

STUDIES ON BRYOZOA (POLYZOA)
OF THE BAY OF FUNDY REGION.
I. BRYOZOA FROM THE INTERTIDAL ZONE
OF MINAS BASIN AND BAY OF FUNDY.

by

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Résumé

24 espèces et une variété de Bryozoaires sont signalées dans la zone intertidale de la Baie de Fundy. Entre les périodes de marées, les Bryozoaires sont surtout confinés dans des flaques rocheuses. Une exception, cependant : *Flustra foliacea* (L.) s'accommode parfaitement des vastes aires vaseuses au niveau des marées, dans le Bassin de Minas. La majorité des espèces collectées montrent une préférence absolue pour un substrat, certaines vivant uniquement sur des algues, d'autres sur des pierres, quelques-unes, seulement, encroûtant indifféremment les unes et les autres. La population, en totalité, présente une distribution amphi-atlantique. Trois espèces euryhalines *Electra monostachys* (Busk) (deux formes, voir p. 339), *E. crustulenta* (Pallas) et *Conopeum reticulum* (L.) ont été trouvées quelquefois dans la région de la rivière Avon du Bassin de Minas, où *E. crustulenta* est nettement prédominante. Un certain nombre de caractères antérieurement mentionnés pour *E. monostachys* de la côte est de l'Amérique du Nord s'appliquent à *E. crustulenta* et *Cribrilina cryptoecium* est signalée pour la première fois dans cette aire de distribution.

Introduction

Hitherto, precise information concerning the composition of the intertidal bryozoan fauna of the Bay of Fundy region has been wanting. Only two truly littoral records in fact exist for the Bay of Fundy region, both from the Minas Basin. One is for the ctenostome *Flustrellidra hispida* (Fabricius) (Whiteaves 1901:114), the other is for the broad-leaved hornwrack, *Flustra foliacea* (Linnaeus) (Bousfield and Leim 1960:25).

Between November 1963 and October 1964, one of us (G.D.C.) collected extensively from the Minas Channel, Minas Basin, and Cobequid Bay areas. Collecting was extended in a westerly direction by the senior author during September 1965 to include that part of the north coast of Nova Scotia lying adjacent to the Bay of Fundy proper (see text-fig. 1).

Results are presented under the following sections:

- A. Systematics
- B. Ecological Considerations
- C. Distribution: I - local;
II - zoogeographic.

Unless otherwise specified, synonymies cited apply strictly to the Bay of Fundy region.

A. SYSTEMATICS

Order CYCLOSTOMATA Busk, 1852

Crisia eburnea (Linnaeus, 1758).

1901 *Crisia eburnea* (Linnaeus): Whiteaves, p. 109.

Substrate: seaweed.

Station distribution: 18, 20.

Geographic distribution: "The species is well known along the Atlantic coast of North America from Greenland and Labrador south to North Carolina" (Maturro 1957:31).

Lichenopora verrucaria (Fabricius, 1780).

Substrate: seaweed and rocks (see part two of these studies, pl. 1, fig. 1).

Station distribution: 16,19.

Geographic distribution: a common arctic and Trans-Atlantic species; Long Island Sound is its southern limit on the American East Coast.

Lichenopora hispida (Fleming, 1828).

1901 *Lichenopora hispida* (Fleming): Whiteaves, p. 112.

Remarks: in every instance the zooria examined proved to be immature (see part two of these studies pl. 1, fig. 2).

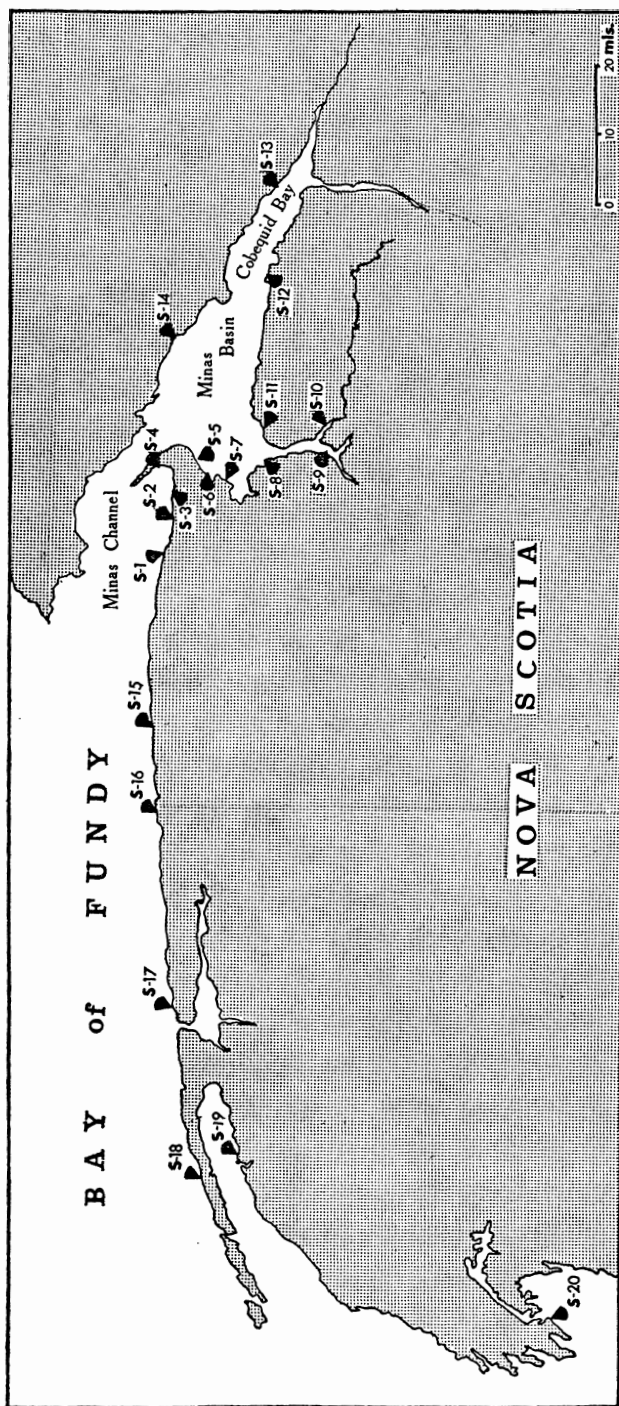
Station distribution: 20.

Geographic distribution: a common arctic and Trans-Atlantic species. On the American East Coast it is known "from the Arctic Ocean to Florida" (Osburn 1933:18).

Tubulipora liliacea (Pallas, 1766).

Substrate: seaweed.

Station distribution: 20.



TEXT-FIG. 1

Localities visited in the Bay of Fundy region 1963-65.

STATIONS VISITED, BAY OF FUNDY REGIC

STATION NO.	LOCALITY	HABITAT	TIDE LEVEL	SPECIES COLLECTED
Kings County				
1	Halls Harbour	Tidal rock-pools	Low	<i>Electra pilosa</i>
2	Baxter Harbour	Tidal rock-pools	Low	<i>Electra pilosa</i>
3	Black Hole Brook	Tidal rock-pools	Low	<i>Electra pilosa</i> <i>Electra crustulenta</i> <i>Conopeum reticulum</i> <i>Callopora aurita</i>
4	Scotts Bay	Tidal rock-pools	Low	<i>Alcyonidium polyoum</i> <i>Flustrellidra hispida</i> <i>Electra pilosa</i> <i>Electra monostachys</i> , multispinous form <i>Electra crustulenta</i> var. <i>arctica</i> <i>Callopora whiteavesii</i> <i>Callopora aurita</i> <i>Cribrilina punctata</i> <i>Cribrilina cryptooecium</i> <i>Hippothoa hyalina</i> <i>Cryptosula pallasiana</i>
5	Blomidon	Tidal flat	Low	<i>Flustra foliacea</i>
6	Delhaven	Tidal flat with scattered rock-pools	Low	<i>Alcyonidium polyoum</i> <i>Electra monostachys</i> , both forms <i>Conopeum reticulum</i>
7	Kingsport	Tidal flat with scattered rock-pools	Low	<i>Alcyonidium polyoum</i> <i>Flustrellidra hispida</i> <i>Electra crustulenta</i> <i>Electra crustulenta</i> var. <i>arctica</i> <i>Electra monostachys</i> , both forms <i>Cryptosula pallasiana</i>
8	Avonport Beach	Tidal flat with scattered rock-pools	Low	<i>Electra crustulenta</i> <i>Electra monostachys</i> , both forms <i>Conopeum reticulum</i>
Hants County				
9	Avon River	Tidal flat, rocks in channel	Low	<i>Electra crustulenta</i>
10	Kennetcook River	Tidal rock-pools adjacent to river	Low	<i>Electra crustulenta</i> <i>Electra monostachys</i> , both forms
11	Cheverie	Tidal rock-pools	Low	<i>Alcyonidium polyoum</i> <i>Electra crustulenta</i> <i>Electra monostachys</i> , both forms <i>Callopora aurita</i> <i>Flustra foliacea</i> <i>Cribrilina punctata</i> <i>Cryptosula pallasiana</i>
12	Burntcoat	Tidal rock-pools	Low	<i>Alcyonidium polyoum</i> <i>Flustrellidra hispida</i> <i>Electra crustulenta</i> <i>Electra monostachys</i> , both forms <i>Callopora aurita</i> <i>Flustra foliacea</i> <i>Cribrilina punctata</i> <i>Cribrilina cryptooecium</i> <i>Escharella immersa</i> <i>Cryptosula pallasiana</i>

NOVA SCOTIA 1963-1965 (SEE FIG. I)

STATION NO.	LOCALITY	HABITAT	TIDE LEVEL	SPECIES COLLECTED
Colchester Co.				
13	Little Dyke	Tidal rock-pools	Low	<i>Aleyonidium polyoum</i> <i>Electra crustulenta</i> <i>Electra monostachys</i> , 3-spined form <i>Callopora aurita</i>
14	Five Islands	Tidal flat with scattered shells	Low	<i>Aleyonidium polyoum</i> <i>Electra crustulenta</i> <i>Cryptosula pallasiana</i>
Annapolis Co.				
15	Margaretsville	Tidal rock-pools	Low	<i>Aleyonidium polyoum</i> <i>Flustrellidra hispida</i> <i>Electra pilosa</i> <i>Callopora whiteavesii</i> <i>Callopora aurita</i> <i>Cribrilina annulata</i> <i>Cribrilina punctata</i> <i>Cribrilina cryptoecium</i> <i>Hippothoa hyalina</i> <i>Microporella ciliata</i> <i>Escharella immersa</i> <i>Porella minuta</i>
16	Port Lorne	Tidal rock-pools	Low	<i>Lichenopora verrucaria</i> <i>Callopora whiteavesii</i> <i>Tegella arctica</i> <i>Cribrilina cryptoecium</i> <i>Porella minuta</i> <i>Escharella immersa</i>
17	Victoria Beach	Boulder beach	Low	<i>Aleyonidium polyoum</i> <i>Flustrellidra hispida</i> <i>Electra monostachys</i> , multispinous form <i>Callopora whiteavesii</i> <i>Callopora aurita</i> <i>Cribrilina cryptoecium</i> <i>Hippothoa hyalina</i> <i>Rhamphostomella ovata</i> <i>Cryptosula pallasiana</i>
Digby County				
18	Whale Cove	Tidal rock-pools	Low	<i>Crisia eburnea</i> <i>Flustrellidra hispida</i> <i>Electra pilosa</i> <i>Callopora whiteavesii</i> <i>Cribrilina annulata</i> <i>Cribrilina cryptoecium</i> <i>Hippothoa hyalina</i>
19	Gilbert Cove	Tidal flat with sporadic <i>Laminaria</i> (attached)	Low	<i>Lichenopora verrucaria</i> <i>Aleyonidium polyoum</i> <i>Electra pilosa</i> <i>Tegella armifera</i> <i>Cribrilina annulata</i> <i>Hippothoa hyalina</i>
Yarmouth County				
20	Wedgeport	Tidal rock-pools	Low	<i>Crisia eburnea</i> <i>Lichenopora hispida</i> <i>Tubulipora liliacea</i> <i>Aleyonidium polyoum</i> <i>Electra pilosa</i> <i>Electra crustulenta</i> var. <i>arctica</i> <i>Callopora whiteavesii</i> <i>Callopora aurita</i> <i>Cribrilina punctata</i> <i>Cribrilina cryptoecium</i> <i>Hippothoa hyalina</i>

Geographic distribution: a common Trans-Atlantic species. On the American East Coast it occurs southward to Long Island Sound.

Order CTENOSTOMATA Busk, 1852

Alcyonidium polyoum (Hassall, 1841).

Substrate: seaweed and rocks.

Station distribution: 4, 6, 7, 11, 12, 13, 14, 15, 17, 19, 20.

Geographic distribution: "Ranging from Arctic seas, Spitzbergen, and Greenland, southward on both sides of the Atlantic to France and southern New England..." (Osburn 1933:61); North Carolina (Maturo 1957:18).

Flustrellidra hispida (Fabricius, 1780).

1874 *Alcyonidium hispidum* Smitt, Verrill and Smith, p. 414.

1901 *Flustrella hispida* (Fabricius) Whiteaves, p. 114.

Substrate: seaweed.

Station distribution: 4, 7, 12, 15, 17, 18.

Geographic distribution: "Arctic and North Atlantic, Greenland and south to southern New England..." (Osburn 1933:60); Long Island Sound (Hutchins 1945:537-538).

Order CHEILOSTOMATA Busk, 1852

Sub-order ANASCA Levinsen, 1909

Electra pilosa (Linnaeus, 1758).

1874 *Membranipora pilosa* Farre, Verrill and Smith, p. 418, pl. 34, figs. 262, 263.

1901 *Electra pilosa* (Linnaeus) : Whiteaves, p. 95.

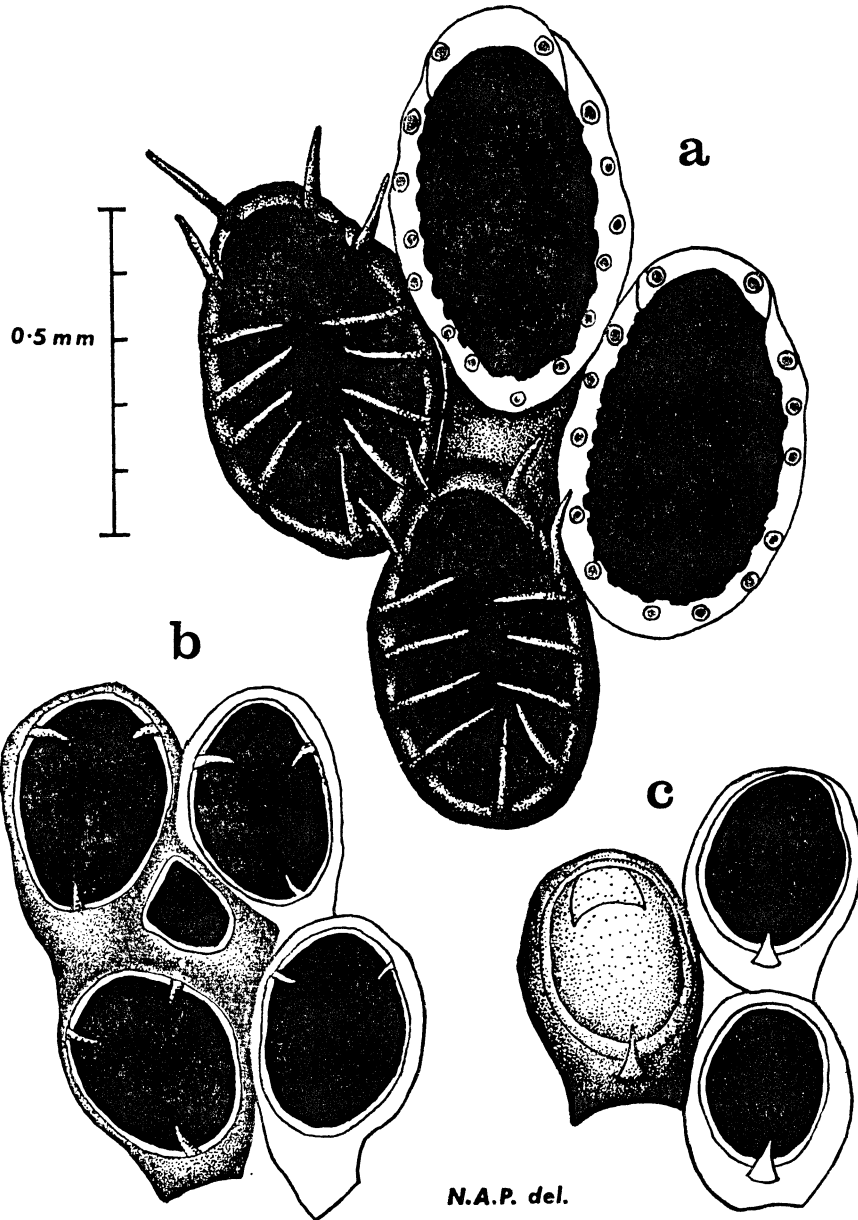
Substrate: seaweed, particularly *Chondrus crispus*.

Station distribution: 1, 2, 3, 4, 15, 18, 19, 20.

Geographic distribution: a common boreal species: "widely distributed along the Atlantic coast from the Chesapeake Bay northward and is excessively abundant along the New England coast in shallow water" (Osburn 1944:39).

Electra crustulenta (Pallas, 1766) Text-fig. 2, c, Pl. 1, 1.

Remarks: the zooecia are normally regularly arranged in closely-packed rows. The opesiaie occupy most of the frontal area being surrounded by a narrow gymnocyst and a strongly beaded cryptocyst. The operculum is calcified and sub-rectangular in outline (Pl. 1, 1).



TEXT-FIG. 2

- a) *Callopora whiteavesii* Norman (Station 15)
Two zoecia with spines intact; two showing spine bases only.
- b) *Electra monostachys* (Busk) (3-spined form) (Station 10).
Four zoecia with a median kenozoecium. Note the apertural spines.
- c) *Electra crustulenta* (Pallas) (Station 10).
Three zoecia, the left member with the frontal membrane and calcified operculum intact. Drawn from a young colony.
- All figures were drawn from calcined material.

This species is extremely abundant in the Kennetcook River, Minas Basin. It has a wide distribution outside the Canadian area, particularly in estuarine environments where the saline content of the water is variable or low (4 parts per thousand, Borg (1931); 2 pts. per thousand, Kluge (1962)).

Substrate: rocks.

Station distribution: 3, 7, 8, 9, 10, 11, 12, 13, 14.

Geographic distribution: a North-Atlantic species extending southward to the Mediterranean. It also occurs in the Black Sea, Caspian and the Baltic.

Electra crustulenta (Pallas) var. *arctica* Borg 1931. Pl. 1, 2.

Synonymy for the New England coast and east coast of Canada (including the Canadian Arctic):

1853 *Hippothoa rugosa* Stimpson, p. 18, fig. 9.

1901 *Electra catenularia* (Jameson) Whiteaves, p. 96 (not *Membranipora catenularia* Jameson 1811).

1912 *Membranipora monostachys* Busk, Osburn, part, p. 227; pl. 22, fig. 29b (see *E. monostachys*).

1932 *Electra monostachys* (Busk) Osburn, p. 7.

1933 *Pyripora catenularia* (Jameson) Osburn, p. 21, pl. 14, figs. 3, 4.

1936 *Electra crustulenta* var. *arctica* Borg : Osburn, p. 541.

1964 *Electra crustulenta* (Pallas) Rogick, p. 177 (part, not pl. 24, fig. 21 = *Conopeum reticulum* (Linnaeus)).

Remarks: zooecial arrangement in this form is subject to considerable variation, ranging from closely-packed multiserial rows in some colonies (Pl. 1, 2), to those in which the zooecia form discrete uni- or biserial rows, branching intermittently (see part 2 of these studies, Pl. 2, 8). The gymnocyst is thickened and enlarged proximally and the opesia reduced, the cryptocyst is finely denticulated around the mural rim. The operculum is calcified and has a sub-quadrate outline.

It occurs in water of normal salinity (eg. 32.84 - 34.92 pts. per thousand, Kluge (1962:272)).

It should be pointed out that the portrayal of Osburn's (1933, pl. 22, fig. 28) figure of *M. lacroixii* as *E. crustulenta*, in Rogick (1964, pl. 24, fig. 21) is erroneous as Rogick (p. 177) clearly considered this to be *Conopeum reticulum* (Linnaeus).

Substrate: rocks.

Station distribution: 4, 7, 20.

Geographic distribution: "It is a North Atlantic species, occurring as far north as Spitzbergen and Greenland... On the American coast it has not been recorded south of Cape Cod" (Osburn 1933:21).

Electra monostachys (Busk, part, 1854).

This species has been briefly discussed by Lagaaij (1963). It occurs in the Bay of Fundy region as two distinct forms, which do not appear to intergrade, and are therefore here treated separately. One form, referred to as the "3-spined form", has paired distal lateral spines and one proximal spine. The other, referred to as the "multispinous form", has from 12-20 spines placed round the opesia.

E. monostachys, 3-spined form, Text-fig. 2 b, Pl. 1, 3.

Remarks: the present material is characterized by a dendritic-type of zoarial growth habit in which the zooecia are somewhat irregularly arranged, being frequently interspersed with aborted individuals i.e. kenozooecia (Pl. 1, 3). The operculum is chitinous, unlike that of *Electra crustulenta*. Each zooecium has two or three spines; a distal pair and usually a median robust spine proximally, curved inwards over the opesia.

This comprises the first definite record of this form from the Atlantic Coast of North America; the two arctic records of the name (Osburn 1919, 1932), from Greenland and Hudson Strait, pertaining to *E. crustulenta* var. *arctica*. *Membranipora monostachys* from the Minas Basin, Bay of Fundy (Kindle 1917) and from Gaspé Bay (Stafford 1912) probably refer to the multispinous form.

Substrate: rocks.

Station distribution: 6, 7, 8, 10, 11, 12.

Geographic distribution: Southern England; associated with waters of low or variable salinity.

E. monostachys, multispinous form, Pl. 1, 4.

Synonymy for the New England coast:

1912 *Membranipora monostachys* Busk, Osburn, part, p. 227, pl. 22, figs. 29, 29a, pl. 30, fig. 87 (not fig. 29b = *E. crustulenta* var. *arctica*).

1933 *Electra monostachys* (Busk) : Osburn, p. 20, pl. 15, fig. 13.

Remarks: this form has been discussed by Marcus (1938, 1940).

Substrate: rocks.

Station distribution: 4, 6, 7, 8, 10, 11, 12, 17.

Geographic distribution: Western Europe; East coast of America (Gulf of Maine to Brazil); Balboa (Panama).

Conopeum reticulum (Linnaeus, 1767) Pl. 2, fig. 5.

Synonymy for the New England coast:

1912 *Membranipora lacroixii* (Audouin) Osburn, p. 227, pl. 22, figs. 28a, b.

1940 *Membranipora lacroixii* (Audouin): Rogick, p. 164, pl. 1, figs. 6-9.

1949 *Membranipora lacroixii* (?) (Audouin): Rogick and Croasdale, p. 59.

1964 *Conopeum reticulum* (Linnaeus): Rogick, p. 177, pl. 26, fig. 39.

Remarks: present specimens comprise old, heavily calcified zoaria. In one or two zooecia a rim of secondary calcification has developed around the margins of the opesia and the opercula are calcified as well. A very consistent feature in this material is the development of a calcified buttress which surrounds the distal pore-opening within the zooecial cavity. No trace of the delicate marginal spines often associated with this species could be found.

Substrate: rocks.

Station distribution: 3, 6, 8.

Geographic distribution: a common North-Atlantic species; on the West Atlantic Coast it occurs from the Gulf of Maine to Beaufort, North Carolina.

Callopora whiteavesii Norman, 1903a. Text-Fig. 2 a.

Synonymy for the east coast of Canada:

1903a *Callopora whiteavesii* Norman, p. 589, pl. 13, fig. 9.

1932 *Callopora whiteavesii* Norman: Osburn, p. 8.

Remarks: a very abundant species, comprising young, infertile colonies. Spines number 9-16 and tend to be directed distally over the opesia. The four spines positioned near the distal margin are rather more robust and point upward (text-fig. 2 a). Avicularia are wanting.

The present record comprises the most southerly latitudinal range recorded to date for this species.

Substrate: rocks.

Station distribution: 4, 15, 16, 17, 18, 20.

Geographic distribution: Hudson Bay; Gulf of St. Lawrence; Greenland; Spitsbergen; Barents Sea, Kara Sea; Laptev Sea; Eastern Siberian Sea; Chukot Sea.

Callopora aurita (Hincks, 1877).

Substrate: rocks.

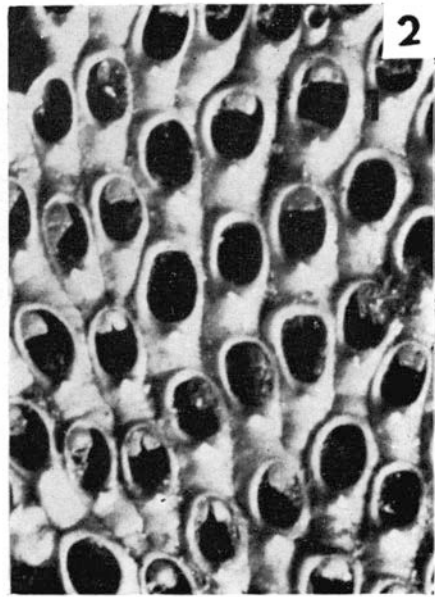
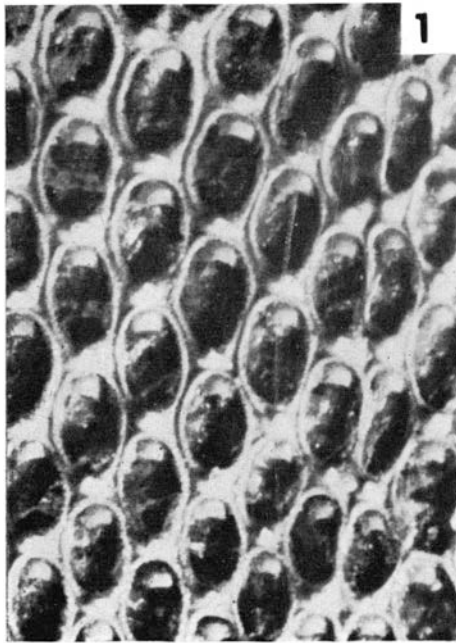
Station distribution: 3, 4, 11, 12, 13, 15, 17, 20.

Geographic distribution: a common northern species. Long Island Sound is its southern limit on the American Coast.

Tegella armifera (Hincks, 1880).

Substrate: seaweed.

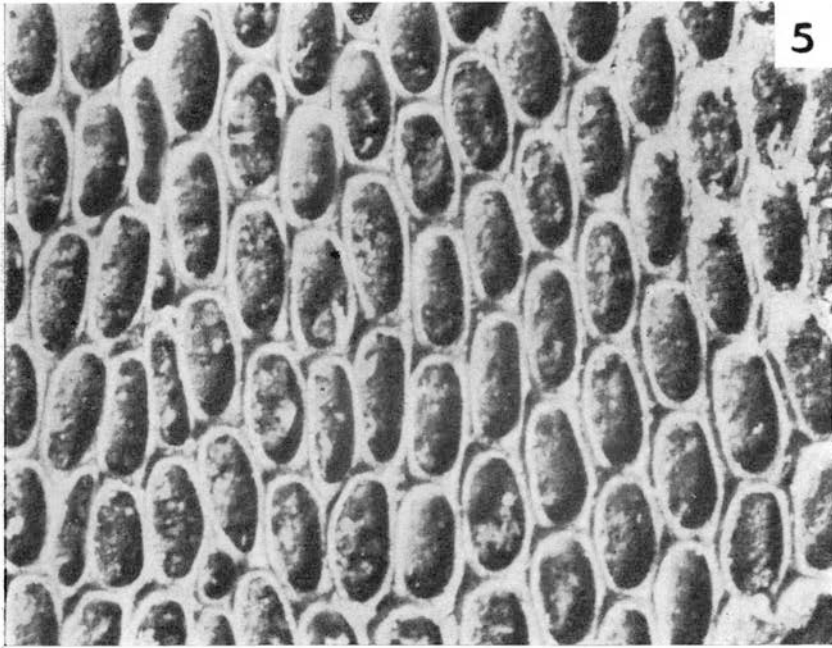
Station distribution: 19.



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PLATE 1

1. *Electra crustulenta* (Pallas). Locality: Kennetcook River, Minas Basin, Nova Scotia (Station 10), x 35.
 2. *E. crustulenta* var. *arctica* Borg. Locality: Wedgeport, Nova Scotia (Station 20), x 35.
 3. *E. monostachys* (Busk) (3-spined form). Locality: Kennetcook River, Minas Basin (Station 10). Note the kenozoocia (one encircled), x 30.
 4. *E. monostachys* (multispinous form). Locality: Kennetcook River, Minas Basin (Station 10), x 30.
- Photography: N.A. Powell.



N.A. POWELL and G.D. CROWELL. PLATE 2

5. *Conopeum reticulum* (Linnaeus). Locality: Avonport Beach, Minas Basin (Station 8). Old zoarium, without marginal spines, x 35.
6. *Flustra foliacea* (Linnaeus). Locality: Blomidon, Minas Basin (Station 5). Fertile zoarium: note the entozoecial ovicells. A vicarious avicularium is indicated, x 35.

Geographic distribution: a common arctic species. It occurs southward to Cape Cod on the American Coast.

Tegella arctica (d'Orbigny, 1851).

Substrate: rocks.

Station distribution: 16.

Geographic distribution: "A northern species of wide range, occurring on the American coast from Greenland to Cape Cod as well as the northern shores of Europe" (Osburn 1933:23).

Flustra foliacea (Linnaeus, 1738) Pl. 2, 6.

1960 *Flustra foliacea* (Linnaeus): Bousfield and Leim, p. 25.

1960 *Flustra foliacea* (Linnaeus): Bousfield, p. 44, pl. 13, fig. 127.

Remarks: recent records from the Minas Basin (Bousfield and Leim 1960:25) as well as the Atlantic coast of Nova Scotia (Bousfield 1960:44) are the first published for this species from the east coast of North America.

Substrate: shells, pebbles, stones and wooden debris.

Station distribution: 5, 11, 12.

Geographic distribution: Barents Sea; Kara Sea; White Sea; Baltic; Kattegat; North Sea; British Isles; North-west Greenland.

Cribrilina annulata (Fabricius, 1780).

1853 *Lepralia annulata* Johnston, Stimpson, p. 18.

Substrate: rare on seaweed and rocks.

Station distribution: 15, 18, 19.

Geographic distribution: "A widely ranging northern species, circumpolar and extending southward along both the Atlantic and Pacific coasts. Cape Cod is apparently near its southern limit on the New England coast" (Osburn 1933:32).

Cribrilina punctata (Hassall, 1841) Pl. 3, 7.

Remarks: Kindle (1917:151) has previously recorded this species from the Minas Basin.

Substrate: rocks.

Station distribution: 4, 11, 12, 15, 20.

Geographic distribution: "It ranges from southern New England and the Madeira Islands northward to the Arctic Ocean" (Osburn 1933:32).

Cribrilina cryptoecium Norman 1903b, Pl. 3, 8.

Remarks: a fairly common species in rock pools along the northern coast of Nova Scotia. Morphologically it is very close to *C. punctata*, especially with regard to the shape of the orifice and the appearance

of the frontal shield (cf. Pl. 3, 7). In the absence of ovicells it is extremely difficult to differentiate between the two species with any certainty. In *C. cryptoecium* the ovicell is non-punctate in contrast to the conspicuously perforated ovicell of *C. punctata*, and bears a robust transverse keel at the proximal third. This structure is uncalcified at the midline, forming a discrete pore. The latter is neither an avicularium nor a kenozoecium (Norman 1903a:102) in the sense of Levinsen's (1909:46) definition of that term. A closely similar pore-like eminence is developed at the proximal extremity of many zooecia (Pl. 3, 8).

First described from specimens collected from the littoral zone of East Finmark, this species has also been recorded from the same environment in the British Isles, along the west coast of Norway (Norman 1903b:102), and the Barents Sea (Kluge 1962:392). This is the first record of the species however, from the West Atlantic and extends its southern latitudinal range considerably.

Substrate: rocks.

Station distribution: 4, 12, 15, 16, 17, 18, 20.

Geographic distribution: British Isles; Western Norway; East Finmark; Barents Sea.

Sub-order *ASCOPHORA* Levinsen, 1909.

Hippothoa hyalina (Linnaeus, 1767).

Substrate: seaweed and rocks.

Station distribution: 4, 15, 17, 18, 19, 20.

Geographic distribution: common in arctic, temperate and tropical seas. "It grows in great profusion all along the New England and eastern Canadian coasts." (Osburn 1933:33.)

Microporella ciliata (Pallas, 1766).

Substrate: rocks.

Station distribution: 15.

Geographic distribution: common in boreal, temperate and tropical waters. On the West Atlantic Coast the species is known from Labrador to Brazil.

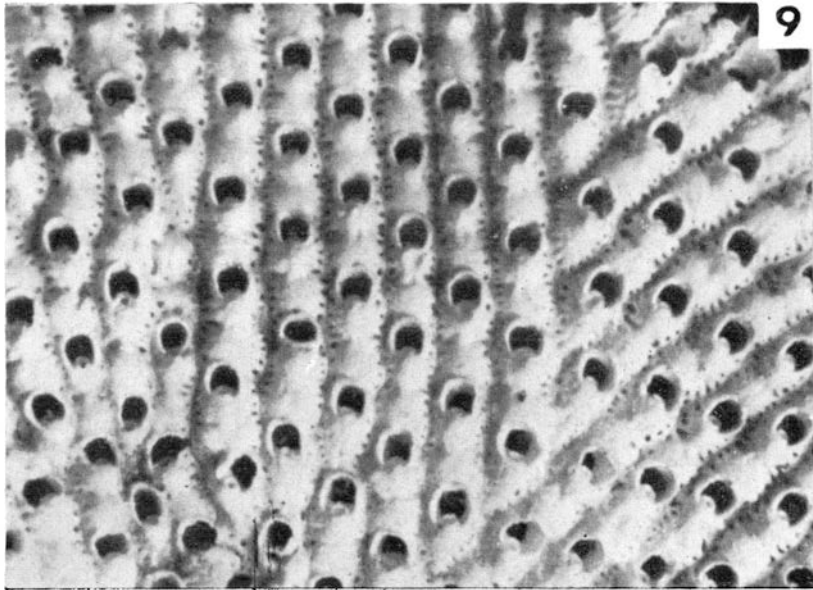
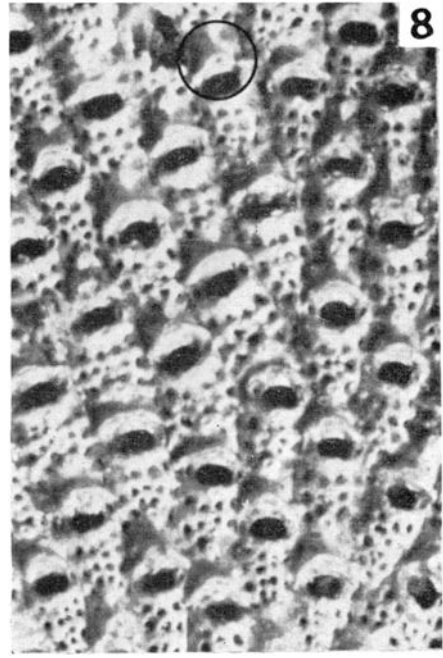
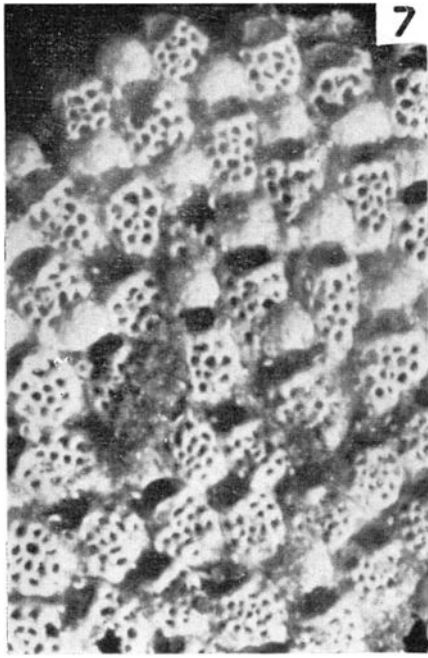
Escharella immersa (Fleming, 1828).

Remarks: listed by Kindle (1917:151) as *Mucronella peachii* (Johnston) from the Minas Basin.

Substrate: rocks.

Station distribution: 12, 15, 16.

Geographic distribution: "An abundant North Atlantic species from Spitzbergen and Greenland southward to the British Islands and



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PLATE 3

7. *Cribrilina punctata* (Hassall). Locality: Wedgeport (Station 20). Fertile zoarium: Note the perforated ovicells, x 33.
8. *Cribrilina cryptoecium* Norman. Locality: Margaretsville (Station 15). Fertile colony, showing the robust transverse keel which is developed over every ovicell and usually opening into a discrete median pore (encircled). A similar pore is often situated within a calcified eminence at the proximal extremity of each zoecium, x 33.
9. *Porella minuta* (Norman). Locality: Port Lorne (Station 16). A lyrula is wanting in this species although the proximal portion of the median avicularium which is directed downwards into the peristomie may superficially resemble that structure, x 33.

southern New England." (Osburn 1933:51); Long Island Sound (Hutchins 1945:544).

Porella minuta Norman, 1868, Pl. 3, 9.

Synonymy for the east coast of Canada:

1901 *Porella minuta* Norman: Whiteaves, p. 103.

1912 *Porella minuta* Norman: Stafford, p. 75.

Remarks: one of the lesser known species among the numerous arctic-boreal representatives of *Porella* in North American waters, it is characterized by both the small size of the zooecia and their arrangement in regular parallel rows. The primary orifice is without a median lyrula although the proximal portion of the avicularium is extended down into the peristomie as a distinct process, which may at first sight resemble a lyrula (Pl. 3, 9). The present record is the most southerly latitudinal range documented to date for this species; the Mediterranean material which Gautier (1962:210) identified as being Norman's species seems to be distinct, owing to the presence of a well developed lyrula.

Substrate: rocks.

Station distribution: 15, 16.

Geographic distribution: Gulf of St. Lawrence; British Isles; Northern Norway; Spitsbergen; Barents Sea; White Sea; Beaufort Sea.

Rhamphostomella ovata (Smitt, 1867).

Substrate: rocks.

Station distribution: 17.

Geographic distribution: "Arctic Seas, Greenland, Iceland, etc. and southward on the American coast to Cape Cod" (Osburn 1933:54).

Cryptosula pallasiana (Moll, 1803).

Substrate: rocks.

Station distribution: 4, 7, 11, 12, 14, 17.

Geographic distribution: a widely distributed boreal species. On the West Atlantic Coast it occurs from Nova Scotia to northern Florida.

B. ECOLOGICAL CONSIDERATIONS

The most favourable habitat for the settlement of bryozoan larvae in the intertidal zone along the north coast of Nova Scotia comprises rock pools and boulder beaches, derived from Triassic basalts which constitute much of the coastline, particularly in the Bay of Fundy proper. Rock pools in the Minas Basin occur in Carboniferous and Triassic sediment.

Generally speaking, the vast areas of tidal mud flats in the Minas Basin are impoverished in species except in localized situations where the occurrence of boulders carried by winter ice movements, has induced the formation of small tidal pools. In these, a small faunule is often present. Only one species, namely *Flustra foliacea*, occupies the actual tidal flats, where it may occur attached to stones, shells and wooden debris in very large numbers (see also Bousfield 1960:44).

Field collecting has shown that several species in the intertidal zone tend to exhibit strong preferences towards one particular type of substrate (see also Ryland 1962): *Crisia eburnea*, *Tubulipora liliacea*, *Lichenopora hispida*, *Electra pilosa* were almost invariably found attached to algae, principally *Chondrus crispus*, *Corallina officinalis*, *Ahnfeltia plicata*. *Flustrellidra hispida* was also taken on *Fucus* and *Ascophyllum*, particularly in the mid-littoral zone. On the other hand, *E. crustulenta* s.l., *E. monostachys* (both forms), *Conopeum reticulum*, *Flustra foliacea*, *Callopora whiteavesii*, *Callopora aurita*, *Cribrilina punctata*, *Cribrilina cryptoecium*, *Escharella immersa*, *Porella minuta* and *Cryptosula pallasiana* consistently encrust stones and rocks. A small number of species were frequently found encrusting both algal and rock substrates, namely, *Alcyonidium polyoum*, *Lichenopora verrucaria*, *Cribrilina annulata*, *Hippothoa hyalina*.

The littoral affinities of *Cribrilina cryptoecium* and *Porella minuta* in north-eastern Norway (East Finmark) were recognized by Norman (1903b); the former species also occurs sporadically in the intertidal zone of the British Isles and Guernsey (Norman 1903b: 103).

It is doubtful whether the remaining species i.e. *Tegella armifera*, *T. arctica*, *Microporella ciliata*, *Rhamphostomella ovata* can be regarded as being typical intertidal species in the Bay of Fundy region, for only one or two specimens of each were taken.

Ecologically, the most striking faunule was encountered at Stations 8, 9 and 10, associated with the fresh-water drainage system of the Avon River (Stns. 8, 9) and its tributary, the Kennetcook River (Stn. 10). The water in the river channels is brackish due to the mixing with salt water which is brought in on the incoming tide. The saline content in this area is at least as low as 4 parts per thousand at low water. Only three species i.e. *E. monostachys* (both forms), *E. crustulenta* s.s., and *Conopeum reticulum* exist in these estuarine conditions; all are recognised elsewhere for their euryhalinity. In the present region, the two species of *Electra* occur in considerable abundance, particularly *E. crustulenta*, which may almost completely encrust small rocks as massive colonies. An analogous observation was documented by Osburn (1944:4) with regard to the estuarine faunule in Chesapeake Bay: "The reduced salinity of the great area of the Bay excludes both the fresh water and the truly marine organisms. The result is a limited number of species which are often represented by excessively large numbers of individuals." Hutchins (1945:547) reported a similar dominance of *Conopeum reticulum* in the upper reaches of the Hammonasset River in Long Island Sound.

C. DISTRIBUTION

I.—Local.

As expected, strong resemblances exist between the littoral fauna of Mount Desert Island (Osburn 1933) and that in the Bay of Fundy: *Crisia eburnea*, *Lichenopora verrucaria*, *Alcyonidium polyoum*, *Flustrellidra hispida*, *Electra pilosa*, *Cribrilina punctata*, *Hippothoa hyalina*, *Escharella immersa* being essentially typical. Several species which Osburn recorded from the intertidal zone are obviously atypical in that environment including: *Hippoporina propinqua* (*Porella propinqua* of Osburn), *Stomachetosella sinuosa*, *Hippoporella hippopus*, *Porella concinna* (*Smittina*, Osburn), *Porella acutirostris* and *Smittina bella* (see part 2 of these studies).

Certain widely-distributed species which appear to be fairly common in the littoral zone of Mount Desert Island were not found in the same environment in the Bay of Fundy i.e. *Crisia cribraria* Stimpson, *Bowerbankia gracilis* Leidy, *Callopora craticula* (Alder), *Tegella unicoloris* (Fleming), *Dendrobeatia murrayana* (Johnston), *Cylindroporella tubulosa* (Norman), *Schizomavella auriculata* (Hassall), *Hippoporina ussowi* (Kluge) (= *Hippodiplosia smitti* of Osburn), *Porella smitti* Kluge (= *P. proboscidea* of Osburn). On the other hand, three species: *Flustra foliacea*, *Callopora whiteavesii*, *Porella minuta* which occur in the littoral zone of the Bay of Fundy, and having littoral affinities in the European-boreal region, were not reported in the Mount Desert Island area.

II.—Zoogeographic.

Considered both in terms as individual species as well as a natural assemblage, most of the intertidal species in the Bay of Fundy region exhibit strong amphi-Atlantic affinities.

Borg (1930:4) for example, documented a fauna of 27 species from the Skelderviken Inlet, a shallow estuarine environment in the Kattegat which included several of the species encountered in the Bay of Fundy region, namely: *Crisia eburnea*, *Lichenopora verrucaria*, *Alcyonidium polyoum*, *Flustrellidra hispida*, *Electra pilosa*, *E. crustulenta*, *Flustra foliacea*, *Callopora aurita*, *Cribrilina punctata*, *Cribrilina annulata*, *Hippothoa hyalina*, *Escharella immersa*.

Ryland (1962:332) listed a moderately large fauna from the littoral zone in the vicinity of Menai Strait, Wales, included among which were: *Crisia eburnea*, *Lichenopora hispida*, *Alcyonidium polyoum*, *Flustrellidra hispida*, *Electra pilosa*, *E. crustulenta*, *Conopeum reticulatum*, *Cribrilina punctata*, *Hippothoa hyalina*, *Escharella immersa* and *Cryptosula pallasiana*.

All the littoral species in the Bay of Fundy area with the exception of three species (*Electra monostachys* (both forms), *Conopeum reticulatum*, *Cryptosula pallasiana*) occur in intertidal or shallow-water environments of the Barents Sea and adjacent Seas (Kluge 1962).

Two species i.e. *Electra monostachys* (3-spined form) and *Cribrilina cryptoecium* have not previously been recorded from the east coast of North America.

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Abstract

Twenty-four species and one variety of Bryozoa are here recorded from the intertidal zone of the Bay of Fundy. Between tides bryozoans are mainly confined to rock pools; one exception, however, is *Flustra foliacea* (Linnaeus) which thrives on the extensive areas of tidal mud flats in the Minas Basin. Definite substrate preferences are exhibited by the majority of species collected, some occur exclusively on algae, others on stones; only a small number encrust both. The assemblage *in toto* has an amphi-Atlantic distribution. Three euryhaline species, *Electra monostachys* (Busk) (two forms, see p. 339), *E. crustulenta* (Pallas) and *Conopeum reticulum* (Linnaeus), were found to occur in the Avon River system in the Minas Basin; *E. crustulenta* being very prevalent. Some previous records of *Electra monostachys* from the east coast of North America have been found to apply to *E. crustulenta*, and *Cribrilina cryptoecium* Norman is documented from this area for the first time.

Zusammenfassung

24 Arten und eine Varietät von Bryozoen aus der Gezeitenzone der Bucht von Fundy werden hier beschrieben. Zwischen den Grenzlinien von Ebbe und Flut findet man die Bryozoen vor allem in Tümpeln in den Felsen; mit einer Ausnahme: *Flustra foliacea* (Linnaeus) entwickelt sich in den weitläufigen flachen Schlammzonen innerhalb der Gezeitengrenzen des Bassins von Minas. Die meisten der eingesammelten Arten zeigen eine Vorliebe für spezielle Substrate; einige Arten gedeihen ausschliesslich auf Algen, andere auf Steinen; nur wenige Arten werden auf beiden Substraten gefunden. Die gesamte Population zeigt eine amphi-atlantische Verbreitung. Drei euryhaline Arten *Electra monostachys* (Busk) (zwei Formen), *E. crustulenta* (Pallas) und *Conopeum reticulum* (Linnaeus) wurden ebenfalls im System des Avon Flusses im Minas Bassin gefunden; *E. crustulenta* ist die häufigste der drei Arten. Einige früher gemeldete Funde von *Electra monostachys* von der Ostküste von Nordamerika sollten *E. crustulenta* zugeordnet werden und *Cribrilina cryptoecium* (Norman) wird zum ersten Mal in dieser Region festgestellt.

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