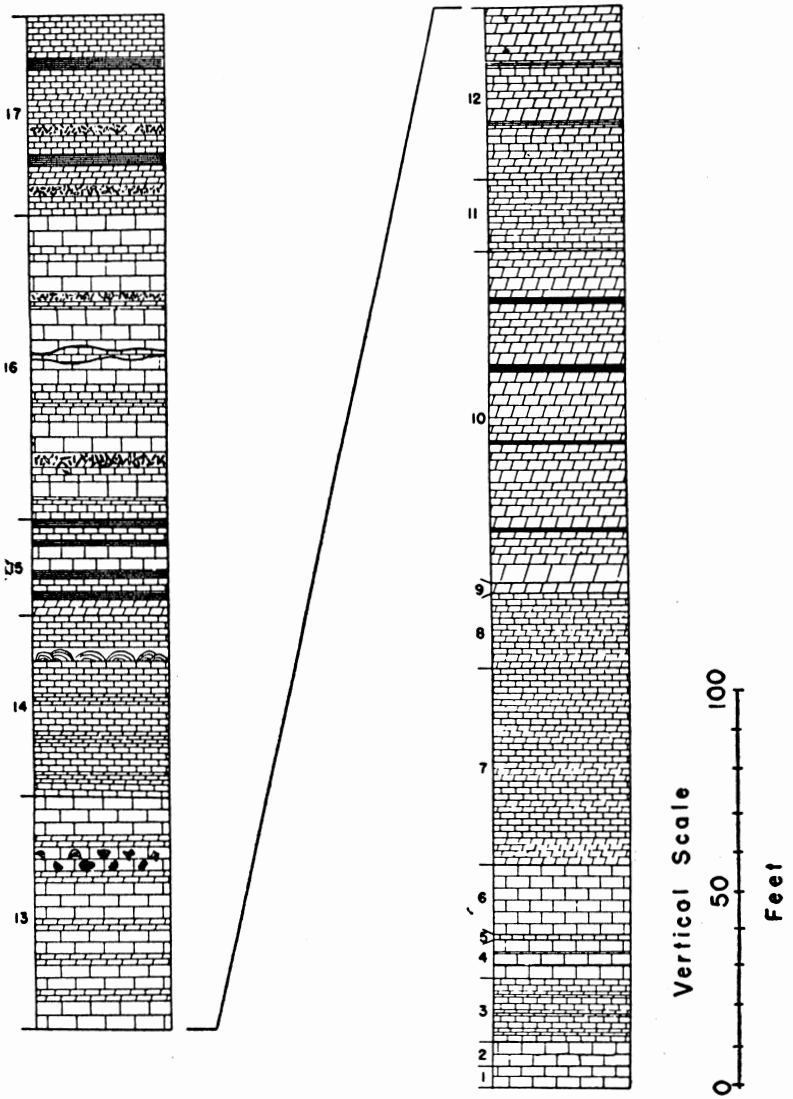

Fig. 1. Columnar section of East Arm formation at the head of Southeast Arm of Bay of Islands.

The dorsal furrow is deep, narrow, and well defined. The occipital furrow is shallow, ordinarily poorly defined, and does not quite reach the dorsal furrow. The occipital ring is broad and flat.

The posterior limbs are long, narrow, and pointed. They are crossed by a deep, intramarginal furrow. The fixed cheeks are rather strongly convex, downsloping, and almost half as wide as the glabella.

The palpebral lobes are small and situated in front of the transverse median line of the glabella. The ocular ridges are distinct, straight, and slightly oblique.

The brim is narrow and slightly convex. The marginal furrow is well defined, narrow, and nearly straight. The border is thickened, striated, and a little wider than the brim. The facial suture seems to be intramarginal for a short distance.

The specific name is given in recognition of Professor Helgi Johnson of Rutgers University.

Genus *Lecanopleura* Raymond, 1937

Lecanopleura ? howsei Troelsen, n.sp.

(Pl. 1, Figs. 1-3).

A single, fairly well preserved internal mold of a cranidium cannot be assigned with certainty to any previously described genus. It shows some resemblance, however, to the *Lecanopleura ?* that was described by Rasetti (1946), but it is with the greatest doubt that the writer refers the present species to the genus described by Rasetti.

The cranidium is subquadrate and moderately convex. The width at the posterior margin is about 4.8 millimeters while the length is 3.3 millimeters.

The glabella is conical and somewhat truncated in front. It is only moderately convex, and its long profile is but slightly curved. The length of the glabella is 2.3 millimeters while its greatest width is 1.8 millimeter. There are three pairs of glabellar furrows. The posterior pair are arcuate and fairly distinct, while the two other pairs are developed as faint, very short depressions.

The dorsal furrow is distinct and narrow but rather shallow. The same is true of the occipital furrow. The occipital ring is almost flat and greatly expanded in the middle.

The brim is narrow, flat in the center, and slightly convex toward the sides. The marginal furrow is narrow, distinct,

and evenly curved. The border is moderately convex and somewhat wider than the brim. The anterior margin is curved.

The fixed cheeks are downsloping and a little convex. They are about half as wide as the glabella, measured on a line through their respective midpoints. The palpebral lobes are poorly preserved but must have been of medium size with their centers immediately in front of the transverse central line of the glabella. The ocular ridges are distinct but narrow; they run obliquely backward from a point a little behind the front of the glabella. The free cheeks are not known.

The posterior limbs are slightly shorter than the occipital ring, and their width is about one-third of the length of the glabella. They are crossed by broad and deep intramarginal furrows. The anterior limbs are wide and strongly downsloping.

The shape of the border suggests that the facial sutures are intramarginal for a considerable distance. At the point where they cross the marginal furrow they turn and run almost straight back to the palpebral lobes. Behind the palpebral lobes the facial sutures run obliquely backward to the posterior margin. A rather abrupt curvature of the distal ends of the intramarginal furrows suggests that the facial sutures cut the margin of the head at the genal angles.

The surface of the holotype, which, as mentioned above, appears to be an internal mold, is finely granulated.

The specific name has been given in recognition of Mr. Claude K. Howse, head of the Geological Survey of Newfoundland.

UNDETERMINED TRILOBITE CRANIDIA.

A number of small cranidia do not fit into any described genus but have not been named as the writer does not believe that sufficient material is at hand to justify the erection of new genera or species. They are described here in the hope that other students of Cambrian faunas may be able to identify similar cranidia from formations the age of which has been definitely established.

Unassigned Species No. 1.

(Pl. 1, Figs. 7-9).

The material consists of a single, fairly well preserved cranidium.

The cranidium is rather strongly arched, both in long profile and in cross section. The border is slightly convex and somewhat tapered toward its extremities. The marginal furrow is distinct but not very deep; it is gently curved from side to side. The brim is a little narrower than the border, flat, and marked by very faint cross lineations that continue across the marginal furrow and the border.

The ratio between length and width of the glabella is about as 1.2:1. In outline the glabella is slightly conical and broadly rounded in front. In cross section the glabella is strongly convex and somewhat angular at its apex, while in long profile it is arched and sloping very steeply down in front. The glabellar furrows are exceedingly faint. The dorsal furrow is continuous, well defined, and rather deep. The occipital ring is broad, expanded in the middle, and slightly less elevated than the highest point of the glabella. The occipital furrow is deep, narrow, and continuous across the glabella.

The fixed cheeks are about half as wide as the glabella, measured on a line through their respective midpoints; they are downsloping and somewhat convex. The palpebral lobes, which are imperfectly preserved, appear to have been slightly less than 0.5 millimeter in length; the degree of their curvature is unknown. The ocular ridges are faint and oblique.

The posterior limbs are two-thirds as long as the occipital ring, while their width is about one-third of the length of the glabella. They are crossed by a broad and deep intramarginal furrow. The free cheeks are not known. The surface of the cranidium is smooth.

Unassigned Species No. 2.

(Pl. 1, Figs. 10-12).

A few fragmentary, more or less squeezed internal molds of cranidia belong to the same general type as Species No. 1 but differ in having a finely granulated surface. In the best preserved specimen, the ratio of width to length of the glabella is as 1:1.5, but the original proportions may have been altered by the deformation of the species:

The cranidia of Species Nos. 1 and 2 disagree with the genus *Blountia* in having deep dorsal furrows. The lack of distinct glabellar furrows distinguish them from *Talbotina* and *Modocia*, while *Brassicicephalus* differs in having a sub-

quadrate glabella and an incomplete marginal furrow. *Greylockia* may be distinguished from the present forms by its broader glabella and longer palpebral lobes. In contrast to the present forms, *Lecanopleura* appears to lack ocular ridges.

DISCUSSION.

The only direct clue to the age of the East Arm formation is furnished by the presence of *Blountiella ?* in the upper part of the sequence. *Blountiella* has previously been reported from the *Aphelaspis* zone of the upper Nolichucky formation of the southern Appalachians (Resser, 1938, p. 30) and from the *Crepicephalus* zone of central Montana (Lochman and Duncan, 1944, p. 54). A species from the *Crepicephalus* zone of the Sullivan formation of Alberta which Resser (1942, p. 61) refers to *Blountiella* apparently belongs to a different genus. As our species seems to be closely related to *Blountiella* there is thus some justification for a tentative assignation of at least the upper part of the East Arm formation to the *Crepicephalus* zone.

In this connection it is of interest that blocks of early late Cambrian age are known to occur in the Cow Head breccia at a point some 30 miles north of Bonne Bay (Schuchert and Dunbar, 1934, pp. 35-36, 76-77). These blocks are made up of "gray to dove-colored somewhat sandy limestones in thin beds which average about one inch or less in thickness, and are separated by thin layers of yellowish shale," a type of rock that is not very prominent in the type section of the East Arm formation. The fauna belongs to the base of the *Crepicephalus* zone (Lochman, 1938), and the blocks may therefore be of the same age as the East Arm formation.

Two other Upper Cambrian formations have previously been found in western Newfoundland. One of them is the Petit Jardin formation, the type section of which is located near Cape St. George and from which Lochman (1938) has described a fauna belonging to the lower part of the *Cedaria* zone. Judged from the description given by Schuchert and Dunbar (1934, p. 34), the lithology of the Petit Jardin formation and the March Point formation, which is of upper Middle Cambrian age and underlies the Petit Jardin formation with apparent conformity, is not unlike that of the East

Arm formation. It is conceivable that Beds 1-12 of the latter formation correspond to the sequence at Cape St. George.

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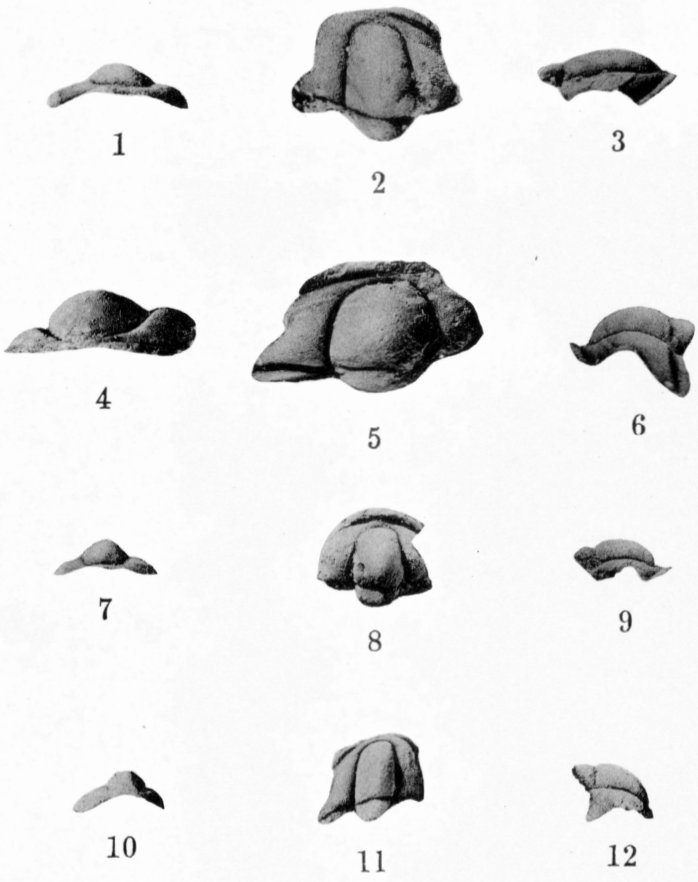

PLATE 1

Middle Cambrian Trilobites from the East Arm formation.

Figs. 1-3, *Lecanopleura* (?) *howsei* Troelsen, n. sp.; 4-6, *Blountiella* (?) *johnsoni* Troelsen, n. sp.; 7-9, unassigned sp. no. 1; 10-12, unassigned sp. no. 2. All figures x 5.